gilmore-lie-groups: formula evidence

The page, the confidence and the picture of an inline formula are its HOST LINE's — a formula has none of its own. A line's confidence is not a formula's.

Inline formulas (first occurrence)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_FO0001	10	1.000	`U(2) \rightarrow H_{4}`	$U(2) \rightarrow H_4$	13.5 Conclusion
gilmore-lie-groups_FO0002	10	1.000	`S O(3)`	$SO(3)$	14.7 Relation with dynamics i
gilmore-lie-groups_FO0003	10	1.000	`S O(4)`	$SO(4)$	14.8 DeSitter symmetry $SO(4,$
gilmore-lie-groups_FO0004	10	0.997	`S O(4,1)`	$SO(4,1)$	14.10 Spin angular momentum 14.11 Spectrum generating grou
gilmore-lie-groups_FO0005	10	1.000	`S O(4,2)`	$SO(4,2)$	14.11 Spectrum generating group 14.12 Conclusion
gilmore-lie-groups_FO0006	15	0.764	`(+,-, \times, \div)`	$(+, -, \times, \div)$	to decide on the solvability of finite degree polynomial equations; then "infinite groups" (i.e. groups depending continuously on one or more real or complex vari-
gilmore-lie-groups_FO0007	15	0.764	`n`	n	to decide on the solvability of finite degree polynomial equations; then "infinite groups" (i.e. groups depending continuously on one or more real or complex vari-
gilmore-lie-groups_FO0008	17	1.000	`G`	G	(i) G_{i+1} is an invariant subgroup of G_i;
gilmore-lie-groups_FO0009	17	1.000	`G=G_{0} \supset G_{1} \supset`	$G = G_0 \supset G_1 \supset$	(i) G_{i+1} is an invariant subgroup of G_i;
gilmore-lie-groups_FO0010	17	1.000	`\cdots \supset G_{\omega}=I`	$\cdots \supset G_\omega = I$	(ii) each factor group G_i/G_{i+1} is comm
gilmore-lie-groups_FO0011	17	1.000	`G_{i+1}`	G_{i+1}	In the statement of this theorem the fi
gilmore-lie-groups_FO0012	17	1.000	`G_{i}`	G_i	In the statement of this theorem the fi
gilmore-lie-groups_FO0013	17	1.000	`G_{i} / G_{i+1}`	G_i/G_{i+1}	"solvable by radicals." This means that in addi
gilmore-lie-groups_FO0014	17	0.998	`G=\left\{g_{1}, g_{2}, \ldots\right\}`	$G = \{g_1, g_2, \ldots\}$	
gilmore-lie-groups_FO0015	18	1.000	`g_{i} \in G, g_{j} \in G`	$g_i \in G, g_j \in G$	(i) Closure: if $g_i \in G$, $g_j \in G$, then $g_i \cdot g_j \in$
gilmore-lie-groups_FO0016	18	1.000	`g_{i} \cdot g_{j} \in G`	$g_i \cdot g_j \in G$	(i) Closure: if $g_i \in G$, $g_j \in G$, then $g_i \cdot g_j \in$
gilmore-lie-groups_FO0017	18	1.000	`g_{i} \in G, g_{j} \in G, g_{k} \in G`	$g_i \in G, g_j \in G, g_k \in G$	(ii) Associativity: for all $g_i \in G$, $g_j \in G$, $g_k \in$
gilmore-lie-groups_FO0018	18	0.835	`I`	I	(iii) Identity: there is a group operation, I (identity operator), with the property that
gilmore-lie-groups_FO0019	18	1.000	`g_{i}`	g_i	
gilmore-lie-groups_FO0020	18	1.000	`g_{i}^{-1}`	g_i^{-1}	
gilmore-lie-groups_FO0021	18	1.000	`z_{1}, z_{2}, \ldots, z_{n}`	$z_1, z_2, \ldots, z_n$	
gilmore-lie-groups_FO0022	18	0.658	`P_{n}`	P_n	The permutation group S_n has a particularly convenient **representation** in terms

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gilmore-lie-groups_F00023	18	0.658	`S_{n}`	S_n	The permutation group S_n has a particularly convenient **representation** in terms
gilmore-lie-groups_F00024	18	0.658	`n!`	$n!$	The permutation group S_n has a particularly convenient **representation** in terms
gilmore-lie-groups_F00025	18	0.996	`n \times n`	$n \times n$	⌈1 0 0⌉ ⌈0 1 0⌉ ⌈0 0 1⌉
gilmore-lie-groups_F00026	18	1.000	`6=3!3 \times 3`	$6 = 3!3 \times 3$	$I \rightarrow$ | 0 1 0 | (123) $\rightarrow$ | 0 0 1 | (321) $\rightarrow$ | 1 0 0 |
gilmore-lie-groups_F00027	18	1.000	`S_{3}`	S_3	⌊0 0
gilmore-lie-groups_F00028	19	1.000	`z_{1}`	z_1	The symbol (123) means that the first root, z_1, is replaced by z_2, z_2 is replaced by
gilmore-lie-groups_F00029	19	1.000	`z_{2}, z_{2}`	z_2, z_2	The symbol (123) means that the first root, z_1, is replaced by z_2, z_2 is replaced by
gilmore-lie-groups_F00030	19	1.000	`z_{3}`	z_3	z_3, and z_3 is replaced by z_1
gilmore-lie-groups_F00031	19	0.768	`\times`	$\times$	tion of a group, $G \rightarrow \Gamma(G)$, is that the product of matrices representing two group
gilmore-lie-groups_F00032	19	1.000	`G \rightarrow \Gamma(G)`	$G \rightarrow \Gamma(G)$	This permutation representation of S_3 is 1:1, or a **faithful representation** of S_3
gilmore-lie-groups_F00033	19	0.988	`\left(\Gamma\left(g_{i}\right) \times \Gamma\left(g_{j} \right)\right)`	$(\Gamma(g_i) \times \Gamma(g_j))$	since knowledge of the 3×3 matrix uniquely identifies the original group operation
gilmore-lie-groups_F00034	19	0.999	`\left(\Gamma\left(g_{i} \cdot g_{j}\right)\right)`	$(\Gamma(g_i \cdot g_j))$	in S_3.
gilmore-lie-groups_F00035	19	0.999	`g_{i}, g_{j} \in G`	$g_i, g_j \in G$	in S_3.
gilmore-lie-groups_F00036	19	0.874	`3 \times 3`	3×3	under the group multiplication in G.
gilmore-lie-groups_F00037	19	1.000	`H`	H	particular subgroup is denoted A_3 (**alternating group**). It consists of those oper-
gilmore-lie-groups_F00038	19	1.000	`A_{3}`	A_3	$S_2(12) = \{I, (12)\}$
gilmore-lie-groups_F00039	19	1.000	`A_{3} \subset S_{3}`	$A_3 \subset S_3$	
gilmore-lie-groups_F00040	19	1.000	`S_{2}(i j)`	$S_2(ij)$	
gilmore-lie-groups_F00041	20	0.706	`(123) \cdot(123)=(321)`	$(123) \cdot (123) = (321)$	products of various lengths in various order
gilmore-lie-groups_F00042	20	1.000	`G, H_{1} \subset G`	$G, H_1 \subset G$	
gilmore-lie-groups_F00043	20	1.000	`H_{2} \subset G`	$H_2 \subset G$	
gilmore-lie-groups_F00044	20	1.000	`g \in G`	$g \in G$	**Example** The subgroups S_2
gilmore-lie-groups_F00045	20	1.000	`S_{2}(12)`	$S_2(12)$	On the other hand, the alternating group $A_3 \subset S_3$ is **self-conjugate**;
gilmore-lie-groups_F00046	20	1.000	`S_{2}(13)`	$S_2(13)$	On the other hand, the alternating group $A_3 \subset S_3$ is **self-conjugate**;
gilmore-lie-groups_F00047	20	1.000	`G=S_{3}`	$G = S_3$	A subgroup $H \subset G$ which is self-conjugate under all operations in G is called
gilmore-lie-groups_F00048	20	1.000	`H \subset G`	$H \subset G$	

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gilmore-lie-groups_F00049	21	1.000	`f`	f	× is called a **homomorphism** if it preserves group multiplication:
gilmore-lie-groups_F00050	21	1.000	`g_{1}, g_{2}, \ldots`	$g_1, g_2, \ldots$	× is called a **homomorphism** if it preserves group multiplication:
gilmore-lie-groups_F00051	21	0.999	`h_{1}, h_{2}, \ldots`	$h_1, h_2, \ldots$	
gilmore-lie-groups_F00052	21	1.000	`h_{i} \in H`	$h_i \in H$	mapping f is an **isomorphism**
gilmore-lie-groups_F00053	21	1.000	`g_{j} \in G`	$g_j \in G$	
gilmore-lie-groups_F00054	21	1.000	`h \in H`	$h \in H$	
gilmore-lie-groups_F00055	21	0.933	`g \in G\left(h_{1}=f\left(g_{1}\right)\right.`	$g \in G\left(h_1 = f\left(g_1\right)\right.$	**Example** The 3.1 mapping f of S_3 onto S_2 given by
gilmore-lie-groups_F00056	21	0.933	`\left.h_{2}=f\left(g_{2}\right), h_{1}=h_{2} \Rightarrow g_{1}=g_{2}\right)`	$h_2 = f\left(g_2\right), h_1 = h_2 \Rightarrow g_1 = g_2\right)$	**Example** The 3.1 mapping f of S_3 onto S_2 given by
gilmore-lie-groups_F00057	21	1.000	`S_{2}`	S_2	
gilmore-lie-groups_F00058	22	0.987	`h`	h	product of an element h in the subgroup H with a group element in a "quotient,
gilmore-lie-groups_F00059	22	1.000	`G / H`	G/H	has $3! = 6$ group elements, so the order of S_3 is 6), then the order of G/H is
gilmore-lie-groups_F00060	22	1.000	`|G|\left(S_{3}\right.`	$\|G\|\left(S_3\right.$	has $3! = 6$ group elements, so the order of S_3 is 6), then the order of G/H is
gilmore-lie-groups_F00061	22	0.637	`3!=6`	$3! = 6$	$\|G/H\| = \|G\|/\|H\|$. For example, for subgroups $H = A_3 = \{I, (123), (321)\}$ and
gilmore-lie-groups_F00062	22	0.866	`|G / H|=|G| /|H|`	$\|G/H\| = \|G\|/\|H\|$	$H = S_2(23) = \{I, (23)\}$ we have
gilmore-lie-groups_F00063	22	0.866	`H=A_{3}=\{I`	$H = A_3 = \{I$	$H = S_2(23) = \{I, (23)\}$ we have
gilmore-lie-groups_F00064	22	0.866	`\}`	$\}$	$H = S_2(23) = \{I, (23)\}$ we have
gilmore-lie-groups_F00065	22	0.992	`H=S_{2}(23)=\{I,(23)\}`	$H = S_2(23) = \{I, (23)\}$	
gilmore-lie-groups_F00066	22	1.000	`|G| /|H|`	$\|G\|/\|H\|$	or $\{I, (23)\}$; for $S_3(23)$ we could equally well have chosen $G/H = S_3/S_3(23) =$
gilmore-lie-groups_F00067	22	0.692	`G / H=S_{3} / A_{3}=\{I`	$G/H = S_3/A_3 = \{I$	$\{I, (123), (321)\}$.
gilmore-lie-groups_F00068	22	0.997	`\{I,(23)\}`	$\{I, (23)\}$	In general, it is not possible to choose the group elements in G/H so that they
gilmore-lie-groups_F00069	22	0.997	`S_{2}(23)`	$S_2(23)$	In general, it is not possible to choose the group elements in G/H so that they
gilmore-lie-groups_F00070	22	0.997	`G / H=S_{3} / S_{2}(23)=`	$G/H = S_3/S_2(23) =$	In general, it is not possible to choose the group elements in G/H so that they
gilmore-lie-groups_F00071	22	0.556	`\{I,(123),(321)\}`	$\{I, (123), (321)\}$	form a sub
gilmore-lie-groups_F00072	22	1.000	`S_{3} / A_{3}`	S_3/A_3	then the group G is the **direct product** of the invariant subgroup H with the factor group G/H: $G = G/H \times H$
gilmore-lie-groups_F00073	22	0.630	`\operatorname{group} G / H: G=G / H \times H`	group $G/H : G = G/H \times H$	The general nth degree pol
gilmore-lie-groups_F00074	22	1.000	`k`	k	$I_1 = \sum z_i = z_1 + z_2 + \cdots + z_n$

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gilmore-lie-groups_F00075	22	1.000	`I_{k}`	I_k	$I_1 = \sum z_i = z_1 + z_2 + \cdots + z_n$
gilmore-lie-groups_F00076	22	1.000	`z_{i}`	z_i	$I_1 = \sum z_i = z_1 + z_2 + \cdots + z_n$
gilmore-lie-groups_F00077	23	0.992	`I_{k}(k=1,2, \ldots, n)`	$I_k(k = 1, 2, \ldots, n)$	The n functions I_k $(k = 1, 2, \ldots, n)$ of the n roots $(z_1, z_2, \ldots, z_n)$ are symmetric:
gilmore-lie-groups_F00078	23	0.992	`\left(z_{1}, z_{2}, \ldots, z_{n}\right)`	$(z_1, z_2, \ldots, z_n)$	The n functions I_k $(k = 1, 2, \ldots, n)$ of the n roots $(z_1, z_2, \ldots, z_n)$ are symmetric:
gilmore-lie-groups_F00079	23	1.000	`f\left(z_{1}, z_{2}, \ldots, z_{n}\right)`	$f\left(z_1, z_2, \ldots, z_n\right)$	any function $f(z_1, z_2, \ldots, z_n)$ that is invariant under S_n can be written as a function
gilmore-lie-groups_F00080	23	1.000	`I_{1}, I_{2}, \ldots, I_{n}`	$I_1, I_2, \ldots, I_n$	of the invariants $I_1, I_2, \ldots, I_n$. The invariants are easily expressed in terms of
gilmore-lie-groups_F00081	23	1.000	`G_{\omega-1} \supset G_{\omega}=I`	$G_{\omega-1} \supset G_{\omega} = I$	the $\lvert G_{\omega-1}\rvert/\lvert G_{\omega}\rvert$ inequivalent one-dimensional representations of $G_{\omega-1}$. Linear
gilmore-lie-groups_F00082	23	1.000	`G_{\omega-1} / G_{\omega}=G_{\omega-1}`	$G_{\omega-1}/G_{\omega} = G_{\omega-1}$	combinations of the roots z_i are identified that transform under (i.e., are basis
gilmore-lie-groups_F00083	23	1.000	`\left|G_{\omega-1}\right| /\left|G_{\omega}\right|`	$\left\|G_{\omega-1}\right\| / \left\|G_{\omega}\right\|$	functions for) the one-dimensional irreducible representations of $G_{\omega-1}$. These
gilmore-lie-groups_F00084	23	1.000	`G_{\omega-1}`	$G_{\omega-1}$	functions for) the one-dimensional irreducible representations of $G_{\omega-1}$. These
gilmore-lie-groups_F00085	23	1.000	`G_{\omega}=I`	$G_{\omega} = I$	Next, the next pair of grou
gilmore-lie-groups_F00086	23	1.000	`G_{\omega-2} \supset G_{\omega-1}`	$G_{\omega-2} \supset G_{\omega-1}$	(i) symmetric under $G_{\omega-1}$; ii) not all symmetric under $G_{\omega-2}$
gilmore-lie-groups_F00087	23	1.000	`G_{\omega-2}`	$G_{\omega-2}$	These solutions are then fed dov
gilmore-lie-groups_F00088	23	1.000	`G=G_{0} \supset`	$G = G_0 \supset$	he roots $z_1, z_2, \ldots, z_n$ and functions of the invariants $I_1, I_2, \ldots, I_n$.
gilmore-lie-groups_F00089	23	1.000	`G_{1}`	G_1	This brief description will now be illustrated by using Galois theory to solve
gilmore-lie-groups_F00090	24	1.000	`\Gamma^{1}, \Gamma^{2}`	Γ^1, Γ^2	$\lfloor u_2 \rfloor^{-}$
gilmore-lie-groups_F00091	24	1.000	`r_{1}-r_{2}`	$r_1 - r_2$	$(r_1 - r_2)\ \Big\}\ \longrightarrow\ +(r_1 - r_2)$ (1.20)
gilmore-lie-groups_F00092	24	0.899	`\left(r_{1}-r_{2}\right)`	$(r_1 - r_2)$	[illegible]
gilmore-lie-groups_F00093	24	1.000	`\Gamma^{2}`	Γ^2	$(r_1 - r_2)^2 = r_1^2 - 2r_1r_2 + r_2^2$
gilmore-lie-groups_F00094	24	1.000	`\Gamma^{1}`	Γ^1	$(r_1 - r_2)^2 = r_1^2 - 2r_1r_2 + r_2^2$
gilmore-lie-groups_F00095	24	1.000	`\left(r_{1}-r_{2}\right)^{2}`	$(r_1 - r_2)^2$	$= r_1^2 + 2r_1r_2 + r_2^2 - 4r_1r_2 = I_1^2 - 4I_2 = D$ (1.21)
gilmore-lie-groups_F00096	24	0.999	`I_{1}, I_{2}`	I_1, I_2	
gilmore-lie-groups_F00097	25	1.000	`D`	D	where D is the **discriminant** of the quadratic equation. Since $(r_1 - r_2) = \pm\sqrt{D}$,
gilmore-lie-groups_F00098	25	1.000	`\left(r_{1}-r_{2}\right)= \pm \sqrt{D}`	$\left(r_1 - r_2\right) = \pm\sqrt{D}$	where D is the **discriminant** of the quadratic equation. Since $(r_1 - r_2) = \pm\sqrt{D}$,
gilmore-lie-groups_F00099	25	1.000	`x`	x	[illegible]
gilmore-lie-groups_F00100	25	1.000	`z`	z	$z = x + \frac{1}{3}I_1$

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gilmore-lie-groups_F00101	26	1.000	`S_{3} / A_{3}=S_{2}`	$S_3/A_3 = S_2$	equation can be solved.
gilmore-lie-groups_F00102	26	1.000	`A_{3} / I=A_{3}`	$A_3/I = A_3$	equation can be solved.
gilmore-lie-groups_F00103	26	1.000	`A_{3} \supset I`	$A_3 \supset I$	$\mid I \quad (123) \quad (321)$ Basis functions
gilmore-lie-groups_F00104	26	0.877	`v_{1}=s_{1}+s_{2}+s_{3}`	$v_1 = s_1 + s_2 + s_3$	$\Gamma^3 \mid 1 \quad \omega \quad \omega^2 \quad v_2 = s_1 + \omega s_2 + \omega^2 s_3$ $\Gamma^3 \mid 1 \quad \omega^2 \quad \omega \quad v_3 = s_1 + \omega^2 s_2 + \omega s_3$ $\omega^3 = +1 \qquad \omega = e^{2\pi i/3} = \frac{-1+i\sqrt{3}}{}$
gilmore-lie-groups_F00105	26	0.877	`\omega`	ω	$\Gamma^3 \mid 1 \quad \omega \quad \omega^2 \quad v_2 = s_1 + \omega s_2 + \omega^2 s_3$ $\Gamma^3 \mid 1 \quad \omega^2 \quad \omega \quad v_3 = s_1 + \omega^2 s_2 + \omega s_3$ $\omega^3 = +1 \qquad \omega = e^{2\pi i/3} = \frac{-1+i\sqrt{3}}{}$
gilmore-lie-groups_F00106	26	0.877	`\omega^{2}`	ω^2	$\Gamma^3 \mid 1 \quad \omega \quad \omega^2 \quad v_2 = s_1 + \omega s_2 + \omega^2 s_3$ $\Gamma^3 \mid 1 \quad \omega^2 \quad \omega \quad v_3 = s_1 + \omega^2 s_2 + \omega s_3$ $\omega^3 = +1 \qquad \omega = e^{2\pi i/3} = \frac{-1+i\sqrt{3}}{}$
gilmore-lie-groups_F00107	26	0.877	`v_{2}=s_{1}+\omega s_{2}+\omega^{2} s_{3}`	$v_2 = s_1 + \omega s_2 + \omega^2 s_3$	$\Gamma^3 \mid 1 \quad \omega \quad \omega^2 \quad v_2 = s_1 + \omega s_2 + \omega^2 s_3$ $\Gamma^3 \mid 1 \quad \omega^2 \quad \omega \quad v_3 = s_1 + \omega^2 s_2 + \omega s_3$ $\omega^3 = +1 \qquad \omega = e^{2\pi i/3} = \frac{-1+i\sqrt{3}}{}$
gilmore-lie-groups_F00108	26	0.877	`\Gamma^{3}`	Γ^3	$\Gamma^3 \mid 1 \quad \omega \quad \omega^2 \quad v_2 = s_1 + \omega s_2 + \omega^2 s_3$ $\Gamma^3 \mid 1 \quad \omega^2 \quad \omega \quad v_3 = s_1 + \omega^2 s_2 + \omega s_3$ $\omega^3 = +1 \qquad \omega = e^{2\pi i/3} = \frac{-1+i\sqrt{3}}{}$
gilmore-lie-groups_F00109	26	0.877	`v_{3}=s_{1}+\omega^{2} s_{2}+\omega s_{3}`	$v_3 = s_1 + \omega^2 s_2 + \omega s_3$	$\Gamma^3 \mid 1 \quad \omega \quad \omega^2 \quad v_2 = s_1 + \omega s_2 + \omega^2 s_3$ $\Gamma^3 \mid 1 \quad \omega^2 \quad \omega \quad v_3 = s_1 + \omega^2 s_2 + \omega s_3$ $\omega^3 = +1 \qquad \omega = e^{2\pi i/3} = \frac{-1+i\sqrt{3}}{}$
gilmore-lie-groups_F00110	26	1.000	`(123)^{-1}`	$(123)^{-1}$	
gilmore-lie-groups_F00111	26	1.000	`v_{2}`	v_2	
gilmore-lie-groups_F00112	27	1.000	`v_{1}`	v_1	Since v_1 is symmetric under both A_3 and S_3, it can be expressed in terms of the
gilmore-lie-groups_F00113	27	1.000	`v_{3}`	v_3	The remaining functions, v_2 and v_3, are symmetric under I but not under A_3. We now proceed to the next group-subgroup pair: $S_3 \supset A_3$. To construct func-
gilmore-lie-groups_F00114	27	1.000	`S_{3} \supset A_{3}`	$S_3 \supset A_3$	We now proceed to the next group-subgroup pair: $S_3 \supset A_3$. To construct func- ions symmetric under A_3 but not under S_3 we observe that the cubes of v_2 and v_3
gilmore-lie-groups_F00115	27	1.000	`S_{2}=S_{3} / A_{3}`	$S_2 = S_3/A_3$	form
gilmore-lie-groups_F00116	27	1.000	`v_{2}^{3}`	v_2^3	form

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gilmore-lie-groups_F00117	27	1.000	`v_{3}^{3}`	v_3^3	form
gilmore-lie-groups_F00118	27	1.000	`J_{1}, J_{2}`	J_1, J_2	(of orders 1, 2, 3) of the original cubic equation (1.29) as follows:
gilmore-lie-groups_F00119	27	0.995	`I_{1}, I_{2}, I_{3}`	I_1, I_2, I_3	
gilmore-lie-groups_F00120	27	0.995	`J_{1}`	J_1	
gilmore-lie-groups_F00121	27	0.995	`J_{2}`	J_2	
gilmore-lie-groups_F00122	27	1.000	`I_{1}=s_{1}+s_{2}+`	$I_1 = s_1 + s_2 +$	$z = y + \frac{1}{3} I_1$ (1.38)
gilmore-lie-groups_F00123	27	1.000	`s_{3}=0`	$s_3 = 0$	
gilmore-lie-groups_F00124	28	1.000	`J_{1}=v_{2}^{3}+v_{3}^{3}`	$J_1 = v_2^3 + v_3^3$	as follows
gilmore-lie-groups_F00125	28	1.000	`J_{2}=v_{2}^{3} v_{3}^{3}`	$J_2 = v_2^3 v_3^3$	as follows
gilmore-lie-groups_F00126	28	1.000	`I_{2}^{\prime}, I_{3}^{\prime}`	I_2', I_3'	as follows
gilmore-lie-groups_F00127	28	1.000	`v_{2}^{3}, v_{3}^{3}`	v_2^3, v_3^3	$x^2 - (-27I_3')x + (-27I_2'^3) = 0$
gilmore-lie-groups_F00128	28	1.000	`s_{1}, s_{2}, s_{3}`	s_1, s_2, s_3	
gilmore-lie-groups_F00129	28	1.000	`v_{1}, v_{2}, v_{3}`	v_1, v_2, v_3	
gilmore-lie-groups_F00130	29	1.000	`z=z^{\prime}+\frac{1}{4} I_{1}`	$z = z' + \frac{1}{4} I_1$	$(z' - t_1)(z' - t_2)(z' - t_3)(z' - t_4) = z'^4 - I_1' z'^3 + I_2' z'^2 - I_3' z' + I_4' =$
gilmore-lie-groups_F00131	29	1.000	`S_{4}`	S_4	
gilmore-lie-groups_F00132	29	1.000	`A_{4}`	A_4	
gilmore-lie-groups_F00133	29	0.957	`V_{4}`	V_4	
gilmore-lie-groups_F00134	29	0.957	`\{I,(12)(34),(13)(24),(14)(23)\}`	$\{I, (12)(34), (13)(24), (14)(23)\}$	
gilmore-lie-groups_F00135	30	1.000	`S_{4} / A_{4}=S_{2}`	$S_4/A_4 = S_2$	(i) A_4 is invariant in S_4 and $S_4/A_4 =$
gilmore-lie-groups_F00136	30	0.987	`A_{4} / V_{4}=C_{3}=\{I`	$A_4/V_4 = C_3 = \{I$	(ii) V_4 is invariant in A_4 and $A_4/V_4 = C_3 = \{I, (234), (432)\}$
gilmore-lie-groups_F00137	30	0.987	`V_{4} / I=V_{4}=\{I`	$V_4/I = V_4 = \{I$	(iii) I is invariant in V_4 and $V_4/I = V_4 = \{I, (12)(34), (13)(24), (14)(23)\}$.
gilmore-lie-groups_F00138	30	0.669	`w_{1}=t_{1}+t_{2}+t_{3}+t_{4}`	$w_1 = t_1 + t_2 + t_3 + t_4$	Γ^1 1 1 1 1 $w_1 = t_1 + t_2 + t_3 + t_4$ Γ^2 1 1 −1 −1 $w_2 = t_1 + t_2 - t_3 - t_4$ Γ^3 1 −1 1 −1 $w_3 = t_1 - t_2 + t_3 - t_4$ Γ^4 1 −1 −1 1 $w_4 = t_1 - t_2 - t_3 + t_4$ The linear combinations of these roots that transform under each of the

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gilmore-lie-groups_F00139	30	0.669	`w_{2}=t_{1}+t_{2}-t_{3}-t_{4}`	$w_2 = t_1 + t_2 - t_3 - t_4$	$\begin{array}{c\|cccc} \Gamma^1 & 1 & 1 & 1 & 1 \\ \Gamma^2 & 1 & 1 & -1 & -1 \\ \Gamma^3 & 1 & -1 & 1 & -1 \\ \Gamma^4 & 1 & -1 & -1 & 1 \end{array} \quad \begin{array}{l} w_1 = t_1 + t_2 + t_3 + t_4 \\ w_2 = t_1 + t_2 - t_3 - t_4 \\ w_3 = t_1 - t_2 + t_3 - t_4 \\ w_4 = t_1 - t_2 - t_3 + t_4 \end{array}$ The linear combinations of these roots that transform under each of the
gilmore-lie-groups_F00140	30	0.669	`w_{3}=t_{1}-t_{2}+t_{3}-t_{4}`	$w_3 = t_1 - t_2 + t_3 - t_4$	$\begin{array}{c\|cccc} \Gamma^1 & 1 & 1 & 1 & 1 \\ \Gamma^2 & 1 & 1 & -1 & -1 \\ \Gamma^3 & 1 & -1 & 1 & -1 \\ \Gamma^4 & 1 & -1 & -1 & 1 \end{array} \quad \begin{array}{l} w_1 = t_1 + t_2 + t_3 + t_4 \\ w_2 = t_1 + t_2 - t_3 - t_4 \\ w_3 = t_1 - t_2 + t_3 - t_4 \\ w_4 = t_1 - t_2 - t_3 + t_4 \end{array}$ The linear combinations of these roots that transform under each of the
gilmore-lie-groups_F00141	30	0.669	`\Gamma^{4}`	Γ^4	$\begin{array}{c\|cccc} \Gamma^1 & 1 & 1 & 1 & 1 \\ \Gamma^2 & 1 & 1 & -1 & -1 \\ \Gamma^3 & 1 & -1 & 1 & -1 \\ \Gamma^4 & 1 & -1 & -1 & 1 \end{array} \quad \begin{array}{l} w_1 = t_1 + t_2 + t_3 + t_4 \\ w_2 = t_1 + t_2 - t_3 - t_4 \\ w_3 = t_1 - t_2 + t_3 - t_4 \\ w_4 = t_1 - t_2 - t_3 + t_4 \end{array}$ The linear combinations of these roots that transform under each of the
gilmore-lie-groups_F00142	30	0.669	`w_{4}=t_{1}-t_{2}-t_{3}+t_{4}`	$w_4 = t_1 - t_2 - t_3 + t_4$	$\begin{array}{c\|cccc} \Gamma^1 & 1 & 1 & 1 & 1 \\ \Gamma^2 & 1 & 1 & -1 & -1 \\ \Gamma^3 & 1 & -1 & 1 & -1 \\ \Gamma^4 & 1 & -1 & -1 & 1 \end{array} \quad \begin{array}{l} w_1 = t_1 + t_2 + t_3 + t_4 \\ w_2 = t_1 + t_2 - t_3 - t_4 \\ w_3 = t_1 - t_2 + t_3 - t_4 \\ w_4 = t_1 - t_2 - t_3 + t_4 \end{array}$ The linear combinations of these roots that transform under each of the
gilmore-lie-groups_F00143	30	0.971	`w_{2}, w_{3}, w_{4}`	w_2, w_3, w_4	to construct from these linear combinations functions that are
gilmore-lie-groups_F00144	30	1.000	`A_{4} \supset V_{4}`	$A_4 \supset V_4$	(i) symmetric under V_4,
gilmore-lie-groups_F00145	30	1.000	`A_{4} / V_{4}`	A_4/V_4	sum of the roots is zero, the three functions w_2, w_3, w_4
gilmore-lie-groups_F00146	30	0.999	`w_{1}=I_{1}`	$w_1 = I_1$	[illegible]
gilmore-lie-groups_F00147	30	0.999	`w_{2}^{2}, w_{3}^{2}, w_{4}^{2}`	w_2^2, w_3^2, w_4^2	[illegible]
gilmore-lie-groups_F00148	30	1.000	`w_{j}^{2}(j=2,3,4)`	$w_j^2 (j = 2, 3, 4)$	
gilmore-lie-groups_F00149	30	1.000	`C_{3}=A_{4} / V_{4}`	$C_3 = A_4/V_4$	
gilmore-lie-groups_F00150	31	1.000	`J_{k}`	J_k	symmetric functions (coefficients) of the original quartic equation (1.45) or (1.46).
gilmore-lie-groups_F00151	31	1.000	`C_{3}`	C_3	symmetric functions (coefficients) of the original quartic equation (1.45) or (1.46).
gilmore-lie-groups_F00152	31	1.000	`S_{4} \supset A_{4}`	$S_4 \supset A_4$	If the three solutions of the resolvent cubic equation are called y_2, y_3, y_4, then
gilmore-lie-groups_F00153	31	1.000	`y_{2}, y_{3}, y_{4}`	y_2, y_3, y_4	[illegible]
gilmore-lie-groups_F00154	31	1.000	`w_{2} w_{3} w_{4}=8 I_{3}^{\prime}`	$w_2 w_3 w_4 = 8 I_3'$	[illegible]
gilmore-lie-groups_F00155	31	1.000	`\pm \sqrt{y_{j}}`	$\pm\sqrt{y_j}$	[illegible]

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gilmore-lie-groups_F00156	31	1.000	`8 I_{3}^{\prime}`	$8I_3'$	
gilmore-lie-groups_F00157	31	1.000	`t_{i}`	t_i	
gilmore-lie-groups_F00158	31	1.000	`I_{1}`	I_1	
gilmore-lie-groups_F00159	31	1.000	`w_{j}\left(I^{\prime}\right)`	$w_j\left(I'\right)$	
gilmore-lie-groups_F00160	31	1.000	`w_{j}`	w_j	
gilmore-lie-groups_F00161	31	1.000	`S_{5}`	S_5	
gilmore-lie-groups_F00162	32	1.000	`A_{5}`	A_5	A_5 of order 60 is an invariant subgroup. S_5 has no invariant subgroups except A_5
gilmore-lie-groups_F00163	32	1.000	`S_{5} / A_{5}=S_{2}`	$S_5/A_5=S_2$	equation does not satisfy the conditions of Galois' theorem, so cannot be solved by
gilmore-lie-groups_F00164	32	1.000	`A_{5} / I=A_{5}`	$A_5/I=A_5$	equation does not satisfy the conditions of Galois' theorem, so cannot be solved by
gilmore-lie-groups_F00165	33	1.000	`t_{1}^{\prime}=-3, t_{2}^{\prime}=-2, t_{3}^{\prime}=`	$t_1'=-3, t_2'=-2, t_3'=$	Next, we introduce linear combinations of the four roots $t_1'=-3, t_2'=-2, t_3'=$
gilmore-lie-groups_F00166	33	0.961	`1, t_{4}^{\prime}=4`	$1, t_4'=4$	$1, t_4'=$
gilmore-lie-groups_F00167	33	1.000	`y=y^{\prime}+\frac{1}{3} J_{1}=y^{\prime}+ \frac{1}{3}(4+16+100)=y^{\prime}+40`	$y=y'+\frac{1}{3}J_1=y'+\frac{1}{3}(4+16+100)=y'+40$	$y_2'=y_2-40\rightarrow\ \ 16-40=-24$
gilmore-lie-groups_F00168	34	0.990	`v_{2}^{3}+v_{3}^{3}, v_{2}^{3} v_{3}^{3}`	$v_2^3+v_3^3, v_2^3v_3^3$	
gilmore-lie-groups_F00169	34	0.990	`J_{2}^{\prime}, J_{3}^{\prime}`	J_2', J_3'	
gilmore-lie-groups_F00170	34	1.000	`x=x^{\prime}+\frac{1}{2} K_{1}`	$x=x'+\frac{1}{2}K_1$	$x^{-}+6520730931 2=0$
gilmore-lie-groups_F00171	35	1.000	`y_{1}, y_{2}, y_{3}`	y_1, y_2, y_3	The values y_1, y_2, y_3 of the resolvent cubic are complex linear combinations of
gilmore-lie-groups_F00172	35	0.982	`v_{2}, v_{3}`	v_2, v_3	
gilmore-lie-groups_F00173	35	1.000	`w_{2} w_{3} w_{4}=8 I_{3}^{\prime}=80`	$w_2w_3w_4=8I_3'=80$	in (1.57); this choice of signs serves only to permute the order of the roots. In the
gilmore-lie-groups_F00174	36	1.000	`S_{4} / A_{4}, A_{4} / V_{4}, V_{4}`	$S_4/A_4, A_4/V_4, V_4$	1. Compute S_4/A_4, A_4/V_4, V_4 and show that they are commutative.
gilmore-lie-groups_F00175	36	0.986	`V_{8}`	V_8	2. Construct the group V_8 with the property $S_4 \supset V_8 \supset V_4$ (see Fig. 1.5). (Hint: include
gilmore-lie-groups_F00176	36	0.986	`S_{4} \supset V_{8} \supset V_{4}`	$S_4 \supset V_8 \supset V_4$	2. Construct the group V_8 with the property $S_4 \supset V_8 \supset V_4$ (see Fig. 1.5). (Hint: include
gilmore-lie-groups_F00177	36	1.000	`z^{3}-7 z+6=0((z-1)(z-2)(z+3)=0)`	$z^3-7z+6=0((z-1)(z-2)(z+3)=0)$	
gilmore-lie-groups_F00178	36	1.000	`\left(x-v_{2}^{3}\right)\left(x-v_{3}^{3} \right)=x^{2}-162 x+`	$\left(x-v_2^3\right)\left(x-v_3^3\right)=x^2-162x+$	$9261=0$. Solve this quadratic to find $v_2^3, v_3^3=81\pm i30\sqrt{3}$, so that $v_2, v_3=\frac{1}{2}(3\pm$
gilmore-lie-groups_F00179	36	0.996	`9261=0`	$9261=0$	$i5\sqrt{3}$). Invert Eq. (1.43) to determine the three roots of the original equation:
gilmore-lie-groups_F00180	36	0.996	`v_{2}^{3}, v_{3}^{3}=81 \pm i 30 \sqrt{3}`	$v_2^3, v_3^3=81\pm i30\sqrt{3}$	$i5\sqrt{3}$). Invert Eq. (1.43) to determine the three roots of the original equation:

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gilmore-lie-groups_F00181	36	0.996	`v_{2}, v_{3}=\frac{1}{2}(3 \pm`	$v_2, v_3 = \frac{1}{2}(3\pm$	$i5\sqrt{3}$). Invert Eq. (1.43) to determine the three roots of the original equation: $(1, 2, -3)$
gilmore-lie-groups_F00182	36	1.000	`i 5 \sqrt{3}`	$i5\sqrt{3}$	$(1, 2, -3)$.
gilmore-lie-groups_F00183	36	0.543	`x+y, x-y, x y`	$x+y, x-y, xy$	numbers that can be constructed from integers by addition, subtraction, multiplication,
gilmore-lie-groups_F00184	36	0.543	`x / y`	x/y	numbers that can be constructed from integers by addition, subtraction, multiplication,
gilmore-lie-groups_F00185	36	1.000	`\sqrt{x}`	$\sqrt{x}$	division, and extraction of square roots is called the set of constructable numbers. This
gilmore-lie-groups_F00186	36	1.000	`x+i y=(x, y)`	$x+iy=(x,y)$	number satisfies an algebraic equation of degree K with integer coefficients, where
gilmore-lie-groups_F00187	36	1.000	`K`	K	**a. Square a circle?** For the circle of radius 1 the area is π. Squaring a circle means
gilmore-lie-groups_F00188	36	1.000	`K=2^{n}`	$K=2^n$	finding an interval of length x,
gilmore-lie-groups_F00189	36	1.000	`\pi`	π	ruler and compass alone. **b. Double the cube?** A cube with edge length 1 has volume $1^3 = 1$. A cube with
gilmore-lie-groups_F00190	36	1.000	`x^{2}-\pi=0`	$x^2-\pi=0$	**b. Double the cube?** A cube with edge length 1 has volume $1^3 = 1$. A cube with twice the volume has edge length x, where x satisfies $x^3 - 2 = 0$. Although the
gilmore-lie-groups_F00191	36	1.000	`1^{3}=1`	$1^3=1$	**c. Trisect an angle?** If 3θ is some angle, the trigonometric functions of 3θ and
gilmore-lie-groups_F00192	36	1.000	`x^{3}-2=0`	$x^3-2=0$	$\frac{1}{3}(3\theta)=\theta$ are related by
gilmore-lie-groups_F00193	36	1.000	`3 \neq 2^{n}`	$3\neq 2^n$	$i3\theta$ $e^{i\theta\times 3}$
gilmore-lie-groups_F00194	36	1.000	`3 \theta`	3θ	$\cos(3\theta)+i\sin(3\theta)=(\cos^3(\theta)-3\cos(\theta)\sin^2(\theta))$
gilmore-lie-groups_F00195	36	1.000	`\frac{1}{3}(3 \theta)=\theta`	$\frac{1}{3}(3\theta)=\theta$	
gilmore-lie-groups_F00196	37	1.000	`\cos (3 \theta)`	$\cos(3\theta)$	Whether $\cos(3\theta)$ is rational or irrational, the equation for $\cos(\theta)$:
gilmore-lie-groups_F00197	37	1.000	`\cos (\theta)`	$\cos(\theta)$	Whether $\cos(3\theta)$ is rational or irrational, the equation for $\cos(\theta)$:
gilmore-lie-groups_F00198	37	1.000	`\left(x^{2}+a x+b\right)(x+c)=0`	$\left(x^2+ax+b\right)(x+c)=0$	For example, if $\cos(3\theta)=0$, $c=0$ so that $a=0$ and $b=-3/4$. Then $\cos(\theta)=0$
gilmore-lie-groups_F00199	37	1.000	`a, b, c`	a, b, c	For example, if $\cos(3\theta)=0$, $c=0$ so that $a=0$ and $b=-3/4$. Then $\cos(\theta)=0$
gilmore-lie-groups_F00200	37	1.000	`\cos (3 \theta)=0, c=0`	$\cos(3\theta)=0, c=0$	or $\pm\sqrt{3}/2$ for $3\theta=\pi/2\,(+)$, $3\pi/2\,(0)$, or $5\pi/2\,(-)$.
gilmore-lie-groups_F00201	37	1.000	`a=0`	$a=0$	or $\pm\sqrt{3}/2$ for $3\theta=\pi/2\,(+)$, $3\pi/2\,(0)$, or $5\pi/2\,(-)$.
gilmore-lie-groups_F00202	37	1.000	`b=-3 / 4`	$b=-3/4$	or $\pm\sqrt{3}/2$ for $3\theta=\pi/2\,(+)$, $3\pi/2\,(0)$, or $5\pi/2\,(-)$.
gilmore-lie-groups_F00203	37	1.000	`\cos (\theta)=0`	$\cos(\theta)=0$	or $\pm\sqrt{3}/2$ for $3\theta=\pi/2\,(+)$, $3\pi/2\,(0)$, or $5\pi/2\,(-)$.
gilmore-lie-groups_F00204	37	0.986	`\pm \sqrt{3} / 2`	$\pm\sqrt{3}/2$	
gilmore-lie-groups_F00205	37	0.986	`3 \theta=\pi / 2(+), 3 \pi / 2(0)`	$3\theta=\pi/2(+), 3\pi/2(0)$	
gilmore-lie-groups_F00206	37	0.986	`5 \pi / 2(-)`	$5\pi/2(-)$	
gilmore-lie-groups_F00207	38	1.000	`g_{i}, g_{j}, g_{k}, \ldots`	$g_i, g_j, g_k, \ldots$	

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gilmore-lie-groups_F00208	38	1.000	`g_{i} \circ g_{j} \in G`	$g_i \circ g_j \in G$	
gilmore-lie-groups_F00209	38	1.000	`e`	e	
gilmore-lie-groups_F00210	38	1.000	`g_{i} \in G`	$g_i \in G$	(iv) **Inverse:** every group op
gilmore-lie-groups_F00211	39	1.000	`2 \times 2`	2×2	**Example** We consider the set of real 2×2 matrices $SL(2;\mathbb{R})$:
gilmore-lie-groups_F00212	39	1.000	`S L(2 ; \mathbb{R})`	$SL(2;\mathbb{R})$	**Example** We consider the set of real 2×2 matrices $SL(2;\mathbb{R})$:
gilmore-lie-groups_F00213	39	1.000	`\alpha, \beta, \gamma, \delta`	$\alpha, \beta, \gamma, \delta$	
gilmore-lie-groups_F00214	39	0.797	`A`	A	matrix multiplication), then C is a real 2×2 matrix. If $\det(A) = +1$ and $\det(B) = +1$,
gilmore-lie-groups_F00215	39	0.797	`B`	B	matrix multiplication), then C is a real 2×2 matrix. If $\det(A) = +1$ and $\det(B) = +1$,
gilmore-lie-groups_F00216	39	0.797	`A \circ B=C`	$A \circ B = C$	matrix multiplication), then C is a real 2×2 matrix. If $\det(A) = +1$ and $\det(B) = +1$,
gilmore-lie-groups_F00217	39	0.797	`\circ`	$\circ$	matrix multiplication), then C is a real 2×2 matrix. If $\det(A) = +1$ and $\det(B) = +1$,
gilmore-lie-groups_F00218	39	0.922	`C`	C	then $\det(C) = \det(A)\det(B) = +1$.
gilmore-lie-groups_F00219	39	0.922	`\operatorname{det}(A)=+1`	$\operatorname{det}(A) = +1$	then $\det(C) = \det(A)\det(B) = +1$.
gilmore-lie-groups_F00220	39	0.922	`\operatorname{det}(B)=+1`	$\operatorname{det}(B) = +1$	then $\det(C) = \det(A)\det(B) = +1$.
gilmore-lie-groups_F00221	39	1.000	`\operatorname{det}(C)=\operatorname{det}(A) \operatorname{det}(B)=+1`	$\operatorname{det}(C) = \operatorname{det}(A)\operatorname{det}(B) = +1$	) **Associativity:** $(A \circ B) \circ C$ and $A \circ (B$
gilmore-lie-groups_F00222	39	0.998	`(A \circ B) \circ C`	$(A \circ B) \circ C$	
gilmore-lie-groups_F00223	39	0.998	`A \circ(B \circ C)`	$A \circ (B \circ C)$	
gilmore-lie-groups_F00224	39	1.000	`g_{i} \rightarrow g(x)`	$g_i \rightarrow g(x)$	fold. A **manifold** is a space that looks Euclidean on a small scale everywhere. For
gilmore-lie-groups_F00225	39	1.000	`i`	i	example, every point on the surface of a unit sphere $S^2 \subset R^3$:
gilmore-lie-groups_F00226	39	1.000	`S^{2} \subset R^{3}: x^{2}+y^{2}+z^{2}=1`	$S^2 \subset R^3 : x^2 + y^2 + z^2 = 1$	
gilmore-lie-groups_F00227	39	1.000	`R^{2}`	R^2	**Definition** An n-dimensional differentiable manifold M^n consists of the follow-
gilmore-lie-groups_F00228	39	1.000	`S^{2}`	S^2	ing.
gilmore-lie-groups_F00229	39	1.000	`M^{n}`	M^n	
gilmore-lie-groups_F00230	39	1.000	`T`	T	
gilmore-lie-groups_F00231	39	1.000	`U_{\alpha}`	U_α	
gilmore-lie-groups_F00232	39	0.896	`T: \cup_{\alpha} U_{\alpha}=T`	$T : \cup_\alpha U_\alpha = T$	
gilmore-lie-groups_F00233	40	1.000	`p`	p	that is indistinguishable from an open neighborhood of any point in the plane R^2.
gilmore-lie-groups_F00234	40	1.000	`\phi_{\alpha}`	ϕ_α	

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gilmore-lie-groups_F00235	40	1.000	`\phi_{\alpha}\left(U_{\alpha}\right)=V_{\alpha} \subset R^{n}`	$\phi_\alpha\left(U_\alpha\right)=V_\alpha \subset R^n$	
gilmore-lie-groups_F00236	40	1.000	`V_{\alpha}`	V_α	
gilmore-lie-groups_F00237	40	1.000	`\phi_{\alpha} \circ \phi_{\beta}^{-1}: \phi_{\beta} \left(U_{\alpha} \cap U_{\beta}\right) \rightarrow \phi_{ \alpha}\left(U_{\alpha} \cap\right.`	$\phi_\alpha \circ \phi_\beta^{-1}: \phi_\beta\left(U_\alpha \cap U_\beta\right) \rightarrow \phi_\alpha\left(U_\alpha \cap\right.$	
gilmore-lie-groups_F00238	40	0.988	`U_{\beta}`	U_β	**Remarks** The charts ϕ_α allow construction of coordinate systems on the
gilmore-lie-groups_F00239	40	0.988	`R^{n}`	R^n	**Remarks** The charts ϕ_α allow construction of coordinate systems on the
gilmore-lie-groups_F00240	40	1.000	`\phi_{\alpha} \circ \phi_{\beta}^{-1}`	$\phi_\alpha \circ \phi_\beta^{-1}$	replaced by other adjectives (C^k, smooth, analytic, . . .) in the definition above.
gilmore-lie-groups_F00241	40	1.000	`R^{n} \rightarrow R^{n}`	$R^n \rightarrow R^n$	replaced by other adjectives (C^k, smooth, analytic, . . .) in the definition above.
gilmore-lie-groups_F00242	40	0.697	`C^{k}`	C^k	condition $\det(A)=+1$ places one constraint on these four real variables. Therefo
gilmore-lie-groups_F00243	40	1.000	`x_{1} \rightarrow 0`	$x_1 \rightarrow 0$	fold R^2 (plane) $\times S^1$ (circle) (see Fig. 2.2). This is not at all obvious, but will become
gilmore-lie-groups_F00244	40	1.000	`\times S^{1}`	$\times S^1$	each operation in the group uniquely.
gilmore-lie-groups_F00245	41	0.999	`z^{2}-x^{2}-y^{2}=1`	$z^2-x^2-y^2=1$	
gilmore-lie-groups_F00246	41	1.000	`H^{2} \times S^{1}`	$H^2 \times S^1$	
gilmore-lie-groups_F00247	41	0.698	`\left.U_{\alpha}\right)`	$U_\alpha)$	$\lvert x_n-x_n\rvert^2$), this definition is equivalent to
gilmore-lie-groups_F00248	41	0.698	`\cup_{\alpha}^{\text {finite }} T \subset U_{\alpha}`	$\cup_\alpha^{\text{finite }} T \subset U_\alpha$	$\lvert x_n-x_n\rvert^2$), this definition is equivalent to
gilmore-lie-groups_F00249	41	1.000	`\left(\left|x-x^{\prime}\right|^{2}=\left|x_{1}-x_{1}^{ \prime}\right|^{2}+\cdots+\right.`	$\left(\lvert x-x^{\prime}\rvert^2=\lvert x_1-x_1^{\prime}\rvert^2+\cdots+\right.$	space is compact if every infinite sequence of points has a subsequence that converges to a point in the space.
gilmore-lie-groups_F00250	41	1.000	`\left|x_{n}-x_{n}^{\prime}\right|^{2}`	$\lvert x_n-x_n^{\prime}\rvert^2$	converges to a point in the space.
gilmore-lie-groups_F00251	42	1.000	`\left(g(x), x \in M^{n}\right)`	$\left(g(x), x \in M^n\right)$	operations $(g(x), x \in M^n)$ and a combinatorial operation defined by $g(x) \circ g(y)=$
gilmore-lie-groups_F00252	42	1.000	`g(x) \circ g(y)=`	$g(x) \circ g(y)=$	operations $(g(x), x \in M^n)$ and a combinatorial operation defined by $g(x) \circ g(y)=$
gilmore-lie-groups_F00253	42	1.000	`g(z)`	$g(z)$	$g(z)$, where the coordinate $z \in M^n$ depends on the coordinates $x \in M^n$ and $y \in M^n$
gilmore-lie-groups_F00254	42	1.000	`z \in M^{n}`	$z \in M^n$	$g(z)$, where the coordinate $z \in M^n$ depends on the coordinates $x \in M^n$ and $y \in M^n$
gilmore-lie-groups_F00255	42	1.000	`x \in M^{n}`	$x \in M^n$	$g(z)$, where the coordinate $z \in M^n$ depends on the coordinates $x \in M^n$ and $y \in M^n$
gilmore-lie-groups_F00256	42	1.000	`y \in M^{n}`	$y \in M^n$	$g(z)$, where the coordinate $z \in M^n$ depends on the coordinates $x \in M^n$ and $y \in M^n$
gilmore-lie-groups_F00257	42	1.000	`z=\phi(x, y)`	$z=\phi(x, y)$	through a function $z=\varphi(x$
gilmore-lie-groups_F00258	42	1.000	`g(x) \circ g(y)=g(z)`	$g(x) \circ g(y)=g(z)$	(ii) **Smoothness of the group inversion map** Th
gilmore-lie-groups_F00259	42	1.000	`y=\psi(x)`	$y=\psi(x)$	by $g(x)^{-1}=g(y)$, is differentiable.

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gilmore-lie-groups_F00260	42	1.000	`g(x)^{-1}=g(y)`	$g(x)^{-1} = g(y)$	It is possible to combine thes
gilmore-lie-groups_F00261	42	1.000	`g(\phi(x, y))`	$g(\phi(x, y))$	
gilmore-lie-groups_F00262	42	1.000	`\phi`	ϕ	
gilmore-lie-groups_F00263	42	1.000	`x_{1}`	x_1	
gilmore-lie-groups_F00264	42	1.000	`y_{1}`	y_1	
gilmore-lie-groups_F00265	42	1.000	`x_{2}-x_{3}`	$x_2 - x_3$	
gilmore-lie-groups_F00266	42	1.000	`x_{1}=0`	$x_1 = 0$	
gilmore-lie-groups_F00267	42	1.000	`y_{2}-y_{3}`	$y_2 - y_3$	
gilmore-lie-groups_F00268	42	1.000	`y_{1}=0`	$y_1 = 0$	
gilmore-lie-groups_F00269	43	0.983	`\left(y_{1}, y_{2}, y_{3}\right)`	(y_1, y_2, y_3)	inverse. We can determine the coordinates (y_1, y_2, y_3) of $[g(x_1, x_2, x_3)]^{-1}$ by setting
gilmore-lie-groups_F00270	43	0.983	`\left[g\left(x_{1}, x_{2}, x_{3}\right)\right]^{-1}`	$\left[g\left(x_1, x_2, x_3\right)\right]^{-1}$	inverse. We can determine the coordinates (y_1, y_2, y_3) of $[g(x_1, x_2, x_3)]^{-1}$ by setting
gilmore-lie-groups_F00271	43	0.998	`\left(z_{1}, z_{2}, z_{3}\right)=(1,0,0)`	$\left(z_1, z_2, z_3\right) = (1, 0, 0)$	$(z_1, z_2, z_3) = (1, 0, 0)$ and solving for (y_1, y_2, y_3) in terms of (x_1, x_2, x_3). Or more
gilmore-lie-groups_F00272	43	0.998	`\left(x_{1}, x_{2}, x_{3}\right)`	$\left(x_1, x_2, x_3\right)$	$(z_1, z_2, z_3) = (1, 0, 0)$ and solving for (y_1, y_2, y_3) in terms of (x_1, x_2, x_3). Or more
gilmore-lie-groups_F00273	43	1.000	`[g(x)]^{-1}=g(y)=g(\psi(x))`	$[g(x)]^{-1} = g(y) = g(\psi(x))$	
gilmore-lie-groups_F00274	43	0.964	`(x, y,|z|, \theta)`	$(x, y, \|z\|, \theta)$	parameterizes $SL(2;\mathbb{R})$ is three dimensional. It is $H^{2+} \times S^1$, where H^{2+} is the
gilmore-lie-groups_F00275	43	0.882	`(-x,-y,-|z|, \theta+\pi)`	$(-x, -y, -\|z\|, \theta + \pi)$	upper sheet of the two-sheeted hyperboloid.
gilmore-lie-groups_F00276	43	1.000	`H^{2+} \times S^{1}`	$H^{2+} \times S^1$	
gilmore-lie-groups_F00277	43	1.000	`H^{2+}`	H^{2+}	
gilmore-lie-groups_F00278	43	1.000	`\phi(x, y)`	$\phi(x, y)$	
gilmore-lie-groups_F00279	43	1.000	`g(x) \circ g(y)=g(z)=g(\phi(x, y))`	$g(x) \circ g(y) = g(z) = g(\phi(x, y))$	
gilmore-lie-groups_F00280	44	1.000	`[g(x)]^{-1}=`	$[g(x)]^{-1} =$	In addition, the mapping $y = \psi(x)$ of a group operation to its inverse $[g(x)]^{-1} =$
gilmore-lie-groups_F00281	44	1.000	`g(y)=g(\psi(x))`	$g(y) = g(\psi(x))$	$g(y) = g(\psi(x))$ is also differential
gilmore-lie-groups_F00282	44	0.863	`\operatorname{SL}(2 ; \mathbb{R})`	$\operatorname{SL}(2;\mathbb{R})$	trated in Fig. 2.2.
gilmore-lie-groups_F00283	44	1.000	`M`	M	O in $SO(n)$: $M = SO$. Devise an algorithm for constructing these matrices. Show
gilmore-lie-groups_F00284	44	1.000	`S L(n ; \mathbb{R})`	$SL(n;\mathbb{R})$	O in $SO(n)$: $M = SO$. Devise an algorithm for constructing these matrices. Show
gilmore-lie-groups_F00285	44	1.000	`S`	S	$S = (MM^T)^{1/2}$ and $O = S^{-1}M$. How do you compute the square root of a matrix? Show that O is compact while S and M are not compact.

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gilmore-lie-groups_F00286	44	0.755	`O`	O	Show that O is compact while S and M are not compact.
gilmore-lie-groups_F00287	44	0.755	`S O(n): M=S O`	$SO(n): M = SO$	Show that O is compact while S and M are not compact.
gilmore-lie-groups_F00288	44	1.000	`S=\left(M M^{t}\right)^{1 / 2}`	$S = \left(MM^t\right)^{1/2}$	4. Construct the most general linear transformation $(x, y, z) \to (x', y', z')$ that leaves
gilmore-lie-groups_F00289	44	1.000	`O=S^{-1} M`	$O = S^{-1}M$	4. Construct the most general linear transformation $(x, y, z) \to (x', y', z')$ that leaves
gilmore-lie-groups_F00290	44	1.000	`(x, y, z) \rightarrow\left(x^{\prime}, y^{\prime}, z^{\prime}\right)`	$(x, y, z) \rightarrow \left(x^{\prime}, y^{\prime}, z^{\prime}\right)$	
gilmore-lie-groups_F00291	44	1.000	`M_{1}`	M_{1}	
gilmore-lie-groups_F00292	44	1.000	`M_{2}`	M_{2}	
gilmore-lie-groups_F00293	44	0.995	`[S O(1,1)]`	$[SO(1,1)]$	
gilmore-lie-groups_F00294	44	0.972	`(c t)^{2}-x^{2}`	$(ct)^{2}-x^{2}$	
gilmore-lie-groups_F00295	44	0.972	`S O(2)`	$SO(2)$	
gilmore-lie-groups_F00296	44	0.999	`x^{2}+y^{2}`	$x^{2}+y^{2}$	
gilmore-lie-groups_F00297	45	1.000	`(c t)^{2}-x^{2}-y^{2}-z^{2}`	$(ct)^{2}-x^{2}-y^{2}-z^{2}$	$(ct)^2 - x^2 - y^2 - z^2$. This is the Lorentz group $O(3, 1)$. Four disconnected mani-
gilmore-lie-groups_F00298	45	1.000	`O(3,1)`	$O(3,1)$	$(ct)^2 - x^2 - y^2 - z^2$. This is the Lorentz group $O(3, 1)$. Four disconnected mani-
gilmore-lie-groups_F00299	45	0.535	`S L(2 ; \mathbb{C})`	$SL(2;\mathbb{C})$	trices in this group have the structure $\left[\begin{array}{ll}\alpha & \beta \\ \gamma & \delta\end{array}\right]$, where $\alpha, \beta, \gamma, \delta$ are complex numbers
gilmore-lie-groups_F00300	45	0.788	`\left[\begin{array}{ll}\alpha & \beta \\ \gamma & \delta \end{array}\right]`	$\left[\begin{array}{ll}\alpha & \beta \\ \gamma & \delta \end{array}\right]$	and $\alpha\delta - \beta\gamma = 1$. Define the matrix X by
gilmore-lie-groups_F00301	45	0.987	`\alpha \delta-\beta \gamma=1`	$\alpha\delta - \beta\gamma = 1$	$\left[\begin{array}{l} ct+z \end{array}\right.$
gilmore-lie-groups_F00302	45	0.987	`X`	X	$\left[\begin{array}{l} ct+z \end{array}\right.$
gilmore-lie-groups_F00303	45	1.000	`\mathbf{x}`	$\mathbf{x}$	**a.** Show that X is hermitian: $X^{\dagger} \equiv \left(X^{t}\right)^{*} = X$.
gilmore-lie-groups_F00304	45	1.000	`\mathbf{x}=(x, y, z)`	$\mathbf{x} = (x, y, z)$	**a.** Show that X is hermitian: $X^{\dagger} \equiv \left(X^{t}\right)^{*} = X$.
gilmore-lie-groups_F00305	45	1.000	`\sigma=\left(\sigma_{1}, \sigma_{2}, \sigma_{3}\right)= \left(\sigma_{x}, \sigma_{y}, \sigma_{z}\right)`	$\sigma = \left(\sigma_{1}, \sigma_{2}, \sigma_{3}\right) = \left(\sigma_{x}, \sigma_{y}, \sigma_{z}\right)$	**a.** Show that X is hermitian: $X^{\dagger} \equiv \left(X^{t}\right)^{*} = X$.
gilmore-lie-groups_F00306	45	1.000	`X^{\dagger} \equiv\left(X^{t}\right)^{*}=X`	$X^{\dagger} \equiv \left(X^{t}\right)^{*} = X$	to construct X.
gilmore-lie-groups_F00307	45	1.000	`g \in S L(2 ; \mathbb{C})`	$g \in SL(2;\mathbb{C})$	in the matrix elements $\alpha, \beta, \gamma, \delta$ of g and $\alpha^*, \beta^*, \gamma^*, \delta^*$ of its adj
gilmore-lie-groups_F00308	45	1.000	`g^{\dagger} X g=X^{\prime}=H\left(x^{\prime}, y^{\prime}, z^{\prime}, c t^{\prime}\right)`	$g^{\dagger} X g = X^{\prime} = H\left(x^{\prime}, y^{\prime}, z^{\prime}, ct^{\prime}\right)$	in the matrix elements $\alpha, \beta, \gamma, \delta$ of g and $\alpha^*, \beta^*, \gamma^*, \delta^*$ of its adj
gilmore-lie-groups_F00309	45	0.964	`\left(x^{\prime}, y^{\prime}, z^{\prime}, c t^{\prime} \right)`	$\left(x^{\prime}, y^{\prime}, z^{\prime}, ct^{\prime}\right)$	**e.** Find the subgroup of $SL(2;\mathbb{C})$ that leaves $t' = t$. (It is $SU(2) \subset SL(2;\mathbb{C})$).
gilmore-lie-groups_F00310	45	0.918	`(x, y, z, c t)`	(x, y, z, ct)	. For any $g \in SL(2;\mathbb{C})$ write $g = kh$, where $h \in SU(2)$, $h^{\dagger} = h^{-1}$, h has the
gilmore-lie-groups_F00311	45	1.000	`g`	g	form $h = \mathrm{EXP}(\frac{i}{2}\sigma \cdot \theta)$ and $k \in SL(2;\mathbb{C})/SU(2)$, $k^{\dagger} = k^{+1}$, k has the form
gilmore-lie-groups_F00312	45	1.000	`\alpha^{*}, \beta^{*}, \gamma^{*}, \delta^{*}`	$\alpha^{*}, \beta^{*}, \gamma^{*}, \delta^{*}$	form $h = \mathrm{EXP}(\frac{i}{2}\sigma \cdot \theta)$ and $k \in SL(2;\mathbb{C})/SU(2)$, $k^{\dagger} = k^{+1}$, k has the form

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gilmore-lie-groups_F00313	45	1.000	`g^{\dagger}`	$g^{\dagger}$	form $h = \mathrm{EXP}(\frac{i}{2}\sigma \cdot \theta)$ and $k \in SL(2;\mathbb{C})/SU(2)$, $k^{\dagger} = k^{+1}$, k has the form
gilmore-lie-groups_F00314	45	0.990	`t^{\prime}=t`	$t' = t$	$k = \mathrm{EXP}(\frac{1}{2}\sigma \cdot \mathbf{b})$. The three vector **b** is called a boost vector. The three vectors θ
gilmore-lie-groups_F00315	45	0.990	`S U(2) \subset S L(2 ; \mathbb{C})`	$SU(2) \subset SL(2;\mathbb{C})$	$k = \mathrm{EXP}(\frac{1}{2}\sigma \cdot \mathbf{b})$. The three vector **b** is called a boost vector. The three vectors θ
gilmore-lie-groups_F00316	45	0.952	`g=k h`	$g = kh$	and **b** are real. Construct $k^{\dagger}H(x, y, z, ct)k = H(x', y', z', ct')$. If this is too diffi-
gilmore-lie-groups_F00317	45	0.952	`h \in S U(2), h^{\dagger}=h^{-1}, h`	$h \in SU(2), h^{\dagger} = h^{-1}, h$	and **b** are real. Construct $k^{\dagger}H(x, y, z, ct)k = H(x', y', z', ct')$. If this is too diffi-
gilmore-lie-groups_F00318	45	0.461	`h=\operatorname{EXP}\left(\frac{i}{2} \sigma \cdot \theta \right)`	$h = \mathrm{EXP}\left(\frac{i}{2}\sigma \cdot \theta\right)$	cult, choose **b** along the z-axis, $\mathbf{b} = (0, 0, b)$.
gilmore-lie-groups_F00319	45	0.461	`k \in \operatorname{SL}(2 ; \mathbb{C}) / \operatorname{SU}(2), k^{\dagger}=k^{+1}, k`	$k \in \mathrm{SL}(2;\mathbb{C})/\mathrm{SU}(2), k^{\dagger} = k^{+1}, k$	cult, choose **b** along the z-axis, $\mathbf{b} = (0, 0, b)$.
gilmore-lie-groups_F00320	45	1.000	`k=\operatorname{EXP}\left(\frac{1}{2} \sigma \cdot \mathbf{b}\right)`	$k = \mathrm{EXP}\left(\frac{1}{2}\sigma \cdot \mathbf{b}\right)$	Show that the usual Lorentz transformation law results. Applying $k(b')$ after applying $k(b)$ results in (a) $k(b' + b)$, (b) two successive
gilmore-lie-groups_F00321	45	1.000	`\mathbf{b}`	$\mathbf{b}$	Show that the usual Lorentz transformation law results. Applying $k(b')$ after applying $k(b)$ results in (a) $k(b' + b)$, (b) two successive
gilmore-lie-groups_F00322	45	1.000	`\theta`	θ	Show that the usual Lorentz transformation law results. Applying $k(b')$ after applying $k(b)$ results in (a) $k(b' + b)$, (b) two successive
gilmore-lie-groups_F00323	45	0.899	`k^{\dagger} H(x, y, z, c t) k=H\left(x^{\prime}, y^{ \prime}, z^{\prime}, c t^{\prime}\right)`	$k^{\dagger}H(x, y, z, ct)k = H\left(x', y', z', ct'\right)$	Applying $k(b')$ after applying $k(b)$ results in (a) $k(b' + b)$, (b) two successive Lorentz transformations. Show that the velocity addition law for colinear boosts
gilmore-lie-groups_F00324	45	0.893	`\mathbf{b}=(0,0, b)`	$\mathbf{b} = (0, 0, b)$	results.
gilmore-lie-groups_F00325	45	0.458	`k\left(b^{\prime}\right)`	$k\left(b'\right)$	related to the Thomas precession (Gilmore 1974b).
gilmore-lie-groups_F00326	45	0.458	`k(b)`	$k(b)$	related to the Thomas precession (Gilmore 1974b).
gilmore-lie-groups_F00327	45	0.458	`(a) k\left(b^{\prime}+b\right)`	$(a)k\left(b' + b\right)$	related to the Thomas precession (Gilmore 1974b).
gilmore-lie-groups_F00328	45	0.981	`\mathbf{b}^{\prime}`	$\mathbf{b}'$	$f(\theta + 2\pi) = f(\theta)$. The mapping must be 1:1, so an additional condition is imposed
gilmore-lie-groups_F00329	45	0.981	`k\left(\mathbf{b}^{\prime}\right) k(\mathbf{b})=k\left( \mathbf{b}^{\prime \prime}\right) h(\theta)`	$k\left(\mathbf{b}'\right)k(\mathbf{b}) = k\left(\mathbf{b}''\right)h(\theta)$	$f(\theta + 2\pi) = f(\theta)$. The mapping must be 1:1, so an additional condition is imposed
gilmore-lie-groups_F00330	45	0.981	`\mathbf{b}^{\prime \prime}, \theta`	$\mathbf{b}'', \theta$	$f(\theta + 2\pi) = f(\theta)$. The mapping must be 1:1, so an additional condition is imposed
gilmore-lie-groups_F00331	45	1.000	`\theta \rightarrow \theta^{\prime}=\theta+k+f(\theta)`	$\theta \rightarrow \theta' = \theta + k + f(\theta)$	
gilmore-lie-groups_F00332	45	1.000	`0 \leq k<2 \pi`	$0 \leq k < 2\pi$	
gilmore-lie-groups_F00333	45	1.000	`f(\theta)`	$f(\theta)$	
gilmore-lie-groups_F00334	45	0.991	`f(\theta+2 \pi)=f(\theta)`	$f(\theta + 2\pi) = f(\theta)$	
gilmore-lie-groups_F00335	45	0.991	`1: 1`	$1 : 1$	
gilmore-lie-groups_F00336	45	1.000	`f(\theta): d f(\theta) / d \theta>-1`	$f(\theta) : df(\theta)/d\theta > -1$	
gilmore-lie-groups_F00337	46	0.769	`(a, b, c, d)`	(a, b, c, d)	9. Rational fractional transformations (a, b, c, d) map points on the real line (real pro-
gilmore-lie-groups_F00338	46	1.000	`R P^{1}`	RP^{1}	jective line RP^{1}) to the real line as follov

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gilmore-lie-groups_F00339	46	1.000	(\lambda a, \lambda b, \lambda c, \lambda d)=\lambda(a, b, c, d)(\lambda \neq 0)	$(\lambda a, \lambda b, \lambda c, \lambda d) = \lambda(a, b, c, d)(\lambda \neq 0)$	identical mappings
gilmore-lie-groups_F00340	46	1.000	A, B, C, D	A, B, C, D	**b.** Show that the tra
gilmore-lie-groups_F00341	46	0.668	(\lambda, 0,0, \lambda)	$(\lambda, 0, 0, \lambda)$	**c.** Construct the inverse transformation $x' \to x$, and show
gilmore-lie-groups_F00342	46	0.999	x^{\prime} \rightarrow x	$x' \to x$	**d** Show that the transformation degeneracy $x' = (a, b, c, d)x = \lambda(a, b, c, d)x$ can
gilmore-lie-groups_F00343	46	0.999	\lambda(d,-b,-c, a)	$\lambda(d, -b, -c, a)$	**d** Show that the transformation degeneracy $x' = (a, b, c, d)x = \lambda(a, b, c, d)x$ can
gilmore-lie-groups_F00344	46	1.000	\lambda \neq 0	$\lambda \neq 0$	be lifted by requiring that the four parameters a, b, c, d describin
gilmore-lie-groups_F00345	46	1.000	D=a d-b c \neq 0	$D = ad - bc \neq 0$	be lifted by requiring that the four parameters a, b, c, d describin
gilmore-lie-groups_F00346	46	1.000	x^{\prime}=(a, b, c, d) x=\lambda(a, b, c, d) x	$x' = (a, b, c, d)x = \lambda(a, b, c, d)x$	mations satisfy the constraint $D = ad - bc = 1$.
gilmore-lie-groups_F00347	46	1.000	a, b, c, d	a, b, c, d	**e.** It is useful to introduce homogeneous coordinates (y, z) and define the real projec-
gilmore-lie-groups_F00348	46	1.000	D=a d-b c=1	$D = ad - bc = 1$	tive coordinate x as the ratio of these homoger
gilmore-lie-groups_F00349	46	0.980	(y, z)	(y, z)	homogeneous coordinates transform linearly under $SL(2; \mathbb{R})$ then the real projec-
gilmore-lie-groups_F00350	46	1.000	x=y / z	$x = y/z$	tive coordinates x transform under rational fractional transformations:
gilmore-lie-groups_F00351	46	0.477	x_{1}, x_{2}, x_{3}	x_1, x_2, x_3	$x \to x' = \frac{\ldots}{(x - x_1)(x_2 - x_1)}$
gilmore-lie-groups_F00352	46	0.477	\infty	∞	$x \to x' = \frac{\ldots}{(x - x_1)(x_2 - x_1)}$
gilmore-lie-groups_F00353	46	0.996	D=1	$D = 1$	0. The real projective space RP^n is the space of all straight lines through the origin
gilmore-lie-groups_F00354	46	1.000	\left(x_{1}^{\prime}, x_{2}^{\prime}, x_{3}^{\prime} \right)	(x_1', x_2', x_3')	with $x' \neq 0 \leftrightarrow x \neq 0$ and $x' = 0 \leftrightarrow x = 0$. A straight line through the $x \neq 0$ and $y \neq 0$ if (and only if) $y = \lambda x$ for some real scale factor λ
gilmore-lie-groups_F00355	46	1.000	R P^{n}	RP^n	factor can always be chosen so that y is in the unit sphere in R^{n+1}: $y \in S^n \subset R^{n+1}$.
gilmore-lie-groups_F00356	46	0.987	R^{n+1}	R^{n+1}	In fact, two values of λ can be chosen: $\lambda = \pm 1/(\sum_{i=1}^{n+1} x_i^2)^{1/2}$. In R^3 the straight
gilmore-lie-groups_F00357	46	0.987	S L(n+1 ; \mathbb{R}) \operatorname{maps} x=\left(x_{1}, x_{2}, \ldots, x_{n+1}\right) \in R^{n+1}	$SL(n+1; \mathbb{R})$ maps $x = (x_1, x_2, \ldots, x_{n+1}) \in R^{n+1}$	In fact, two values of λ can be chosen: $\lambda = \pm 1/(\sum_{i=1}^{n+1} x_i^2)^{1/2}$. In R^3 the straight
gilmore-lie-groups_F00358	46	0.987	x^{\prime} \in R^{n+1}	$x' \in R^{n+1}$	In fact, two values of λ can be chosen: $\lambda = \pm 1/(\sum_{i=1}^{n+1} x_i^2)^{1/2}$. In R^3 the straight
gilmore-lie-groups_F00359	46	1.000	x^{\prime} \neq 0 \leftrightarrow x \neq 0	$x' \neq 0 \leftrightarrow x \neq 0$	line containing (x, y, z) can be represented by homogeneous coordinates $(X, Y) =$
gilmore-lie-groups_F00360	46	1.000	x^{\prime}=0 \leftrightarrow x=0	$x' = 0 \leftrightarrow x = 0$	line containing (x, y, z) can be represented by homogeneous coordinates $(X, Y) =$
gilmore-lie-groups_F00361	46	1.000	x \neq 0	$x \neq 0$	$(x/z, y/z)$ if $z \neq 0$. Straight lines through the origin of R^3 are mapped to straight lines in R^3 by $x \to x' = Mx$, $M \in SL(2; \mathbb{R})$. Show that the homogeneous coordinates
gilmore-lie-groups_F00362	46	1.000	y \neq 0	$y \neq 0$	$(x/z, y/z)$ if $z \neq 0$. Straight lines through the origin of R^3 are mapped to straight lines in R^3 by $x \to x' = Mx$, $M \in SL(2; \mathbb{R})$. Show that the homogeneous coordinates
gilmore-lie-groups_F00363	46	1.000	y=\lambda x	$y = \lambda x$	$(x/z, y/z)$ if $z \neq 0$. Straight lines through the origin of R^3 are mapped to straight lines in R^3 by $x \to x' = Mx$, $M \in SL(2; \mathbb{R})$. Show that the homogeneous coordinates
gilmore-lie-groups_F00364	46	1.000	y	y	in R^3 by $x \to x' = Mx$, $M \in SL(2; \mathbb{R})$. Show that the homogeneous coordinates
gilmore-lie-groups_F00365	46	1.000	R^{n+1}: y \in S^{n} \subset R^{n+1}	$R^{n+1}: y \in S^n \subset R^{n+1}$	in R^3 by $x \to x' = Mx$, $M \in SL(2; \mathbb{R})$. Show that the homogeneous coordinates

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gilmore-lie-groups_F00366	46	1.000	`\lambda`	λ	
gilmore-lie-groups_F00367	46	1.000	`\lambda= \pm 1 /\left(\sum_{i=1}^{n+1} x_{i}^{2} \right)^{1 / 2}`	$\lambda = \pm 1/\left(\sum_{i=1}^{n+1} x_i^2\right)^{1/2}$	
gilmore-lie-groups_F00368	46	1.000	`R^{3}`	R^3	
gilmore-lie-groups_F00369	46	0.983	`(x, y, z)`	(x, y, z)	
gilmore-lie-groups_F00370	46	0.983	`(X, Y)=`	$(X, Y) =$	
gilmore-lie-groups_F00371	46	1.000	`(x / z, y / z)`	$(x/z, y/z)$	
gilmore-lie-groups_F00372	46	1.000	`z \neq 0`	$z \neq 0$	
gilmore-lie-groups_F00373	46	1.000	`x \rightarrow x^{\prime}=M x, M \in S L(3 ; \mathbb{R})`	$x \rightarrow x^{\prime}=M x, M \in S L(3 ; \mathbb{R})$	
gilmore-lie-groups_F00374	47	1.000	`x^{\prime}`	$x^{\prime}$	representing the two lines containing x and $x^{\prime}$ are related by the linear fractional
gilmore-lie-groups_F00375	47	1.000	`R P^{n} \rightarrow R P^{n}`	$RP^{n} \rightarrow RP^{n}$	[illegible]
gilmore-lie-groups_F00376	47	0.989	`S L(2 ; \mathbb{R}) / S O(2) \simeq\left[ \begin{array}{cc}z+x & y \\ y & z-x\end{array}\right]`	$SL(2;\mathbb{R})/SO(2) \simeq \left[\begin{array}{cc}z+x & y \\ y & z-x\end{array}\right]$	manifold in the Minkowski $2+1$ dimensional space-time with metric $(+1, -1, -1)$
gilmore-lie-groups_F00377	47	1.000	`x=r \cos \phi, y=r \sin \phi`	$x = r\cos\phi, y = r\sin\phi$	$1+r^2$ [illegible]
gilmore-lie-groups_F00378	47	0.633	`S O(3) / S O(2)`	$SO(3)/SO(2)$	measure on S^2 are obtained from the results above for H^2 by the substitutions $1+r^2 \rightarrow 1-r^2$. Show that the disk $0 \leq r \leq 1, 0 \leq \phi \leq 2\pi$ maps onto the up-
gilmore-lie-groups_F00379	47	0.633	`S^{2} \subset R^{3}`	$S^2 \subset R^3$	measure on S^2 are obtained from the results above for H^2 by the substitutions $1+r^2 \rightarrow 1-r^2$. Show that the disk $0 \leq r \leq 1, 0 \leq \phi \leq 2\pi$ maps onto the up-
gilmore-lie-groups_F00380	47	1.000	`z^{2}+\left(x^{2}+y^{2}\right)=1`	$z^2+\left(x^2+y^2\right)=1$	$1+r^2 \rightarrow 1-r^2$. Show that the disk $0 \leq r \leq 1, 0 \leq \phi \leq 2\pi$ maps onto the up- per hemisphere of the sphere, with $r=0$ mapping to the north pole and $r=1$
gilmore-lie-groups_F00381	47	1.000	`d s^{2}=d z^{2}+\left(d x^{2}+d y^{2}\right)`	$ds^2 = dz^2 + \left(dx^2 + dy^2\right)$	[illegible] mapping to the equator. Show that the geodesic length from the north pole to the
gilmore-lie-groups_F00382	47	1.000	`H^{2}`	H^2	[illegible] equator along the longitude $\phi = 0$ is $s = \int_0^1 dr/\sqrt{1-r^2} = \pi/2$ and the volume of
gilmore-lie-groups_F00383	47	1.000	`1+r^{2} \rightarrow 1-r^{2}`	$1+r^2 \rightarrow 1-r^2$	the hemisphere surface is $V = \int_{r=0}^{r=1} \int_{\phi=0}^{\phi=2\pi} dV(r,\phi) = \int_0^1 r dr/\sqrt{1-r^2} \int_0^{2\pi} d\phi =$
gilmore-lie-groups_F00384	47	1.000	`0 \leq r \leq 1,0 \leq \phi \leq 2 \pi`	$0 \leq r \leq 1, 0 \leq \phi \leq 2\pi$	the hemisphere surface is $V = \int_{r=0}^{r=1} \int_{\phi=0}^{\phi=2\pi} dV(r,\phi) = \int_0^1 r dr/\sqrt{1-r^2} \int_0^{2\pi} d\phi =$
gilmore-lie-groups_F00385	47	1.000	`r=0`	$r = 0$	2π.
gilmore-lie-groups_F00386	47	1.000	`r=1`	$r = 1$	2π.
gilmore-lie-groups_F00387	47	1.000	`\phi=0`	$\phi = 0$	
gilmore-lie-groups_F00388	47	1.000	`s=\int_{0}^{1} d r / \sqrt{1-r^{2}}=\pi / 2`	$s = \int_0^1 dr/\sqrt{1-r^2} = \pi/2$	
gilmore-lie-groups_F00389	47	1.000	`V=\int_{r=0}^{r=1} \int_{\phi=0}^{\phi=2 \pi} d V(r, \phi)=\int_{0}^{1} r d r / \sqrt{1-r^{2}} \int_{0}^{2 \pi} d \phi=`	$V = \int_{r=0}^{r=1} \int_{\phi=0}^{\phi=2\pi} dV(r,\phi) = \int_0^1 r dr/\sqrt{1-r^2} \int_0^{2\pi} d\phi =$	
gilmore-lie-groups_F00390	47	1.000	`2 \pi`	2π	

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gilmore-lie-groups_F00391	48	0.969	`G L(n ; \mathbb{F})`	$GL(n;\mathbb{F})$	numbers, and quaternions, and various of their subgroups obtained by
gilmore-lie-groups_F00392	48	1.000	`\mathbb{F}`	$\mathbb{F}$	imposing linear, bilinear and quadratic, and n-linear constraints on these
gilmore-lie-groups_F00393	48	1.000	`H_{1} \subset G`	$H_1 \subset G$	**Example** If H_1 is the two-dimensional subgroup of $SL(2;\mathbb{R})$ described in (3.1)
gilmore-lie-groups_F00394	48	1.000	`H_{12}=H_{1} \cap H_{2}`	$H_{12} = H_1 \cap H_2$	above and H_2 is the one-dimens
gilmore-lie-groups_F00395	48	1.000	`H_{1} \cap H_{2}`	$H_1 \cap H_2$	$H_1 = SO(2)$ $\begin{bmatrix} \cos\theta & \sin\theta \end{bmatrix}$ $\theta \in [0, 2\pi)$ (3.2)
gilmore-lie-groups_F00396	48	0.950	`H_{1}`	H_1	
gilmore-lie-groups_F00397	48	0.817	`H_{2}`	H_2	34
gilmore-lie-groups_F00398	49	1.000	`\pm I_{2}`	$\pm I_2$	discrete group operations $\pm I_2$.
gilmore-lie-groups_F00399	49	0.950	`(\mathbb{F}=\mathbb{R})`	$(\mathbb{F} = \mathbb{R})$	($\mathbb{F} = \mathbb{R}$), complex numbers ($\mathbb{F} = \mathbb{C}$), and quaternions ($\mathbb{F} = \mathbb{Q}$). The complex num-
gilmore-lie-groups_F00400	49	0.950	`\mathbb{F}=\mathbb{C}`	$\mathbb{F} = \mathbb{C}$	($\mathbb{F} = \mathbb{R}$), complex numbers ($\mathbb{F} = \mathbb{C}$), and quaternions ($\mathbb{F} = \mathbb{Q}$). The complex num-
gilmore-lie-groups_F00401	49	0.950	`\mathbb{F}=\mathbb{Q}`	$\mathbb{F} = \mathbb{Q}$	($\mathbb{F} = \mathbb{R}$), complex numbers ($\mathbb{F} = \mathbb{C}$), and quaternions ($\mathbb{F} = \mathbb{Q}$). The complex num-
gilmore-lie-groups_F00402	49	1.000	`1, \mathcal{I}, J, K`	$1, \mathcal{I}, J, K$	We list, in order, matrix groups on which no constraints are imposed (1), on
gilmore-lie-groups_F00403	49	0.900	`[\operatorname{det}(\mathrm{M})=+1]`	$[\operatorname{det}(\mathrm{M}) = +1]$	**1.** $GL(n;\mathbb{F})$. **General linear** group
gilmore-lie-groups_F00404	49	0.999	`G L(1 ; \mathbb{Q})`	$GL(1;\mathbb{Q})$	
gilmore-lie-groups_F00405	49	0.999	`1 \times 1`	1×1	
gilmore-lie-groups_F00406	50	1.000	`A_{i}^{j}`	A_i^j	The determinant of an $n \times n$ matrix A with matrix elements A_i^j is defined by
gilmore-lie-groups_F00407	50	1.000	`\epsilon^{i_{1} i_{2} \cdots i_{n}}`	$\epsilon^{i_1 i_2 \cdots i_n}$	permutation of the integers $1, 2, \ldots, n$; -1 for an odd permutation; and 0 if two
gilmore-lie-groups_F00408	50	0.719	`1,2, \ldots, n ;-1`	$1, 2, \ldots, n; -1$	or more values of the indices i_* are equal. With this definition there is no difficulty
gilmore-lie-groups_F00409	50	1.000	`i_{*}`	i_*	computing the determinant of a matrix containing matrix elements that do not commute (quaternions)
gilmore-lie-groups_F00410	50	1.000	`U T(p, q)`	$UT(p,q)$	$m_{ij} = 0$ $p+1 \le i \le p+q$ (3.6)
gilmore-lie-groups_F00411	50	1.000	`n \times n(n=p+q)`	$n \times n(n = p+q)$	$m_{ij} = 0$ $p+1 \le i \le p+q$ (3.6)
gilmore-lie-groups_F00412	50	1.000	`U T(1,1)`	$UT(1,1)$	$\begin{bmatrix} y' \end{bmatrix} = \begin{bmatrix} 0 & d \end{bmatrix} \begin{bmatrix} y \end{bmatrix} = \begin{bmatrix} dy \end{bmatrix}$ (3.7)
gilmore-lie-groups_F00413	50	0.991	`y=0`	$y = 0$	p and q.
gilmore-lie-groups_F00414	50	0.991	`y=0 \rightarrow y^{\prime}=0`	$y = 0 \rightarrow y' = 0$	p and q.
gilmore-lie-groups_F00415	50	1.000	`x=0`	$x = 0$	
gilmore-lie-groups_F00416	50	1.000	`V_{p} \oplus V_{q}`	$V_p \oplus V_q$	

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gilmore-lie-groups_F00417	50	1.000	`V_{q}`	V_q	
gilmore-lie-groups_F00418	50	1.000	`V_{p}`	V_p	
gilmore-lie-groups_F00419	50	1.000	`q`	q	
gilmore-lie-groups_F00420	51	1.000	`H T(p, q)`	$HT(p,q)$	$m_{ij}-\delta_{ij}=0$ (3.8)
gilmore-lie-groups_F00421	51	1.000	`H T(1,1)\left(m_{22}=1\right)`	$HT(1,1)\left(m_{22}=1\right)$	
gilmore-lie-groups_F00422	51	1.000	`x \rightarrow`	$x \rightarrow$	
gilmore-lie-groups_F00423	51	0.997	`x^{\prime}=a x+b`	$x^{\prime}=a x+b$	
gilmore-lie-groups_F00424	51	0.999	`U T(p, q, r)`	$UT(p,q,r)$	
gilmore-lie-groups_F00425	51	1.000	`U T(p, q+r) \cap U T(p+q, r)`	$UT(p,q+r) \cap UT(p+q,r)$	
gilmore-lie-groups_F00426	52	0.460	`S U(1,1)`	$SU(1,1)$	structure (3.10) are encountered in treatments of squeezed states of the electromag-
gilmore-lie-groups_F00427	52	1.000	`\operatorname{Sol}(n)=U T(1,1,1, \ldots, 1)`	$\operatorname{Sol}(n)=UT(1,1,1,\ldots,1)$	**Example** We consider the subgroup of 3×3 matrices in $UT(1,1,1)$ of
gilmore-lie-groups_F00428	52	0.971	`U T(1,1,1)`	$UT(1,1,1)$	
gilmore-lie-groups_F00429	52	1.000	`\hat{n}=a^{\dagger} a`	$\hat{n}=a^{\dagger} a$	tification between operator and matrix groups to develop some powerful operator
gilmore-lie-groups_F00430	52	1.000	`a^{\dagger}`	$a^{\dagger}$	tification between operator and matrix groups to develop some powerful operator
gilmore-lie-groups_F00431	52	1.000	`a`	a	tification between operator and matrix groups to develop some powerful operator
gilmore-lie-groups_F00432	52	0.994	`I=a a^{\dagger}-a^{\dagger} a=\left[a, a^{\dagger}\right]`	$I=a a^{\dagger}-a^{\dagger} a=\left[a, a^{\dagger}\right]$	disentangling theorems.
gilmore-lie-groups_F00433	52	1.000	`\operatorname{Nil}(n)`	$\operatorname{Nil}(n)$	**Example** Matrices in $Nil(3)$ of the form
gilmore-lie-groups_F00434	52	1.000	`\operatorname{Sol}(n)`	$\operatorname{Sol}(n)$	**Example** Matrices in $Nil(3)$ of the form
gilmore-lie-groups_F00435	52	0.998	`\operatorname{Nil}(3)`	$\operatorname{Nil}(3)$	
gilmore-lie-groups_F00436	52	0.976	`a^{\dagger}, a, I`	$a^{\dagger}, a, I$	The set of change of basis transformations $\langle p \mid q\rangle=\frac{1}{\sqrt{2}} e^{2 \pi i p q / h}$ encountered in
gilmore-lie-groups_F00437	52	0.716	`(p`	$(p$	**7** $A(p,q)$ This group consists of matrices that are the sum of an identity matrix
gilmore-lie-groups_F00438	52	0.716	`q)`	$q)$	**7** $A(p,q)$ This group consists of matrices that are the sum of an identity matrix
gilmore-lie-groups_F00439	52	0.716	`[p, q]=\hbar / i`	$[p, q]=\hbar / i$	**7** $A(p,q)$ This group consists of matrices that are the sum of an identity matrix
gilmore-lie-groups_F00440	52	1.000	`\langle p \mid q\rangle=\frac{1}{\sqrt{2}} e^{2 \pi i p q / h}`	$\langle p \mid q\rangle=\frac{1}{\sqrt{2}} e^{2 \pi i p q / h}$	
gilmore-lie-groups_F00441	52	0.995	`A(p, q)`	$A(p,q)$	
gilmore-lie-groups_F00442	52	0.998	`(p, q)`	(p,q)	

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gilmore-lie-groups_F00443	53	1.000	A B=B A	$AB = BA$	group.
gilmore-lie-groups_F00444	53	1.000	A(1,1)	$A(1,1)$	transformations of the x-axis (3.9): $x \rightarrow x' = x + a$. Successive transformations
gilmore-lie-groups_F00445	53	0.798	x \rightarrow x^{\prime}=x+a	$x \rightarrow x' = x + a$	of this type commute
gilmore-lie-groups_F00446	53	1.000	M^{\dagger} G M=G	$M^{\dagger} G M = G$	but indefinite we can set $G = I_{p,q}$ (9). If G is nonsingular and antisymmetric, we
gilmore-lie-groups_F00447	53	0.679	G=I_{n}	$G = I_n$	can take (10)
gilmore-lie-groups_F00448	53	0.573	G=I_{p, q}	$G = I_{p,q}$	$G = \left[\begin{array}{cc} 0 & I_n \end{array}\right]$
gilmore-lie-groups_F00449	53	1.000	I_{n}	I_n	
gilmore-lie-groups_F00450	54	0.936	G L(n ; \mathbb{F}), \mathbb{F}=\mathbb{R}, \mathbb{C}, \mathbb{Q}	$GL(n; \mathbb{F}), \mathbb{F} = \mathbb{R}, \mathbb{C}, \mathbb{Q}$	terize the matrix groups $GL(n; \mathbb{F}), \mathbb{F} = \mathbb{R}, \mathbb{C}, \mathbb{Q}$
gilmore-lie-groups_F00451	54	1.000	C^{2}	C^2	two-dimensional linear vector space C^2 (of spin states, for example), and quaternion valued 1×1 matrices that preserve length in a one-dimensional linear vector space
gilmore-lie-groups_F00452	54	1.000	\mathbb{Q}	$\mathbb{Q}$	
gilmore-lie-groups_F00453	54	0.808	S U(1 ; \mathbb{Q})	$SU(1; \mathbb{Q})$	$a_1^2 + b_1^2 + a_2^2 + b_2^2 = 1$ (3.16)
gilmore-lie-groups_F00454	54	1.000	R^{4}	R^4	
gilmore-lie-groups_F00455	54	0.992	G=I_{p, q}, p+q=n	$G = I_{p,q}, p + q = n$	condition $M^{\dagger} G M = G$, where
gilmore-lie-groups_F00456	54	1.000	p \neq 0, q \neq 0	$p \neq 0, q \neq 0$	**Example** The Lorentz group preserves the invariant $x^2 + y^2 + z^2 - (ct)^2$ and is
gilmore-lie-groups_F00457	54	1.000	x^{2}+y^{2}+z^{2}-(c t)^{2}	$x^2 + y^2 + z^2 - (ct)^2$	$\left[\begin{array}{cc} A^t & C^t \end{array}\right]\left[\begin{array}{cc} I_3 & 0 \end{array}\right]\left[\begin{array}{cc} A & B \end{array}\right]$
gilmore-lie-groups_F00458	55	0.999	N \times N	$N \times N$	**10. Antisymmetric metric-preserving groups** The metric G is an $N \times N$ non-
gilmore-lie-groups_F00459	55	1.000	\operatorname{det}(G)=\operatorname{det} \left(G^{t}\right)=\operatorname{det}(-G)=(-)^{N} \operatorname{det}(G), N	$\operatorname{det}(G) = \operatorname{det}\left(G^t\right) = \operatorname{det}(-G) = (-)^N \operatorname{det}(G), N$	metric matrix can be chosen to have the canonical forms
gilmore-lie-groups_F00460	55	1.000	N=2 n	$N = 2n$	metric matrix can be chosen to have the canonical forms
gilmore-lie-groups_F00461	55	1.000	i \sigma_{y}=\left[\begin{array}{cc}0 & 1 \\ -1 & 0 \end{array}\right]	$i\sigma_y = \left[\begin{array}{cc} 0 & 1 \\ -1 & 0 \end{array}\right]$	equations of motion.
gilmore-lie-groups_F00462	55	0.990	\operatorname{Sp}(2 n ; \mathbb{R})	$\operatorname{Sp}(2n; \mathbb{R})$	**Example** The symplectic group $Sp(2; \mathbb{R}) \subset GL(2; \mathbb{R})$ satisfies the constraint
gilmore-lie-groups_F00463	55	0.935	\operatorname{Sp}(2 ; \mathbb{R}) \subset G L(2 ; \mathbb{R})	$\operatorname{Sp}(2; \mathbb{R}) \subset GL(2; \mathbb{R})$	$\left\|\begin{array}{cc} b & d \end{array}\right\|\left\|\begin{array}{cc} -1 & 0 \end{array}\right\|\left\|\begin{array}{cc} c & d \end{array}\right\| = \left\|\begin{array}{cc} bc - ad & 0 \end{array}\right\| = \left\|\begin{array}{cc} -1 & 0 \end{array}\right\|$ (3.21)
gilmore-lie-groups_F00464	55	0.510	a d-b c=+1	$ad - bc = +1$	a singular metric G.
gilmore-lie-groups_F00465	55	0.510	\operatorname{Sp}(2 ; \mathbb{R})=S L(2 ; \mathbb{R})	$\operatorname{Sp}(2; \mathbb{R}) = SL(2; \mathbb{R})$	a singular metric G.
gilmore-lie-groups_F00466	55	1.000	M G M^{t}=G	$MGM^t = G$	
gilmore-lie-groups_F00467	56	0.999	E(3)	$E(3)$	R^3 is
gilmore-lie-groups_F00468	56	0.607	\mathbf{t}	$\mathbf{t}$	closely similar arguments the Poincaré group, consisting of Lorentz transformations ($A \in SO(3,1)$, $AI_{3,1}A^t = I_{3,1}$ (3.17)) and space-time displacements is isomorphic

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gilmore-lie-groups_F00469	56	0.792	`A \in S O(3,1), A I_{3,1} A^{t}=I_{3,1}`	$A \in SO(3,1), AI_{3,1}A^{t} = I_{3,1}$	
gilmore-lie-groups_F00470	56	0.608	`\mathbf{v}`	$\mathbf{v}$	
gilmore-lie-groups_F00471	56	0.608	`(\mathbf{t})`	$(\mathbf{t})$	
gilmore-lie-groups_F00472	56	0.608	`\left(t_{4}\right)`	(t_{4})	
gilmore-lie-groups_F00473	57	0.991	`\left[\begin{array}{cc}a & b \\ c & d\end{array}\right] \in S L(2 ; \mathbb{R}) \subset G L(2 ; \mathbb{R})`	$\left[\begin{array}{cc}a & b \\ c & d\end{array}\right] \in SL(2;\mathbb{R}) \subset GL(2;\mathbb{R})$	is bilinear.
gilmore-lie-groups_F00474	57	0.998	`U(1,1)`	$U(1,1)$	$SU(1,1) = U(1,1) \cap SL(2;\mathbb{C}) \rightarrow$
gilmore-lie-groups_F00475	57	1.000	`a^{*} a-b^{*} b=+1`	$a^{*}a - b^{*}b = +1$	
gilmore-lie-groups_F00476	57	1.000	`U(n)`	$U(n)$	2×2 matrix according to the prescription given in Eq. (3.3). The resulting matrix
gilmore-lie-groups_F00477	57	1.000	`U^{\dagger} U=I_{n}`	$U^{\dagger}U = I_{n}$	is a real $2n \times 2n$ matrix M. This matrix inherits the constraint that comes with the
gilmore-lie-groups_F00478	57	1.000	`2 n \times 2 n`	$2n \times 2n$	condition that determines orthogonal groups. This group of $2n \times 2n$ matrices forms
gilmore-lie-groups_F00479	57	1.000	`M^{t} M=I_{2 n}`	$M^{t}M = I_{2n}$	an *orthogonal* representation of the *unitary* group. It is a subgroup of $SO(2n)$. This
gilmore-lie-groups_F00480	57	1.000	`{ }^{\dagger}`	†	matrix group is called $OU(2n)$. Symbolically,
gilmore-lie-groups_F00481	57	1.000	`{ }^{t}`	^{t}	matrix group is called $OU(2n)$. Symbolically,
gilmore-lie-groups_F00482	57	1.000	`I_{2 n}`	I_{2n}	$U(n) \xrightarrow{\mathbb{C} \to 2\times 2\ \mathbb{R}} OU(2n) \subset SO(2n)$ (3.21)
gilmore-lie-groups_F00483	57	0.712	`S O(2 n)`	$SO(2n)$	
gilmore-lie-groups_F00484	57	1.000	`O U(2 n)`	$OU(2n)$	
gilmore-lie-groups_F00485	58	0.999	`U(n ; \mathbb{Q})=S p(n)`	$U(n;\mathbb{Q}) = Sp(n)$	$U^{\dagger}U = I_{n}$, this process generates $2n \times 2n$ complex matrices M that inherit the
gilmore-lie-groups_F00486	58	1.000	`M^{\dagger} M=I_{2 n}`	$M^{\dagger}M = I_{2n}$	tion that determines unitary groups (over $\mathbb{C}$). This group of $2n \times 2n$ matrices forms
gilmore-lie-groups_F00487	58	1.000	`\mathbb{C}`	$\mathbb{C}$	a *unitary* representation of the *symplectic* group. It is a subgroup of $SU(2n)$. This
gilmore-lie-groups_F00488	58	0.945	`\operatorname{SU}(2 n)`	$\mathrm{SU}(2n)$	matrix group is called $USp(2n)$. Symbolically,
gilmore-lie-groups_F00489	58	1.000	`U \operatorname{Sp}(2 n)`	$U\,\mathrm{Sp}(2n)$	$\mathbb{Q} \to 2\times 2\ \mathbb{C}$
gilmore-lie-groups_F00490	58	1.000	`\mathbb{R}`	$\mathbb{R}$	of Lie group theory (representation theory of noncompact unimodular groups). There are in fact three distinct groups over the integers that are sometimes con-
gilmore-lie-groups_F00491	58	1.000	`G L(n ; \mathbb{Z})`	$GL(n;\mathbb{Z})$	For $n = 2$ these groups of matrices have
gilmore-lie-groups_F00492	58	1.000	`m \in G L(n ; \mathbb{Z}), \operatorname{det}(m)= \pm 1`	$m \in GL(n;\mathbb{Z}), \mathrm{det}(m) = \pm 1$	For $n = 2$ these groups of matrices have
gilmore-lie-groups_F00493	58	1.000	`S L(n ; \mathbb{Z})`	$SL(n;\mathbb{Z})$	If $\det(m) = n$, with n an integer, then
gilmore-lie-groups_F00494	58	1.000	`m \in S L(n ; \mathbb{Z}), \operatorname{det}(m)=+1`	$m \in SL(n;\mathbb{Z}), \mathrm{det}(m) = +1$	If $\det(m) = n$, with n an integer, then

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gilmore-lie-groups_F00495	58	1.000	`P S L(n ; \mathbb{Z}), n`	$PSL(n;\mathbb{Z}), n$	any matrix composed of integers must be an integer. t
gilmore-lie-groups_F00496	58	1.000	`P S L(n ; \mathbb{Z})=S L(n ; \mathbb{Z}) /\left \{I_{n},-I_{n}\right\}`	$PSL(n;\mathbb{Z}) = SL(n;\mathbb{Z})/\left\{I_n, -I_n\right\}$	any matrix composed of integers must be an integer. t
gilmore-lie-groups_F00497	58	0.999	`n=2`	$n = 2$	$GL(2;\mathbb{Z})$. The modular group $PSL(2;\mathbb{Z})$ is obtained by identifying each pair of
gilmore-lie-groups_F00498	58	0.999	`\left[\begin{array}{ll}a & b \\ c & d\end{array}\right]`	$\left[\begin{array}{ll}a & b \\ c & d\end{array}\right]$	$GL(2;\mathbb{Z})$. The modular group $PSL(2;\mathbb{Z})$ is obtained by identifying each pair of
gilmore-lie-groups_F00499	58	1.000	`\operatorname{det}(m)=n`	$\operatorname{det}(m) = n$	matrices in $SL(2;\mathbb{Z})$ of the form $\left[\begin{array}{ll}-a & -b \\ \end{array}\right] \simeq \left[\begin{array}{ll}a & b \\ \end{array}\right]$.
gilmore-lie-groups_F00500	58	1.000	`\operatorname{det}\left(m^{-1}\right)=1 / n`	$\operatorname{det}\left(m^{-1}\right) = 1/n$	matrices in $SL(2;\mathbb{Z})$ of the form $\left[\begin{array}{ll}-a & -b \\ \end{array}\right] \simeq \left[\begin{array}{ll}a & b \\ \end{array}\right]$.
gilmore-lie-groups_F00501	58	1.000	`\operatorname{det}(m)=`	$\operatorname{det}(m) =$	As a hint of the useful properties of these groups, we consider the matrix
gilmore-lie-groups_F00502	58	0.714	`\pm 1`	± 1	$\left[\begin{array}{ll} & \\ & \end{array}\right]$
gilmore-lie-groups_F00503	58	0.714	`G L(2 ; \mathbb{Z})`	$GL(2;\mathbb{Z})$	$\left[\begin{array}{ll} & \\ & \end{array}\right]$
gilmore-lie-groups_F00504	58	0.714	`S L(2 ; \mathbb{Z}) \subset`	$SL(2;\mathbb{Z}) \subset$	$\left[\begin{array}{ll} & \\ & \end{array}\right]$
gilmore-lie-groups_F00505	58	1.000	`P S L(2 ; \mathbb{Z})`	$PSL(2;\mathbb{Z})$	$\left\|\begin{array}{ll}1 & 1 \\ 1 & 0\end{array}\right\| \in GL(n;\mathbb{Z})$ (3.33)
gilmore-lie-groups_F00506	58	0.906	`S L(2 ; \mathbb{Z})`	$SL(2;\mathbb{Z})$	$\left[\begin{array}{ll}1 & 0\end{array}\right]$
gilmore-lie-groups_F00507	58	0.906	`\left[\begin{array}{ll}-a & -b \\ -c & -d\end{array}\right] \simeq\left[\begin{array}{ll}a & b \\ c & d\end{array}\right]`	$\left[\begin{array}{ll}-a & -b \\ -c & -d\end{array}\right] \simeq \left[\begin{array}{ll}a & b \\ c & d\end{array}\right]$	$\left[\begin{array}{ll}1 & 0\end{array}\right]$
gilmore-lie-groups_F00508	59	1.000	`F(n)`	$F(n)$	where $F(n)$ is the nth Fibonacci number, defined recursively by
gilmore-lie-groups_F00509	59	1.000	`n=1(F(0)=0, F(1)=1)`	$n = 1(F(0) = 0, F(1) = 1)$	in the groups $GL(2;\mathbb{Z})$, $GL(3;\mathbb{Z})$, etc. The group $GL(n;\mathbb{Z})$ has important subgroups defined by imposing linear
gilmore-lie-groups_F00510	59	0.998	`G L(2 ; \mathbb{Z}), G L(3 ; \mathbb{Z})`	$GL(2;\mathbb{Z}), GL(3;\mathbb{Z})$	with $GL(n;\mathbb{R})$.
gilmore-lie-groups_F00511	59	0.998	`G L(n ; \mathbb{R})`	$GL(n;\mathbb{R})$	of Example (5)
gilmore-lie-groups_F00512	59	1.000	`M^{t} I_{n} M=I_{n}`	$M^t I_n M = I_n$	group $S(n;\mathbb{Z})$, consists of $n!$ $n \times n$ matrices in which all but one matrix element in every row or column is zero, and the nonzero matrix element is $+1$. An im-
gilmore-lie-groups_F00513	59	1.000	`O(n ; \mathbb{Z})`	$O(n;\mathbb{Z})$	group S_n.
gilmore-lie-groups_F00514	59	1.000	`\operatorname{det}(m)=+1`	$\operatorname{det}(m) = +1$	
gilmore-lie-groups_F00515	60	1.000	`A_{n}`	A_n	ple, the alternating group A_n consists of unimodular matrices in P_n:
gilmore-lie-groups_F00516	60	0.932	`O(2 ; \mathbb{Z})`	$O(2;\mathbb{Z})$	**Example** The group $O(2;\mathbb{Z})$ consists of the $8 = 2^2 \times 2!$ matrices
gilmore-lie-groups_F00517	60	0.932	`8=2^{2} \times 2!`	$8 = 2^2 \times 2!$	**Example** The group $O(2;\mathbb{Z})$ consists of the $8 = 2^2 \times 2!$ matrices
gilmore-lie-groups_F00518	60	0.974	`O(3 ; \mathbb{Z})`	$O(3;\mathbb{Z})$	of the six matrices
gilmore-lie-groups_F00519	60	0.974	`2^{3} \times 3!=48`	$2^3 \times 3! = 48$	of the six matrices

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gilmore-lie-groups_F00520	60	0.974	`6=3!`	$6 = 3!$	of the six matrices
gilmore-lie-groups_F00521	60	1.000	`A_{3} \subset S_{3} \subset O(3 ; \mathbb{Z})`	$A_3 \subset S_3 \subset O(3;\mathbb{Z})$	
gilmore-lie-groups_F00522	60	0.997	`G_{2}, F_{4}, E_{6}, E_{7}, E_{8}`	G_2, F_4, E_6, E_7, E_8	also of great interest, but fall outside the scope of our discussions.
gilmore-lie-groups_F00523	60	1.000	`G L(n ; \mathbb{Z}), S L(n ; \mathbb{Z})`	$GL(n;\mathbb{Z}), SL(n;\mathbb{Z})$	
gilmore-lie-groups_F00524	60	1.000	`P S L(n ; \mathbb{Z})`	$PSL(n;\mathbb{Z})$	
gilmore-lie-groups_F00525	61	1.000	`\mathcal{I} J=-\mathcal{K}`	$\mathcal{I}J = -\mathcal{K}$	where $\mathcal{I}J = -\mathcal{K}$.
gilmore-lie-groups_F00526	61	0.997	`\sigma_{x}, \sigma_{y}, \sigma_{z}`	$\sigma_x, \sigma_y, \sigma_z$	that any pair of the unit quaternions anticommute: i.e., $\{\mathcal{I}, \mathcal{J}\} = \mathcal{I}\mathcal{J} + \mathcal{J}\mathcal{I} = 0$.
gilmore-lie-groups_F00527	61	0.924	`\{\mathcal{I}, \mathcal{J}\}=\mathcal{I} \mathcal{J}+ \mathcal{J} \mathcal{I}=0`	$\{\mathcal{I}, \mathcal{J}\} = \mathcal{I}\mathcal{J} + \mathcal{J}\mathcal{I} = 0$	Show that the unit quaternions $\mathcal{I}, J, K$ generate a group of order 8 under multi-
gilmore-lie-groups_F00528	61	1.000	`\mathcal{I}, J, K`	$\mathcal{I}, J, K$	plication. Show that this group is isomorphic to $Q(\mathcal{I};\mathbb{Z})$. Exhibit this isomorphism
gilmore-lie-groups_F00529	61	0.464	`S U(1 ; \mathbb{Q}) \sim S U(2 ; \mathbb{C})`	$SU(1;\mathbb{Q}) \sim SU(2;\mathbb{C})$	4. Show that the dimensionalities (ove
gilmore-lie-groups_F00530	61	1.000	`p+q=n`	$p + q = n$	
gilmore-lie-groups_F00531	61	0.996	`S L_{i}(n ; \mathbb{C})`	$SL_i(n;\mathbb{C})$	$SL_2(n;\mathbb{C})$ $\det(M) = e^{\lambda}$ $2n^2 - 1$
gilmore-lie-groups_F00532	61	0.996	`G L(n ; \mathbb{C})`	$GL(n;\mathbb{C})$	$SL_2(n;\mathbb{C})$ $\det(M) = e^{\lambda}$ $2n^2 - 1$
gilmore-lie-groups_F00533	61	1.000	`\phi, \lambda, r`	ϕ, λ, r	restriction $\mathbb{C} \to \mathbb{R}$? and the field extension $\mathbb{C} \to \mathbb{Q}$?
gilmore-lie-groups_F00534	61	1.000	`r \neq 0`	$r \neq 0$	restriction $\mathbb{C} \to \mathbb{R}$? and the field extension $\mathbb{C} \to \mathbb{Q}$?
gilmore-lie-groups_F00535	61	1.000	`2 n^{2}-1`	$2n^2 - 1$	A subgroup of $UT(1, 1)$ includes matrices of the form $\begin{bmatrix} -1 & a \\ 0 & 1 \end{bmatrix}$, $a \in R$. Show that the
gilmore-lie-groups_F00536	61	1.000	`S L_{3}(n ; \mathbb{C})`	$SL_3(n;\mathbb{C})$	A subgroup of $UT(1, 1)$ includes matrices of the form $\begin{bmatrix} -1 & a \\ 0 & 1 \end{bmatrix}$, $a \in R$. Show that the
gilmore-lie-groups_F00537	61	1.000	`S L(n ; \mathbb{C})=S L_{1}(n ; \mathbb{C}) \cap S L_{2}(n ; \mathbb{C})`	$SL(n;\mathbb{C}) = SL_1(n;\mathbb{C}) \cap SL_2(n;\mathbb{C})$	the form $\begin{bmatrix} 1 & a \\ 0 & -1 \end{bmatrix}$ are also included, then the parameterizing manifold consists of how
gilmore-lie-groups_F00538	61	1.000	`\mathbb{C} \rightarrow \mathbb{R}`	$\mathbb{C} \to \mathbb{R}$	many copies of R^1?
gilmore-lie-groups_F00539	61	1.000	`\mathbb{C} \rightarrow \mathbb{Q}`	$\mathbb{C} \to \mathbb{Q}$	many copies of R^1?
gilmore-lie-groups_F00540	61	0.936	`\left[\begin{array}{cc}-1 & a \\ 0 & 1\end{array}\right], a \in R`	$\begin{bmatrix} -1 & a \\ 0 & 1 \end{bmatrix}, a \in R$	
gilmore-lie-groups_F00541	61	1.000	`R^{1}`	R^1	
gilmore-lie-groups_F00542	61	1.000	`\left[\begin{array}{cc}1 & a \\ 0 & -1\end{array}\right]`	$\begin{bmatrix} 1 & a \\ 0 & -1 \end{bmatrix}$	

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gilmore-lie-groups_F00543	62	0.837	`p^{2}+q^{2}+p q`	$p^{2}+q^{2}+pq$	Group / Dimension $UT(p,q)$ / p^2+q^2+pq $HT(p,q)$ / $p(p+q)$ $UT(p,q,r)$ / $p^2+q^2+r^2+pq+pr+qr$ $Sol(n)$ / $n(n+1)/2$ $Nil(n)$ / $n(n-1)/2$ $A(p,q)$ / pq ens to these dimensions if the matrix groups are over the
gilmore-lie-groups_F00544	62	0.837	`p(p+q)`	$p(p+q)$	Group / Dimension $UT(p,q)$ / p^2+q^2+pq $HT(p,q)$ / $p(p+q)$ $UT(p,q,r)$ / $p^2+q^2+r^2+pq+pr+qr$ $Sol(n)$ / $n(n+1)/2$ $Nil(n)$ / $n(n-1)/2$ $A(p,q)$ / pq ens to these dimensions if the matrix groups are over the
gilmore-lie-groups_F00545	62	0.837	`p^{2}+q^{2}+r^{2}+p q+p r+q r`	$p^{2}+q^{2}+r^{2}+pq+pr+qr$	Group / Dimension $UT(p,q)$ / p^2+q^2+pq $HT(p,q)$ / $p(p+q)$ $UT(p,q,r)$ / $p^2+q^2+r^2+pq+pr+qr$ $Sol(n)$ / $n(n+1)/2$ $Nil(n)$ / $n(n-1)/2$ $A(p,q)$ / pq ens to these dimensions if the matrix groups are over the
gilmore-lie-groups_F00546	62	0.837	`n(n+1) / 2`	$n(n+1)/2$	Group / Dimension $UT(p,q)$ / p^2+q^2+pq $HT(p,q)$ / $p(p+q)$ $UT(p,q,r)$ / $p^2+q^2+r^2+pq+pr+qr$ $Sol(n)$ / $n(n+1)/2$ $Nil(n)$ / $n(n-1)/2$ $A(p,q)$ / pq ens to these dimensions if the matrix groups are over the
gilmore-lie-groups_F00547	62	0.837	`n(n-1) / 2`	$n(n-1)/2$	Group / Dimension $UT(p,q)$ / p^2+q^2+pq $HT(p,q)$ / $p(p+q)$ $UT(p,q,r)$ / $p^2+q^2+r^2+pq+pr+qr$ $Sol(n)$ / $n(n+1)/2$ $Nil(n)$ / $n(n-1)/2$ $A(p,q)$ / pq ens to these dimensions if the matrix groups are over the
gilmore-lie-groups_F00548	62	0.837	`p q`	pq	Group / Dimension $UT(p,q)$ / p^2+q^2+pq $HT(p,q)$ / $p(p+q)$ $UT(p,q,r)$ / $p^2+q^2+r^2+pq+pr+qr$ $Sol(n)$ / $n(n+1)/2$ $Nil(n)$ / $n(n-1)/2$ $A(p,q)$ / pq ens to these dimensions if the matrix groups are over the
gilmore-lie-groups_F00549	62	1.000	`\mathbf{F}=d \mathbf{p} / d t`	$\mathbf{F}=d\mathbf{p}/dt$	tions can be written in the form

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gilmore-lie-groups_F00550	62	1.000	`\left(\nabla^{2}-\frac{1}{c^{2}} \frac{\partial^{2}}{ \partial t^{2}}\right) A_{\mu}=-\frac{4 \pi}{c} j_{\mu}`	$\left(\nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right) A_\mu = -\frac{4\pi}{c} j_\mu$	Poincaré not invariant invariant ow do you reconcile these results? ow that the group of 2×2 matrices $SU(2)$ is parameterized by two compl
gilmore-lie-groups_F00551	62	0.814	`S U(2)`	$SU(2)$	$SU(2) = \begin{vmatrix} -c_2^* & c_1^* \end{vmatrix}$
gilmore-lie-groups_F00552	62	1.000	`c_{1}=a_{1}+i b_{1}`	$c_1 = a_1 + ib_1$	ubject to the condition $a_1^2 + b_1^2 + a_2^2 + b_2^2$
gilmore-lie-groups_F00553	62	1.000	`c_{2}=a_{2}+i b_{2}`	$c_2 = a_2 + ib_2$	ubject to the condition $a_1^2 + b_1^2 + a_2^2 + b_2^2$
gilmore-lie-groups_F00554	62	1.000	`a_{1}^{2}+b_{1}^{2}+a_{2}^{2}+b_{2}^{2}=1`	$a_1^2 + b_1^2 + a_2^2 + b_2^2 = 1$	11. The group of 2×2 matrices $SU(1,1)$ is parameterized by two complex numbers $c_1 = a_1 + ib_1$ and $c_2 = a_2 + ib_2$ so that
gilmore-lie-groups_F00555	62	0.991	`S^{3} \subset R^{4}`	$S^3 \subset R^4$	$SU(1,1) = \begin{bmatrix} c_1 & c_2 \end{bmatrix}$
gilmore-lie-groups_F00556	62	1.000	`a_{1}^{2}+b_{1}^{2}-a_{2}^{2}-b_{2}^{2}=1`	$a_1^2 + b_1^2 - a_2^2 - b_2^2 = 1$	
gilmore-lie-groups_F00557	62	1.000	`\left[\begin{array}{cc}m_{11} & x \\ m_{21} & m_{22} \end{array}\right]`	$\left[\begin{array}{cc} m_{11} & x \\ m_{21} & m_{22} \end{array}\right]$	
gilmore-lie-groups_F00558	62	1.000	`m_{11}^{2}+x^{2}=1`	$m_{11}^2 + x^2 = 1$	
gilmore-lie-groups_F00559	62	1.000	`m_{11}= \pm \sqrt{1-x^{2}}`	$m_{11} = \pm\sqrt{1-x^2}$	
gilmore-lie-groups_F00560	63	1.000	`m_{21} m_{11}+m_{22} x=0`	$m_{21} m_{11} + m_{22} x = 0$	is orthogonal to the first, so that $m_{21}m_{11} + m_{22}x = 0$. As a result, we find
gilmore-lie-groups_F00561	63	0.994	`m_{i j} i \geq j`	$m_{ij} i \geq j$	An alternative parameterization of $SO(3)$ is given by
gilmore-lie-groups_F00562	63	0.495	`Z_{2}`	Z_2	are necessary to cover $SO(3)$ completely?
gilmore-lie-groups_F00563	63	0.495	`Z_{1}`	Z_1	are necessary to cover $SO(3)$ completely?
gilmore-lie-groups_F00564	63	0.495	`(x, y)`	(x, y)	are necessary to cover $SO(3)$ completely?
gilmore-lie-groups_F00565	63	0.854	`M \in G L(n ; \mathbb{Z})`	$M \in GL(n;\mathbb{Z})$	17 Estimate the Fibonacci number $F(n)$ from the eigen
gilmore-lie-groups_F00566	63	0.854	`\operatorname{det}(M)`	$\operatorname{det}(M)$	17 Estimate the Fibonacci number $F(n)$ from the eigen
gilmore-lie-groups_F00567	63	1.000	`O(n ; \mathbb{Z}) \supset S_{n} \supset A_{n}`	$O(n;\mathbb{Z}) \supset S_n \supset A_n$	generating matrix (3.33). What happens to this sequence if different initial (other than $F(0) = 0$, $F(1) = 1$) are introduced?
gilmore-lie-groups_F00568	63	1.000	`2^{n} \times n!, n!, \frac{1}{2} n!`	$2^n \times n!, n!, \frac{1}{2} n!$	generating matrix (3.33). What happens to this sequence if different initial (other than $F(0) = 0$, $F(1) = 1$) are introduced?
gilmore-lie-groups_F00569	63	1.000	`\lambda_{ \pm}=\frac{1}{2}(1 \pm \sqrt{5})`	$\lambda_{\pm} = \frac{1}{2}(1 \pm \sqrt{5})$	18. Derive other Fibonacci-type series using other symmetric generating matrices in
gilmore-lie-groups_F00570	63	0.999	`F(0)=0, F(1)=1`	$F(0) = 0, F(1) = 1$	
gilmore-lie-groups_F00571	63	1.000	`\left[\begin{array}{cc}2 & -1 \\ -1 & 1\end{array}\right]`	$\left[\begin{array}{cc} 2 & -1 \\ -1 & 1 \end{array}\right]$	quantum number n have the same energy $E(nlm) = -E_0/n^2$ (E_0 =
gilmore-lie-groups_F00572	63	1.000	`|n l m\rangle`	$\|nlm\rangle$	potential, the overall symmetry reduces to that of the rotation group: there is a
gilmore-lie-groups_F00573	63	1.000	`n^{2}`	n^2	potential, the overall symmetry reduces to that of the rotation group: there is a

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gilmore-lie-groups_F00574	63	1.000	`E(n l m)=-E_{0} / n^{2}\left(E_{0}=13.6 \mathrm{eV} \right)`	$E(nlm) = -E_0/n^2\,(E_0 = 13.6\mathrm{eV})$	the description of the hydrogen atom bound states are indexed by the principal
gilmore-lie-groups_F00575	63	1.000	`S O(4) \downarrow S O(3)`	$SO(4) \downarrow SO(3)$	number l, $l = 0, 1, 2 \ldots, n-1$, with $\sum_{l=0}$ $(2l+1) = n^2$. The $SO(3)$ multiplet
gilmore-lie-groups_F00576	63	0.993	`n(n=1,2,3, \ldots)`	$n(n = 1, 2, 3, \ldots)$	introduced into a Coulomb potential established by a central charge $+Ze$ can be
gilmore-lie-groups_F00577	63	0.980	`l, l=0,1,2 \ldots, n-1`	$l, l = 0, 1, 2 \ldots, n-1$	
gilmore-lie-groups_F00578	63	0.980	`\sum_{l=0}^{l=n-1}(2 l+1)=n^{2}`	$\sum_{l=0}^{l=n-1} (2l+1) = n^2$	
gilmore-lie-groups_F00579	63	1.000	`l`	l	
gilmore-lie-groups_F00580	63	1.000	`2 l+1`	$2l+1$	
gilmore-lie-groups_F00581	63	1.000	`+Z e`	$+Ze$	
gilmore-lie-groups_F00582	64	1.000	`\delta=0.28`	$\delta = 0.28$	periodic table of the chemical elements: $(n, l) \to 1s;\ 2s, 2p;\ 3s, 3p;\ 4s, 3d, 4p;$
gilmore-lie-groups_F00583	64	0.608	`(n, l) \rightarrow 1 s`	$(n, l) \to 1s$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00584	64	0.608	`2 s`	$2s$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00585	64	0.608	`2 p`	$2p$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00586	64	0.608	`3 s`	$3s$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00587	64	0.608	`3 p`	$3p$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00588	64	0.608	`4 s`	$4s$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00589	64	0.608	`3 d`	$3d$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00590	64	0.608	`4 p`	$4p$	$5s, 4d, 5p;\ 6s, 4f, 5d, 6p;\ 7s, 5f, 6d, 7p;\ 8s, 6f, 7d, 8p; \ldots.$
gilmore-lie-groups_F00591	64	0.957	`5 s, 4 d, 5 p ; 6 s, 4 f, 5 d, 6 p ; 7 s, 5 f, 6 d, 7 p ; 8 s, 6 f, 7 d, 8 p ; \ldots`	$5s, 4d, 5p; 6s, 4f, 5d, 6p; 7s, 5f, 6d, 7p; 8s, 6f, 7d, 8p; \ldots$	20. Symmetries. Show the following equivalences:
gilmore-lie-groups_F00592	64	1.000	`G_{2}`	G_2	
gilmore-lie-groups_F00593	64	1.000	`2 n`	$2n$	
gilmore-lie-groups_F00594	64	1.000	`M^{t} G_{i} M=G_{i}`	$M^t G_i M = G_i$	G_1 G_2 G_1 and G_2
gilmore-lie-groups_F00595	64	1.000	`y^{j}=x^{i} M_{i}{ }^{j}`	$y^j = x^i M_i{}^j$	$\frac{\partial}{\partial x^i} = \frac{\partial y^j}{\partial x^i}\frac{\partial}{\partial y^j} = M_i{}^j \frac{\partial}{\partial y^j}$
gilmore-lie-groups_F00596	64	0.990	`f(q, p)`	$f(q, p)$	$\sum_k \frac{\partial}{\partial q_k}\frac{\partial}{\partial p_k} - \frac{\partial}{\partial q_k}\frac{\partial}{\partial p_k}$
gilmore-lie-groups_F00597	64	0.990	`g(q, p)`	$g(q, p)$	$\sum_k \frac{\partial}{\partial q_k}\frac{\partial}{\partial p_k} - \frac{\partial}{\partial q_k}\frac{\partial}{\partial p_k}$
gilmore-lie-groups_F00598	65	0.666	`(Q, P)`	(Q, P)	**b.** Introduce a new coordinate system (Q, P), related to the original by a linear
gilmore-lie-groups_F00599	65	1.000	`A^{t} C`	$A^t C$	. Show that the same conditions hold for linear transformations and the quantum
gilmore-lie-groups_F00600	65	1.000	`B^{t} D`	$B^t D$	. Show that the same conditions hold for linear transformations and the quantum

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gilmore-lie-groups_F00601	65	1.000	`A^{t} D-B^{t} C=I_{n}`	$A^{t} D-B^{t} C=I_{n}$	. Show that the same conditions hold for linear transformations and the quantumn
gilmore-lie-groups_F00602	65	0.999	`\left[q_{j}, q_{k}\right]=\left[p_{j}, p_{k}\right]=0`	$\left[q_{j}, q_{k}\right]=\left[p_{j}, p_{k}\right]=0$	**Note:** The transformation from classical mechanics to quantum mechanics is made
gilmore-lie-groups_F00603	65	0.999	`\left[q_{j}, p_{k}\right]=i \hbar \delta_{j k}`	$\left[q_{j}, p_{k}\right]=i \hbar \delta_{j k}$	**Note:** The transformation from classical mechanics to quantum mechanics is made
gilmore-lie-groups_F00604	65	1.000	`e^{+i k x}`	$e^{+i k x}$	energy $E=(\hbar k)^{2}/2m$. The complex number A_L is the probability amplitude for finding a particle moving to the right with this momentum. The expected value of the
gilmore-lie-groups_F00605	65	0.644	`m`	m	momentum in the left-hand region is $\langle\hat{p}\rangle=(\left\|A_{L}\right\|^{2}-\left\|B_{L}\right\|^{2})\hbar k$, where the operator
gilmore-lie-groups_F00606	65	0.644	`(+)`	$(+)$	momentum in the left-hand region is $\langle\hat{p}\rangle=(\left\|A_{L}\right\|^{2}-\left\|B_{L}\right\|^{2})\hbar k$, where the operator
gilmore-lie-groups_F00607	65	0.644	`\hbar k`	$\hbar k$	momentum in the left-hand region is $\langle\hat{p}\rangle=(\left\|A_{L}\right\|^{2}-\left\|B_{L}\right\|^{2})\hbar k$, where the operator
gilmore-lie-groups_F00608	65	1.000	`E=(\hbar k)^{2} / 2 m`	$E=(\hbar k)^{2} / 2 m$	$\hat{p}=\frac{\hbar}{i} \frac{d}{dx}$.
gilmore-lie-groups_F00609	65	1.000	`A_{L}`	A_{L}	$\hat{p}=\frac{\hbar}{i} \frac{d}{dx}$.
gilmore-lie-groups_F00610	65	1.000	`\langle\hat{p}\rangle=\left(\left|A_{L}\right|^{2}-\left|B_{L}\right|^{2}\right) \hbar k`	$\langle\hat{p}\rangle=\left(\left\|A_{L}\right\|^{2}-\left\|B_{L}\right\|^{2}\right) \hbar k$	$\left\|A_{L}\right\|^{2}$ $\left\|B_{L}\right\|^{2}$ $\left\|A_{L}\right\|^{2}$ $\left\|B_{L}\right\|^{2}$
gilmore-lie-groups_F00611	65	1.000	`\hat{p}=\frac{\hbar}{i} \frac{d}{d x}`	$\hat{p}=\frac{\hbar}{i} \frac{d}{d x}$	
gilmore-lie-groups_F00612	65	1.000	`V_{L}=V_{R}`	$V_{L}=V_{R}$	
gilmore-lie-groups_F00613	65	1.000	`\psi_{\sigma}(x)=A_{\sigma} e^{+i k x}+B_{\sigma} e^{-i k x}`	$\psi_{\sigma}(x)=A_{\sigma} e^{+i k x}+B_{\sigma} e^{-i k x}$	
gilmore-lie-groups_F00614	65	0.969	`\sigma=L, R`	$\sigma=L, R$	
gilmore-lie-groups_F00615	66	1.000	`A_{L}, A_{R}`	A_{L}, A_{R}	**b.** Since the Schrödinger equation is second order the four amplitudes $A_L, A_R,$
gilmore-lie-groups_F00616	66	1.000	`B_{L}, B_{R}`	B_{L}, B_{R}	B_L, B_R are not independent. Only two are independent. Two linear relations exist
gilmore-lie-groups_F00617	66	1.000	`E`	E	**c.** Show that $T \in SU(1,1)$ by appropria
gilmore-lie-groups_F00618	66	1.000	`T(E) \in U(1,1)`	$T(E) \in U(1,1)$	**c.** Show that $T \in SU(1,1)$ by appropria
gilmore-lie-groups_F00619	66	1.000	`T \in S U(1,1)`	$T \in S U(1,1)$	25. **Crossing symmetry:** A transfer matrix T for a one-dimens
gilmore-lie-groups_F00620	66	1.000	`S \in U(2)`	$S \in U(2)$	$\begin{bmatrix} 1 & t_{12} \end{bmatrix}$
gilmore-lie-groups_F00621	66	1.000	`S(E)`	$S(E)$	cay time $\Gamma_j/\hbar$.
gilmore-lie-groups_F00622	66	1.000	`T(E)`	$T(E)$	cay time $\Gamma_j/\hbar$.
gilmore-lie-groups_F00623	66	1.000	`t_{11}(E)`	$t_{11}(E)$	cay time $\Gamma_j/\hbar$.
gilmore-lie-groups_F00624	66	1.000	`r_{j} /\left[\left(E-E_{j}\right)+i\left(\Gamma_{j} / 2 \right)\right]`	$r_{j} /\left[\left(E-E_{j}\right)+i\left(\Gamma_{j} / 2 \right)\right]$	T_1 and T_2, and also by S-matrices S_1 and S_2 (see Fig. 3.3). The outputs of one region
gilmore-lie-groups_F00625	66	1.000	`E_{j}`	E_{j}	T_1 and T_2, and also by S-matrices S_1 and S_2 (see Fig. 3.3). The outputs of one region
gilmore-lie-groups_F00626	66	1.000	`\Gamma_{j} / \hbar`	$\Gamma_{j} / \hbar$	are inputs to
gilmore-lie-groups_F00627	66	1.000	`V_{1}`	V_{1}	$\begin{vmatrix} i_2 \end{vmatrix} = \begin{vmatrix} 0 & 1 \end{vmatrix} \begin{vmatrix} o_1 \end{vmatrix}$

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gilmore-lie-groups_F00628	66	1.000	`V_{2}`	V_2	$\lvert i_2 \rvert = \lvert 0 \quad 1 \rvert \lvert o_1 \rvert$
gilmore-lie-groups_F00629	66	1.000	`T_{1}`	T_1	$\lfloor i_3 \rfloor \quad \lfloor 1 \quad 0 \rfloor \lfloor o_4 \rfloor$
gilmore-lie-groups_F00630	66	1.000	`T_{2}`	T_2	$\lfloor i_3 \rfloor \quad \lfloor 1 \quad 0 \rfloor \lfloor o_4 \rfloor$
gilmore-lie-groups_F00631	66	1.000	`S_{1}`	S_1	$\lfloor i_3 \rfloor \quad \lfloor 1 \quad 0 \rfloor \lfloor o_4 \rfloor$
gilmore-lie-groups_F00632	67	1.000	`S_{\text {Tot }}`	$S_{\text {Tot }}$	term in this expansion as a
gilmore-lie-groups_F00633	67	1.000	`1 /\left(1-s_{12} s_{43}\right)`	$1/\left(1-s_{12} s_{43}\right)$	ıeir scattering matrices will also be modified $T_i(E) \rightarrow T_i'(E)$ and $S_i(E) \rightarrow S_i'(E)$,
gilmore-lie-groups_F00634	67	1.000	`V_{1}{ }^{\prime}`	$V_1{}'$	fied pair maps into the original total S-matrix $S_{\text{Tot}}(E)$. In fancy terms, find the fiber
gilmore-lie-groups_F00635	67	1.000	`V_{2}{ }^{\prime}`	$V_2{}'$	fied pair maps into the original total S-matrix $S_{\text{Tot}}(E)$. In fancy terms, find the fiber
gilmore-lie-groups_F00636	67	1.000	`T_{i}(E) \rightarrow T_{i}^{\prime}(E)`	$T_i(E) \rightarrow T_i'(E)$	in $U(4) \supset U(2) \otimes U(2) \downarrow U(2)$. (Hint: if this seems daunting, note that to satisfy
gilmore-lie-groups_F00637	67	1.000	`S_{i}(E) \rightarrow S_{i}^{\prime}(E)`	$S_i(E) \rightarrow S_i'(E)$	in $U(4) \supset U(2) \otimes U(2) \downarrow U(2)$. (Hint: if this seems daunting, note that to satisfy
gilmore-lie-groups_F00638	67	1.000	`i=1,2`	$i=1,2$	$T_1(E)T_2(E) = T_{\text{Tot}}(E) = T_1'(E)T_2'(E)$ we can take $T_1'(E) = T_1(E)R$ and $T_2'(E) =$
gilmore-lie-groups_F00639	67	1.000	`E, S_{\text {Tot }}^{\prime}(E)=S_{\text {Tot }}(E)`	$E, S_{\text {Tot }}^{\prime}(E)=S_{\text {Tot }}(E)$	$T_1(E)T_2(E) = T_{\text{Tot}}(E) = T_1'(E)T_2'(E)$ we can take $T_1'(E) = T_1(E)R$ and $T_2'(E) =$
gilmore-lie-groups_F00640	67	1.000	`S_{1}^{\prime}(E)`	$S_1{}^{\prime}(E)$	$R^{-1}T_2(E)$ for any $R \in U(1,1)$. The fiber in $U(2,2) \supset U(1,1) \otimes U(1,1) \downarrow U(1,1)$
gilmore-lie-groups_F00641	67	1.000	`S_{2}^{\prime}(E)`	$S_2{}^{\prime}(E)$	$R^{-1}T_2(E)$ for any $R \in U(1,1)$. The fiber in $U(2,2) \supset U(1,1) \otimes U(1,1) \downarrow U(1,1)$
gilmore-lie-groups_F00642	67	0.998	`S_{\text {Tot }}(E)`	$S_{\text {Tot }}(E)$	over $T_{\text{Tot}}(E)$ consists of the matrices $(T_1(E)R, R^{-1}T_2(E))$. Now map this into the fiber $(S_1'(E), S_2'(E))$ over $S_{\text{Tot}}(E)$
gilmore-lie-groups_F00643	67	0.999	`U(4) \supset U(2) \otimes U(2) \downarrow U(2)`	$U(4) \supset U(2) \otimes U(2) \downarrow U(2)$	fiber $(S_1'(E), S_2'(E))$ over $S_{\text{Tot}}(E)$.
gilmore-lie-groups_F00644	67	0.997	`T_{1}(E) T_{2}(E)=T_{\text {Tot }}(E)=T_{1}^{\prime}(E) T_{2}^{\prime}(E)`	$T_1(E)T_2(E) = T_{\text {Tot }}(E) = T_1'(E)T_2'(E)$	
gilmore-lie-groups_F00645	67	0.997	`T_{1}^{\prime}(E)=T_{1}(E) R`	$T_1'(E) = T_1(E)R$	
gilmore-lie-groups_F00646	67	0.997	`T_{2}^{\prime}(E)=`	$T_2'(E) =$	
gilmore-lie-groups_F00647	67	1.000	`R^{-1} T_{2}(E)`	$R^{-1}T_2(E)$	
gilmore-lie-groups_F00648	67	1.000	`R \in U(1,1)`	$R \in U(1,1)$	
gilmore-lie-groups_F00649	67	1.000	`U(2,2) \supset U(1,1) \otimes U(1,1) \downarrow U(1,1)`	$U(2,2) \supset U(1,1) \otimes U(1,1) \downarrow U(1,1)$	
gilmore-lie-groups_F00650	67	0.932	`T_{\text {Tot }}(E)`	$T_{\text {Tot }}(E)$	
gilmore-lie-groups_F00651	67	0.932	`\left(T_{1}(E) R, R^{-1} T_{2}(E)\right.`	$\left(T_1(E)R, R^{-1}T_2(E)\right.$	
gilmore-lie-groups_F00652	67	0.850	`\left(S_{1}^{\prime}(E), S_{2}^{\prime}(E)\right)`	$\left(S_1'(E), S_2'(E)\right)$	
gilmore-lie-groups_F00653	68	0.987	`n_{1}, n_{2}, \ldots, n_{k}`	$n_1, n_2, \ldots, n_k$	with $n_1, n_2, \ldots, n_k$ leads can be connected together by soldering some of the leads
gilmore-lie-groups_F00654	68	0.718	`k S`	kS	permutation of the rows and columns of this direct sum of S matrices the input-output

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gilmore-lie-groups_F00655	68	0.718	`n_{j} \times n_{j}(j=1,2, \ldots, k)`	$n_j \times n_j(j=1,2,\ldots,k)$	permutation of the rows and columns of this direct sum of S matrices the input-output
gilmore-lie-groups_F00656	68	1.000	`\Gamma`	Γ	connectivity, of the network.
gilmore-lie-groups_F00657	68	0.999	`\left[o_{e}\right]=S_{\text {Network }}\left[i_{e}\right]`	$[o_e]=S_{\text{Network }}[i_e]$	
gilmore-lie-groups_F00658	68	1.000	`S_{\text {Newtork }}`	$S_{\text{Newtork }}$	$S_{\text{Network}}=D+C\Gamma B+C\Gamma A\Gamma B+C\Gamma A\Gamma A\Gamma B+C\Gamma A\Gamma A\Gamma A$
gilmore-lie-groups_F00659	68	1.000	`S_{\text {Newtork }}^{\dagger}=S_{\text {Newtork }}, S_{\text {Newtork }} \subset U(d)`	$S_{\text{Newtork }}^{\dagger}=S_{\text{Newtork }}, S_{\text{Newtork }} \subset U(d)$	$S_{\text{Network}}=D+C\Gamma B+C\Gamma A\Gamma B+C\Gamma A\Gamma A\Gamma B+C\Gamma A\Gamma A\Gamma A$
gilmore-lie-groups_F00660	68	1.000	`U\left(\sum_{j=1}^{k} n_{j}\right) \supset \Pi_{j=1}^{k} \otimes U\left(n_{j}\right)`	$U\left(\sum_{j=1}^{k} n_j\right) \supset \Pi_{j=1}^{k} \otimes U\left(n_j\right)$	each group operation in $U(d)$.
gilmore-lie-groups_F00661	68	1.000	`U(d)`	$U(d)$	30 All the matrices in this problem are square $n \times n$ with: H hermitian; U unitary; A
gilmore-lie-groups_F00662	68	1.000	`d`	d	30 All the matrices in this problem are square $n \times n$ with: H hermitian; U unitary; A
gilmore-lie-groups_F00663	68	0.917	`\Pi_{j=1}^{k} \otimes U\left(n_{j}\right)`	$\Pi_{j=1}^{k} \otimes U\left(n_j\right)$	antihermitian. Show the right-hand column follows from the definition in the left-hand
gilmore-lie-groups_F00664	68	1.000	`U`	U	$H_2=\frac{H_1+H_n}{H_1-H_n} \quad [H_1, H_2]=0 \quad H_1=\frac{H_2+H_n}{H_2-H_n}$
gilmore-lie-groups_F00665	70	1.000	`b`	b	its neighborhood, on the left by group element ba^{-1} (or on the right by $a^{-1}b$). This means a into b and points near a into points near b.
gilmore-lie-groups_F00666	70	1.000	`b a^{-1}`	ba^{-1}	maps a into b and points near a into points near b. It is therefore necessary to study the neighborhood of only one group operation
gilmore-lie-groups_F00667	70	1.000	`a^{-1} b`	$a^{-1}b$	maps a into b and points near a into points near b. It is therefore necessary to study the neighborhood of only one group operation
gilmore-lie-groups_F00668	71	0.953	`(a, b, c)`	(a, b, c)	done by allowing the parameters (a, b, c) to become infinitesimals and expanding the group operation in terms of these infinitesimals to first order.
gilmore-lie-groups_F00669	71	1.000	`\phi(x, y) \rightarrow \phi(x, 0+\delta y)`	$\phi(x, y) \rightarrow \phi(x, 0+\delta y)$	the linearization of the group in the neighborhood of the identity is so powerful.
gilmore-lie-groups_F00670	72	1.000	`\epsilon`	ϵ	given in (4.4). Then if ϵ is a small real number, $I+\epsilon X$ represents an element in
gilmore-lie-groups_F00671	72	1.000	`I+\epsilon X`	$I+\epsilon X$	given in (4.4). Then if ϵ is a small real number, $I+\epsilon X$ represents an element in
gilmore-lie-groups_F00672	72	0.744	`X_{a}`	X_a	given in (4.4)
gilmore-lie-groups_F00673	72	0.744	`X_{b}`	X_b	given in (4.4)
gilmore-lie-groups_F00674	72	0.744	`X_{c}`	X_c	given in (4.4)
gilmore-lie-groups_F00675	72	1.000	`X^{n}`	X^n	must be proportional to X $(=\theta^2 X)$; X^3 is proportional to the identity, and so on. Finesse involves use of the Cayley–Hamilton theorem, that every matrix satisfies
gilmore-lie-groups_F00676	72	1.000	`X^{0}=I_{2}, X^{1}=X`	$X^0=I_2, X^1=X$	Finesse involves use of the Cayley–Hamilton theorem, that every matrix satisfies its secular equation. This means that a 2×2 matrix must satisfy a polynomial
gilmore-lie-groups_F00677	72	1.000	`X^{2}=\theta^{2} I_{2}`	$X^2=\theta^2 I_2$	its secular equation. This means that a 2×2 matrix must satisfy a polynomial equation of degree 2. Thus we can replace X^2 by a function of $X^0=I_2$ and $X^1=X$.
gilmore-lie-groups_F00678	72	1.000	`X^{2}`	X^2	its secular equation. This means that a 2×2 matrix must satisfy a polynomial equation of degree 2. Thus we can replace X^2 by a function of $X^0=I_2$ and $X^1=X$.
gilmore-lie-groups_F00679	72	1.000	`X^{3}=X^{2} X^{1}`	$X^3=X^2 X^1$	its secular equation. This means that a 2×2 matrix must satisfy a polynomial equation of degree 2. Thus we can replace X^2 by a function of $X^0=I_2$ and $X^1=X$.
gilmore-lie-groups_F00680	72	0.991	`X\left(=\theta^{2} X\right), X^{4}`	$X\left(=\theta^2 X\right), X^4$	Similarly, X^3 can be replaced by a linear combination of X^2 and X, and then X^2

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gilmore-lie-groups_F00681	72	0.995	X^{0}=I_{2}	$X^0 = I_2$	$E(X) = f_0(a,b,c)X^0 + f_1(a,b,c)X^1$ (4.8)
gilmore-lie-groups_F00682	72	0.995	X^{1}=X	$X^1 = X$	$E(X) = f_0(a,b,c)X^0 + f_1(a,b,c)X^1$ (4.8)
gilmore-lie-groups_F00683	72	1.000	X^{3}	X^3	$E(X) = f_0(a,b,c)X^0 + f_1(a,b,c)X$ (4.8)
gilmore-lie-groups_F00684	72	0.759	I_{2}	I_2	
gilmore-lie-groups_F00685	73	1.000	f_{0}, f_{1}	f_0, f_1	Furthermore, the functions f_0, f_1 are not arbitrary functions of the three parameters
gilmore-lie-groups_F00686	73	1.000	\theta^{2}=a^{2}+b c	$\theta^2 = a^2 + bc$	X is $\theta^2 = a^2 + bc$. As a result, we know from general and simple considerations
gilmore-lie-groups_F00687	73	1.000	f_{0}\left(\theta^{2}\right)=1+\theta^{2} / 2!+\theta^{4} / 4!+\theta^{6} / 6!+\cdots=\cosh \theta	$f_0\left(\theta^2\right) = 1 + \theta^2/2! + \theta^4/4! + \theta^6/6! + \cdots = \cosh\theta$	$f_1(\theta^2) = 1 + \theta^2/3! + \theta^4/5! + \theta^6/7! + \cdots = \sinh(\theta)/\theta$. These arguments are ap-
gilmore-lie-groups_F00688	73	1.000	f_{1}\left(\theta^{2}\right)=1+\theta^{2} / 3!+\theta^{4} / 5!+\theta^{6} / 7!+\cdots=\sinh (\theta) / \theta	$f_1\left(\theta^2\right) = 1 + \theta^2/3! + \theta^4/5! + \theta^6/7! + \cdots = \sinh(\theta)/\theta$	plicable to the exponential of any matrix Lie algebra.
gilmore-lie-groups_F00689	73	1.000	Y	Y	
gilmore-lie-groups_F00690	73	1.000	g_{1}=I+\epsilon X	$g_1 = I + \epsilon X$	
gilmore-lie-groups_F00691	73	1.000	I+\epsilon \alpha X	$I + \epsilon\alpha X$	
gilmore-lie-groups_F00692	74	1.000	\alpha	α	for any real number α. We can form the produ
gilmore-lie-groups_F00693	74	1.000	\epsilon, \delta	ϵ, δ	$\mathrm{EXP}(\epsilon X)$ and $g_1(\epsilon)^{-1} = \mathrm{EXP}(-\epsilon X)$ are group elements near the identity, as are
gilmore-lie-groups_F00694	74	1.000	g_{1}(\epsilon)=	$g_1(\epsilon) =$	$\mathrm{EXP}(\epsilon X)$ and $g_1(\epsilon)^{-1} = \mathrm{EXP}(-\epsilon X)$ are group elements near the identity, as are
gilmore-lie-groups_F00695	74	1.000	\operatorname{EXP}(\epsilon X)	$\mathrm{EXP}(\epsilon X)$	$g_2(\delta)^{\pm 1} = \mathrm{EXP}(\pm\delta Y)$. Expanding the commutator to lowest order nonvanishing
gilmore-lie-groups_F00696	74	1.000	g_{1}(\epsilon)^{-1}=\operatorname{EXP}(-\epsilon X)	$g_1(\epsilon)^{-1} = \mathrm{EXP}(-\epsilon X)$	$g_2(\delta)^{\pm 1} = \mathrm{EXP}(\pm\delta Y)$. Expanding the commutator to lowest order nonvanishing
gilmore-lie-groups_F00697	74	1.000	g_{2}(\delta)^{ \pm 1}=\operatorname{EXP}(\pm \delta Y)	$g_2(\delta)^{\pm 1} = \mathrm{EXP}(\pm\delta Y)$	terms, we find
gilmore-lie-groups_F00698	74	0.996	g_{1}(\epsilon)=\operatorname{EXP}(\epsilon X)	$g_1(\epsilon) = \mathrm{EXP}(\epsilon X)$	$Y, [X, Y] = (XY - YX)$, to be in its Lie algebra $\mathfrak{g}$
gilmore-lie-groups_F00699	74	0.996	g_{2}(\delta)=	$g_2(\delta) =$	$Y, [X, Y] = (XY - YX)$, to be in its Lie algebra $\mathfrak{g}$
gilmore-lie-groups_F00700	74	1.000	\operatorname{EXP}(\delta Y)	$\mathrm{EXP}(\delta Y)$	$g_1^{-1}g_2^{-1}g_1g_2 = e^{\delta^2[X,Y]} \in G$ (4.14)
gilmore-lie-groups_F00701	74	1.000	Y,[X, Y]=(X Y-Y X)	$Y, [X, Y] = (XY - YX)$	$g_1g_2g_1^{-1}g_2^{-1} \in G \Rightarrow [X,Y]$
gilmore-lie-groups_F00702	74	1.000	\mathfrak{g}	$\mathfrak{g}$	$g_1g_2g_1^{-1}g_2^{-1} \in G \Rightarrow [X,Y]$
gilmore-lie-groups_F00703	74	1.000	g_{1} H g_{1}^{-1} \subset H	$g_1 H g_1^{-1} \subset H$	$g_1Hg_1^{-1} \in H \Rightarrow [X,Y] \in$ Lie algebra of H (4.16)
gilmore-lie-groups_F00704	74	1.000	X, Y, Z	X, Y, Z	This identity involves the cyclic permutation of the operators in a dot mutator. For matrices this identity can be proved by opening up the com
gilmore-lie-groups_F00705	74	0.996	([X, Y]=X Y-Y X)	$([X, Y] = XY - YX)$	
gilmore-lie-groups_F00706	74	1.000	X Y	XY	

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gilmore-lie-groups_F00707	75	1.000	`X \in \mathfrak{g}`	$X \in \mathfrak{g}$	$Y \in \mathfrak{g}$ then every linear combination of X and Y is in $\mathfrak{g}$:
gilmore-lie-groups_F00708	75	1.000	`Y \in \mathfrak{g}`	$Y \in \mathfrak{g}$	
gilmore-lie-groups_F00709	75	1.000	`X \in \mathfrak{g}, Y \in \mathfrak{g}`	$X \in \mathfrak{g}, Y \in \mathfrak{g}$	$[X,[Y,Z]]+[Y,[Z,X]]+[Z,[X,Y]]=0$
gilmore-lie-groups_F00710	75	1.000	`Z \in \mathfrak{g}`	$Z \in \mathfrak{g}$	$[X,[Y,Z]]+[Y,[Z,X]]+[Z,[X,Y]]=0$
gilmore-lie-groups_F00711	75	0.996	`X_{1}, X_{2}, \ldots, X_{n}`	$X_1, X_2, \ldots, X_n$	any two basis vectors can be expressed as a linear superposition of basis vectors
gilmore-lie-groups_F00712	75	1.000	`\left(X_{i}, X_{j}\right)`	(X_i, X_j)	
gilmore-lie-groups_F00713	76	1.000	`C_{i j}{ }^{k}`	$C_{ij}{}^{k}$	The coefficients $C_{ij}{}^{k}$ in this expansion are called **structure constants**. The structure
gilmore-lie-groups_F00714	76	0.865	`X_{a}, X_{b}, X_{c}`	X_a, X_b, X_c	
gilmore-lie-groups_F00715	76	0.865	`\mathfrak{s l}(2 ; R)`	$\mathfrak{sl}(2;R)$	
gilmore-lie-groups_F00716	76	1.000	`Z`	Z	Under the change of basis (4.21) we find
gilmore-lie-groups_F00717	76	1.000	`R(Z)`	$R(Z)$	
gilmore-lie-groups_F00718	77	1.000	`\mathfrak{s l}(2 ; \mathbb{R})`	$\mathfrak{sl}(2;\mathbb{R})$	structed, since the structure constants have been given in (4.23)
gilmore-lie-groups_F00719	77	0.844	`a, b`	a, b	
gilmore-lie-groups_F00720	77	0.844	`c`	c	
gilmore-lie-groups_F00721	78	0.899	`X_{a}, X_{b}`	X_a, X_b	the three generators X_a, X_b, and X_c of $\mathfrak{sl}(2;\mathbb{R})$ to either the nonsemisimple or the
gilmore-lie-groups_F00722	78	0.997	`E(2)`	$E(2)$	$E(2)$ with strt
gilmore-lie-groups_F00723	78	1.000	`P_{x}, P_{y}`	P_x, P_y	Lie algebra. The algebra, and the original group, are therefore nonsemisimple.
gilmore-lie-groups_F00724	78	1.000	`L_{z}`	L_z	There is a beautiful structure theory for simple and semisimple Lie algebras.
gilmore-lie-groups_F00725	78	0.985	`A, B`	A, B	This inner product is positive-definite, that is
gilmore-lie-groups_F00726	78	0.985	`p \times q`	$p \times q$	This inner product is positive-definite, that is
gilmore-lie-groups_F00727	79	0.998	`X_{i}`	X_i	and also on all generators that are not representable as the commutator of two
gilmore-lie-groups_F00728	79	0.998	`C_{i \star}{ }^{*}=0`	$C_{i\star}{}^{*}=0$	and also on all generators that are not representable as the commutator of two
gilmore-lie-groups_F00729	79	1.000	`C_{* \star}^{i}=0`	$C^{i}_{*\star}=0$	The Hilbert–Schmidt inner proc
gilmore-lie-groups_F00730	79	1.000	`V_{0}`	V_0	property) operators. That is to say, the exponential of this subspace is a subset of
gilmore-lie-groups_F00731	79	1.000	`V_{-}`	V_-	Finally, the subspace V_+ is not a subalgebra of $\mathfrak{g}$. It consists of noncompact
gilmore-lie-groups_F00732	79	1.000	`V_{+}`	V_+	

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gilmore-lie-groups_F00733	80	1.000	`X_{ \pm}=X_{b} \pm X_{c}`	$X_{\pm}=X_{b} \pm X_{c}$	$\begin{vmatrix} 0 & 8 & 0 \end{vmatrix}$ X_{+}
gilmore-lie-groups_F00734	80	1.000	`X_{-}`	X_{-}	simply in the defining 2×2 matrix representation of $\mathfrak{sl}(2;\mathbb{R})$
gilmore-lie-groups_F00735	80	1.000	`X_{a}, X_{+}`	X_{a}, X_{+}	$\ulcorner a \quad b \urcorner^{2}$
gilmore-lie-groups_F00736	81	0.644	`\alpha^{1}, \alpha^{2}, \ldots, \alpha^{n}`	$\alpha^{1}, \alpha^{2}, \ldots, \alpha^{n}$	**The and measure.** We assume the coordinates of the identity are $(\alpha^{1}, \alpha^{2}, \ldots, \alpha^{n})$ and the coordinates of a point near the identity are $(\alpha^{1}+d\alpha^{1}, \alpha^{2}+d\alpha^{2} \quad \alpha^{n}+$
gilmore-lie-groups_F00737	81	0.840	`\alpha^{1}+d \alpha^{1}, \alpha^{2}+d \alpha^{2}, \ldots, \alpha^{n}+`	$\alpha^{1}+d\alpha^{1}, \alpha^{2}+d\alpha^{2}, \ldots, \alpha^{n}+$	and the coordinates of a point near the identity are $(\alpha^{1}+d\alpha^{1}, \alpha^{2}+d\alpha^{2}, \ldots, \alpha^{n}+$ $d\alpha^{n})$. If $(x^{1}, x^{2}, \ldots, x^{n})$ represents some other group operation, then the point
gilmore-lie-groups_F00738	81	0.866	`d \alpha^{n}`	$d\alpha^{n}$	$(\alpha^{1}+d\alpha^{1}, \alpha^{2}+d\alpha^{2}, \ldots, \alpha^{n}+d\alpha^{n})$ is mapped to the point $(x^{1}+dx^{1}, x^{2}+$
gilmore-lie-groups_F00739	81	0.866	`\left(x^{1}, x^{2}, \ldots, x^{n}\right)`	$\left(x^{1}, x^{2}, \ldots, x^{n}\right)$	$(\alpha^{1}+d\alpha^{1}, \alpha^{2}+d\alpha^{2}, \ldots, \alpha^{n}+d\alpha^{n})$ is mapped to the point $(x^{1}+dx^{1}, x^{2}+$
gilmore-lie-groups_F00740	81	0.831	`\alpha^{1}+d \alpha^{1}, \alpha^{2}+d \alpha^{2}, \ldots, \alpha^{n}+d \alpha^{n}`	$\alpha^{1}+d\alpha^{1}, \alpha^{2}+d\alpha^{2}, \ldots, \alpha^{n}+d\alpha^{n}$	$dx^{2}, \ldots, x^{n}+dx^{n})$ under left (right) multiplication by the group operation associ-
gilmore-lie-groups_F00741	81	0.831	`x^{1}+d x^{1}, x^{2}+`	$x^{1}+dx^{1}, x^{2}+$	$dx^{2}, \ldots, x^{n}+dx^{n})$ under left (right) multiplication by the group operation associ-
gilmore-lie-groups_F00742	81	1.000	`d x^{2}, \ldots, x^{n}+d x^{n}`	$dx^{2}, \ldots, x^{n}+dx^{n}$	ated with $(x^{1}, x^{2}, \ldots, x^{n})$. The displacements dx and $d\alpha$ are related by a position-
gilmore-lie-groups_F00743	81	0.997	`d x`	dx	dependent *linear* transformation
gilmore-lie-groups_F00744	81	0.997	`d \alpha`	$d\alpha$	dependent *linear* transformation
gilmore-lie-groups_F00745	81	1.000	`d s`	ds	
gilmore-lie-groups_F00746	81	1.000	`\alpha^{i}+d \alpha^{i}`	$\alpha^{i}+d\alpha^{i}$	$ds^{2}=g_{ij}(\mathrm{Id})d\alpha^{i}d\alpha^{j}$
gilmore-lie-groups_F00747	81	0.671	`x, g_{r s}(x)`	$x, g_{rs}(x)$	$g_{rs}(x)dx^{r}dx^{s}=g_{ij}(\mathrm{Id})d\alpha^{i}d\alpha^{j}$ (4.46)
gilmore-lie-groups_F00748	81	1.000	`x, g(x)`	$x, g(x)$	$g(x)=M^{-1}(x)^{T}g(\mathrm{Id})M^{-1}(x)$ (4.47)
gilmore-lie-groups_F00749	82	0.976	`\left(d \alpha^{1}, d \alpha^{2}, d \alpha^{3}\right)`	$\left(d\alpha^{1}, d\alpha^{2}, d\alpha^{3}\right)$	of the identity and the infinitesimals (dx, dy, dz) in the neighborhood of the group operation (x, y, z) can now be read off, matrix element by matrix element
gilmore-lie-groups_F00750	82	0.999	`(d x, d y, d z)`	(dx, dy, dz)	
gilmore-lie-groups_F00751	83	1.000	`[X, Y]=(X Y-Y X)`	$[X, Y]=(XY-YX)$	tional combinatorial operation, the commutator $[X, Y]=(XY-YX)$, and obey the Jacobi identity. Since they are linear vector spaces, many powerful tools are avail
gilmore-lie-groups_F00752	83	1.000	`g_{1}=(I+\epsilon X), g_{1}^{-1}=(I+\epsilon X)^{-1}=I-`	$g_{1}=(I+\epsilon X), g_{1}^{-1}=(I+\epsilon X)^{-1}=I-$	(4.13). In other words, this local result is independent of the parameterization in the
gilmore-lie-groups_F00753	83	1.000	`\epsilon X+\epsilon^{2} X^{2}-\cdots`	$\epsilon X+\epsilon^{2}X^{2}-\cdots$	neighborhood of the identity.
gilmore-lie-groups_F00754	83	1.000	`g_{2}`	g_{2}	neighborhood of the identity.
gilmore-lie-groups_F00755	83	1.000	`X^{\prime}`	$X^{\prime}$	
gilmore-lie-groups_F00756	83	1.000	`(X, X)=2\left(a^{2}+b c\right)`	$(X, X)=2\left(a^{2}+bc\right)$	Suppose that the $n \times n$ matrix Y is defined as the exponential of an $n \times n$ m
gilmore-lie-groups_F00757	83	1.000	`Y=e^{X}`	$Y=e^{X}$	$\overline{n=1}$ n
gilmore-lie-groups_F00758	83	0.570	`\lambda_{i}`	λ_{i}	

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gilmore-lie-groups_F00759	83	0.570	`0<\lambda_{i}<+2`	$0 < \lambda_i < +2$	
gilmore-lie-groups_F00760	83	0.570	`Y \in \operatorname{SL}(2 ; \mathbb{R})`	$Y \in \operatorname{SL}(2;\mathbb{R})$	
gilmore-lie-groups_F00761	83	0.570	`\operatorname{tr} Y<-2`	$\operatorname{tr} Y < -2$	
gilmore-lie-groups_F00762	84	1.000	`X \in \mathfrak{s l}(2 ; \mathbb{R})`	$X \in \mathfrak{sl}(2;\mathbb{R})$	expansion does not converge. That is, there is no 2×2 matrix $X \in \mathfrak{sl}(2;\mathbb{R})$ with the
gilmore-lie-groups_F00763	84	0.637	`\operatorname{tr} e^{X}<-2`	$\operatorname{tr} e^{X} < -2$	property tr e^X <
gilmore-lie-groups_F00764	84	0.952	`\mathbf{L}=`	$\mathbf{L} =$	4. The Lie algebra of $SO(3)$ is spanned by three 3×3 antisymmetric matrices $\mathbf{L} =$
gilmore-lie-groups_F00765	84	1.000	`\left(L_{1}, L_{2}, L_{3}\right)=\left(X_{23}, X_{31}, X_{12}\right)`	$(L_1, L_2, L_3) = (X_{23}, X_{31}, X_{12})$	$(L_1, L_2, L_3) = (X_{23}, X_{31}, X_{12})$, w
gilmore-lie-groups_F00766	84	1.000	`\mathbf{X}=\theta \cdot \mathbf{L}`	$\mathbf{X} = \theta \cdot \mathbf{L}$	$\theta = \theta_1 + \theta_2 + \theta_3$. Show
gilmore-lie-groups_F00767	84	1.000	`\theta^{2}=\theta_{1}^{2}+\theta_{2}^{2}+\theta_{3}^{2}`	$\theta^2 = \theta_1^2 + \theta_2^2 + \theta_3^2$	$f_0(\theta)$
gilmore-lie-groups_F00768	84	1.000	`S O(n)`	$SO(n)$	$X_{ij} = -X_{ji}$ $(1 \leq i \neq j \leq n)$ with matrix elements $(X_{ij})_{\alpha\beta} = \delta_{i\alpha}\delta_{j\beta} - \delta_{i\beta}\delta_{j\alpha}$.
gilmore-lie-groups_F00769	84	1.000	`X_{i j}=-X_{j i}(1 \leq i \neq j \leq n)`	$X_{ij} = -X_{ji}(1 \leq i \neq j \leq n)$	$[X_{ij}, X_{rs}] = X_{is}\delta_{ir} + X_{ir}\delta_{is} - X_{ir}\delta_{is} - X_{is}\delta_{ir}$ (4
gilmore-lie-groups_F00770	84	1.000	`\left(X_{i j}\right)_{\alpha \beta}=\delta_{i \alpha} \delta_{j \beta}-\delta_{i \beta} \delta_{j \alpha}`	$(X_{ij})_{\alpha\beta} = \delta_{i\alpha}\delta_{j\beta} - \delta_{i\beta}\delta_{j\alpha}$	$[X_{ij}, X_{rs}] = X_{is}\delta_{ir} + X_{ir}\delta_{is} - X_{ir}\delta_{is} - X_{is}\delta_{ir}$ (4
gilmore-lie-groups_F00771	84	1.000	`\mathcal{X}_{i j}=x^{i} \partial_{j}-x^{j} \partial_{i}`	$\mathcal{X}_{ij} = x^i\partial_j - x^j\partial_i$	$b_i^\dagger b_j - b_j^\dagger b_i$ $(1 \leq i \neq j \leq n)$ satisfy isomorphic commutation relations.
gilmore-lie-groups_F00772	84	1.000	`\mathcal{B}_{i j}=`	$\mathcal{B}_{ij} =$	$f_i^\dagger f_j - f_j^\dagger f_i$ $(1 \leq i \neq j \leq n)$ satisfy isomorphic commutation relations.
gilmore-lie-groups_F00773	84	1.000	`b_{i}^{\dagger} b_{j}-b_{j}^{\dagger} b_{i}(1 \leq i \neq j \leq n)`	$b_i^\dagger b_j - b_j^\dagger b_i (1 \leq i \neq j \leq n)$	6. The Jacobi identity for operators D, Y, Z (replace X by D in Eq. (4.17)
gilmore-lie-groups_F00774	84	0.963	`\mathcal{F}_{i j}=`	$\mathcal{F}_{ij} =$	rewritten in the form
gilmore-lie-groups_F00775	84	1.000	`f_{i}^{\dagger} f_{j}-f_{j}^{\dagger} f_{i}(1 \leq i \neq j \leq n)`	$f_i^\dagger f_j - f_j^\dagger f_i (1 \leq i \neq j \leq n)$	$[D, [Y, Z]] = [[D, Y], Z] + [Y, [D, Z]]$
gilmore-lie-groups_F00776	84	1.000	`D, Y, Z`	D, Y, Z	Show this. Compare with the expression for the differential operator
gilmore-lie-groups_F00777	84	0.998	`\mathfrak{s o}(4)`	$\mathfrak{so}(4)$	
gilmore-lie-groups_F00778	84	0.998	`4 \times 4`	4×4	
gilmore-lie-groups_F00779	85	1.000	`a_{i j} X_{i j}`	$a_{ij}X_{ij}$	element $a_{ij}X_{ij}$ in the Lie algebra:
gilmore-lie-groups_F00780	85	1.000	`S O(p, q)`	$SO(p,q)$	between the proportionality constant and the dimensions of the defining and regular
gilmore-lie-groups_F00781	85	1.000	`\operatorname{EXP}\left(V_{-}\right)`	$\operatorname{EXP}(V_-)$	torus T^2 for $SO(2,2)$.
gilmore-lie-groups_F00782	85	0.546	`S O(3,1)`	$SO(3,1)$	Construct the infinitesimal generators for the group $SO(3)$ using the parameterizations
gilmore-lie-groups_F00783	85	0.546	`S O(2,2)`	$SO(2,2)$	Construct the infinitesimal generators for the group $SO(3)$ using the parameterizations
gilmore-lie-groups_F00784	85	0.982	`T^{2}`	T^2	proposed in Problems 1

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gilmore-lie-groups_F00785	85	0.752	`e^{\theta \cdot \mathbf{L}} \in S O(3)`	$e^{\theta \cdot \mathbf{L}} \in SO(3)$	Compute the determinant of the metric tensor (4.53) on the group $SL(2;\mathbb{R})$. Show
gilmore-lie-groups_F00786	85	0.752	`\rho(\theta)`	$\rho(\theta)$	Compute the determinant of the metric tensor (4.53) on the group $SL(2;\mathbb{R})$. Show
gilmore-lie-groups_F00787	85	1.000	`g_{\mu \nu}(\theta)`	$g_{\mu\nu}(\theta)$	that the square root of the determinant is equal to the measure, in accordance with the
gilmore-lie-groups_F00788	85	1.000	`d V(x)=\\|g(x)\\|^{1 / 2} d^{n} x`	$dV(x) = \\|g(x)\\|^{1/2} d^n x$	$\mathbf{x} = \mathbf{e}_i x^i$. The inverse matrix, g^{rs}, is well defined.
gilmore-lie-groups_F00789	85	0.623	`(\mathbf{x}, \mathbf{x})`	$(\mathbf{x}, \mathbf{x})$	
gilmore-lie-groups_F00790	85	1.000	`g_{r s}=\left(\mathbf{e}_{r}, \mathbf{e}_{s}\right)`	$g_{rs} = (\mathbf{e}_r, \mathbf{e}_s)$	
gilmore-lie-groups_F00791	85	1.000	`\mathbf{x}=\mathbf{e}_{i} x^{i}`	$\mathbf{x} = \mathbf{e}_i x^i$	
gilmore-lie-groups_F00792	85	1.000	`g^{r s}`	g^{rs}	
gilmore-lie-groups_F00793	85	1.000	`\mathbf{y}=G \mathbf{x},(\mathbf{y}, \mathbf{y})=( \mathbf{x}, \mathbf{x})`	$\mathbf{y} = G\mathbf{x}, (\mathbf{y}, \mathbf{y}) = (\mathbf{x}, \mathbf{x})$	
gilmore-lie-groups_F00794	85	1.000	`G^{t} g G=g`	$G^t g G = g$	
gilmore-lie-groups_F00795	85	1.000	`H^{t} g+g H=0`	$H^t g + g H = 0$	
gilmore-lie-groups_F00796	85	1.000	`X_{r s}=g_{r t} x^{t} \partial_{s}-g_{s t} x^{t} \partial_{r}`	$X_{rs} = g_{rt} x^t \partial_s - g_{st} x^t \partial_r$	
gilmore-lie-groups_F00797	86	1.000	`X_{r s}`	X_{rs}	**d.** Show that the operators X_{rs} satisfy commutation relations
gilmore-lie-groups_F00798	86	0.887	`M=S O`	$M = SO$	15. Every real unimodular 2×2 matrix M can be written in the form $M = SO$, where S
gilmore-lie-groups_F00799	86	1.000	`S^{t}=S^{+1}`	$S^t = S^{+1}$	$S^t = S^{+1}$ $\det(S) = +1$ $S = e^{\Sigma}$ $\mathrm{Tr}\,\Sigma = 0$ $\Sigma^t = +\Sigma$ $O^t = O^{-1}$ $\det(O) = +1$ $O = e^{A}$ $\mathrm{Tr}\,A = 0$ $A^t = -A$
gilmore-lie-groups_F00800	86	1.000	`\operatorname{det}(S)=+1`	$\det(S) = +1$	$S^t = S^{+1}$ $\det(S) = +1$ $S = e^{\Sigma}$ $\mathrm{Tr}\,\Sigma = 0$ $\Sigma^t = +\Sigma$ $O^t = O^{-1}$ $\det(O) = +1$ $O = e^{A}$ $\mathrm{Tr}\,A = 0$ $A^t = -A$
gilmore-lie-groups_F00801	86	1.000	`S=e^{\Sigma}`	$S = e^{\Sigma}$	$S^t = S^{+1}$ $\det(S) = +1$ $S = e^{\Sigma}$ $\mathrm{Tr}\,\Sigma = 0$ $\Sigma^t = +\Sigma$ $O^t = O^{-1}$ $\det(O) = +1$ $O = e^{A}$ $\mathrm{Tr}\,A = 0$ $A^t = -A$
gilmore-lie-groups_F00802	86	1.000	`\operatorname{Tr} \Sigma=0`	$\mathrm{Tr}\,\Sigma = 0$	$S^t = S^{+1}$ $\det(S) = +1$ $S = e^{\Sigma}$ $\mathrm{Tr}\,\Sigma = 0$ $\Sigma^t = +\Sigma$ $O^t = O^{-1}$ $\det(O) = +1$ $O = e^{A}$ $\mathrm{Tr}\,A = 0$ $A^t = -A$
gilmore-lie-groups_F00803	86	1.000	`\Sigma^{t}=+\Sigma`	$\Sigma^t = +\Sigma$	$S^t = S^{+1}$ $\det(S) = +1$ $S = e^{\Sigma}$ $\mathrm{Tr}\,\Sigma = 0$ $\Sigma^t = +\Sigma$ $O^t = O^{-1}$ $\det(O) = +1$ $O = e^{A}$ $\mathrm{Tr}\,A = 0$ $A^t = -A$
gilmore-lie-groups_F00804	86	1.000	`O^{t}=O^{-1}`	$O^t = O^{-1}$	$S^t = S^{+1}$ $\det(S) = +1$ $S = e^{\Sigma}$ $\mathrm{Tr}\,\Sigma = 0$ $\Sigma^t = +\Sigma$ $O^t = O^{-1}$ $\det(O) = +1$ $O = e^{A}$ $\mathrm{Tr}\,A = 0$ $A^t = -A$

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gilmore-lie-groups_F00805	86	1.000	`\operatorname{det}(O)=+1`	$\operatorname{det}(O)=+1$	$S^t = S^{+1}$ $\det(S)=+1$ $S=e^{\Sigma}$ $\operatorname{Tr}\Sigma=0$ $\Sigma^t=+\Sigma$ $O^t=O^{-1}$ $\det(O)=+1$ $O=e^{A}$ $\operatorname{Tr}A=0$ $A^t=-A$
gilmore-lie-groups_F00806	86	1.000	`O=e^{A}`	$O=e^{A}$	$S^t = S^{+1}$ $\det(S)=+1$ $S=e^{\Sigma}$ $\operatorname{Tr}\Sigma=0$ $\Sigma^t=+\Sigma$ $O^t=O^{-1}$ $\det(O)=+1$ $O=e^{A}$ $\operatorname{Tr}A=0$ $A^t=-A$
gilmore-lie-groups_F00807	86	1.000	`\operatorname{Tr} A=0`	$\operatorname{Tr}A=0$	$S^t = S^{+1}$ $\det(S)=+1$ $S=e^{\Sigma}$ $\operatorname{Tr}\Sigma=0$ $\Sigma^t=+\Sigma$ $O^t=O^{-1}$ $\det(O)=+1$ $O=e^{A}$ $\operatorname{Tr}A=0$ $A^t=-A$
gilmore-lie-groups_F00808	86	1.000	`A^{t}=-A`	$A^t=-A$	$S^t = S^{+1}$ $\det(S)=+1$ $S=e^{\Sigma}$ $\operatorname{Tr}\Sigma=0$ $\Sigma^t=+\Sigma$ $O^t=O^{-1}$ $\det(O)=+1$ $O=e^{A}$ $\operatorname{Tr}A=0$ $A^t=-A$
gilmore-lie-groups_F00809	86	0.999	`M M^{t}=S^{2}=e^{2 \Sigma}`	$MM^t=S^2=e^{2\Sigma}$	**b.** Show $O=S^{-1}M=e^{-\Sigma}$
gilmore-lie-groups_F00810	86	1.000	`O=S^{-1} M=e^{-\Sigma} M`	$O=S^{-1}M=e^{-\Sigma}M$	**c.** Write S as a power seri
gilmore-lie-groups_F00811	86	1.000	`\Sigma`	Σ	**d.** Write Σ as a power series expansion in Under what conditions are these expansior
gilmore-lie-groups_F00812	86	1.000	`S-I_{2}`	$S-I_2$	Under what conditions are these expansions run
gilmore-lie-groups_F00813	86	1.000	`M=H U`	$M=HU$	15. Transfer matrices have been described in Chapter 3, Problem 24. In one dimension
gilmore-lie-groups_F00814	86	1.000	`H^{\dagger}=H^{+1}`	$H^{\dagger}=H^{+1}$	15. Transfer matrices have been described in Chapter 3, Problem 24. In one di the transfer matrix for a scattering potential, with free particles incident fror
gilmore-lie-groups_F00815	86	1.000	`U^{\dagger}=U^{-1}`	$U^{\dagger}=U^{-1}$	15. Transfer matrices have been described in Chapter 3, Problem 24. In one di the transfer matrix for a scattering potential, with free particles incident fror
gilmore-lie-groups_F00816	86	1.000	`\hbar k_{L}`	$\hbar k_L$	$\beta_R - i\beta_I \quad \alpha_R - i\alpha_I$
gilmore-lie-groups_F00817	86	1.000	`-\hbar k_{R}`	$-\hbar k_R$	$\beta_R - i\beta_I \quad \alpha_R - i\alpha_I$
gilmore-lie-groups_F00818	86	1.000	`m_{i j}`	m_{ij}	
gilmore-lie-groups_F00819	86	1.000	`\hbar k_{L}=\hbar k_{R}`	$\hbar k_L=\hbar k_R$	$i \quad 0 \qquad 0 \quad i \qquad 0 \quad -1$ (4.61c) $\beta_1 - \beta_2 \quad \alpha_1 - \alpha_2$
gilmore-lie-groups_F00820	86	0.679	`\operatorname{SU}(1,1)`	$\operatorname{SU}(1,1)$	
gilmore-lie-groups_F00821	87	1.000	`\kappa_{R}`	κ_R	wavefunction in the asymptotic left- and right-hand regions of the potential. The real
gilmore-lie-groups_F00822	87	1.000	`\kappa_{L}`	κ_L	wavefunction in the asymptotic left- and right-hand regions of the potential. The real
gilmore-lie-groups_F00823	87	1.000	`\kappa_{L}=\kappa_{R}`	$\kappa_L=\kappa_R$	construct the infinitesimal generators for the group of the transfer matrix for bound
gilmore-lie-groups_F00824	87	1.000	`k_{*}=\sqrt{2 m\left(E-V_{*}\right) / \hbar^{2}}`	$k_*=\sqrt{2m\left(E-V_*\right)/\hbar^2}$	
gilmore-lie-groups_F00825	87	1.000	`E>V_{*}`	$E>V_*$	
gilmore-lie-groups_F00826	87	1.000	`\kappa_{*}=\sqrt{2 m\left(V_{*}-E\right) / \hbar^{2}}`	$\kappa_*=\sqrt{2m\left(V_*-E\right)/\hbar^2}$	

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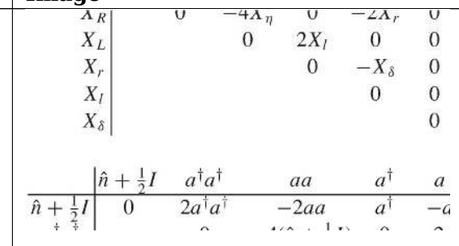
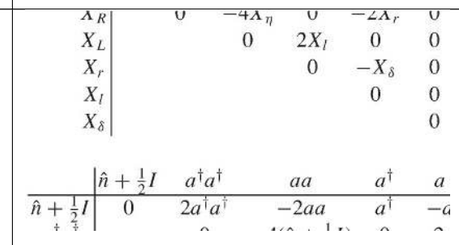
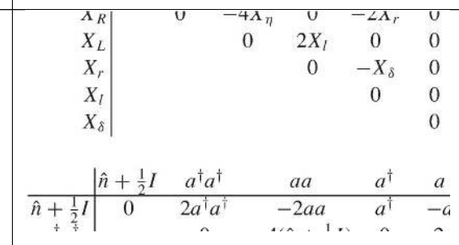
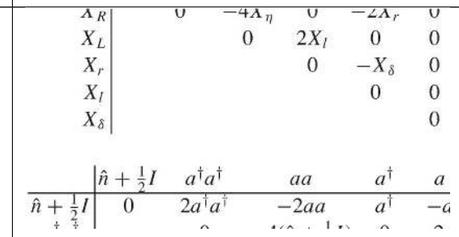
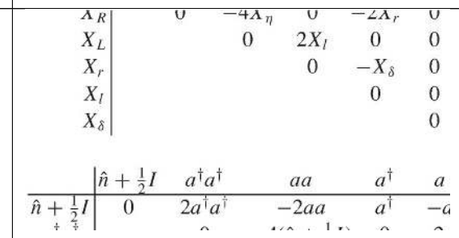
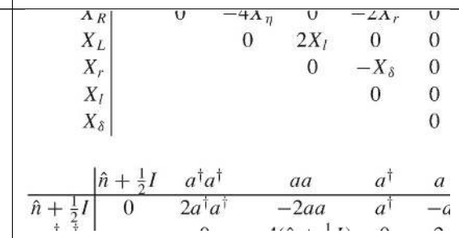
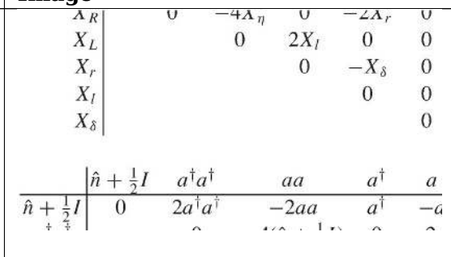
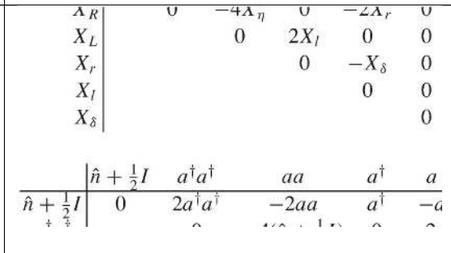
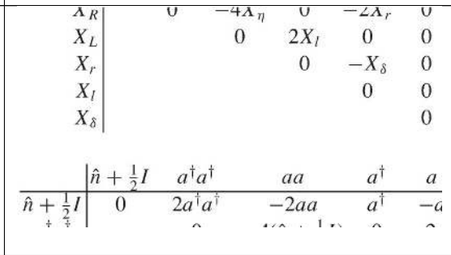
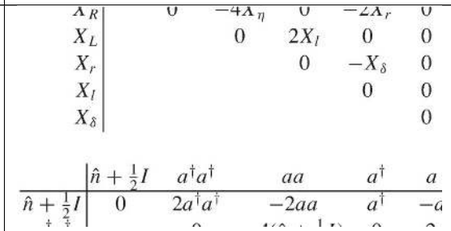
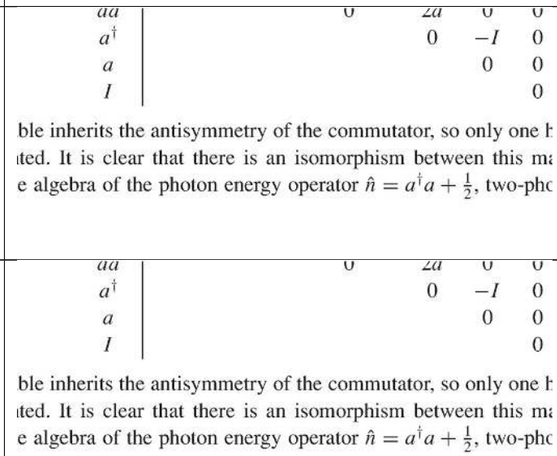
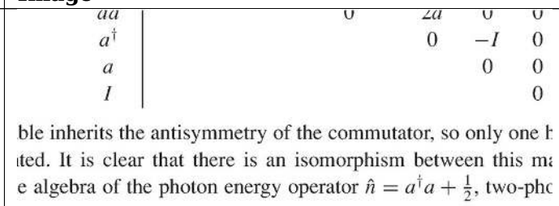
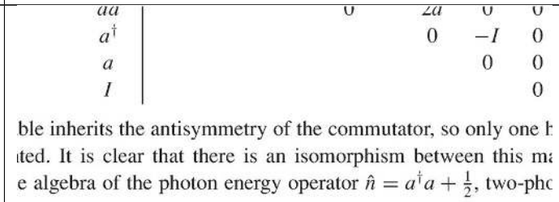
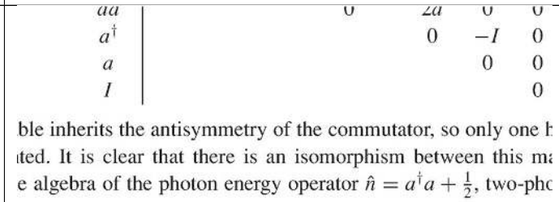
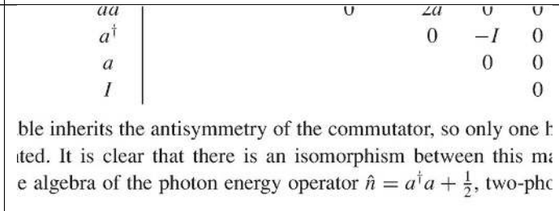
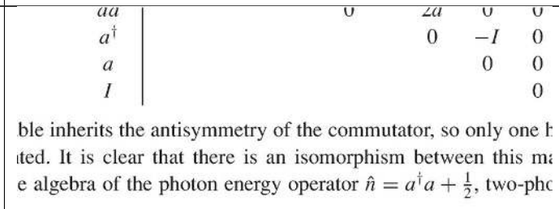
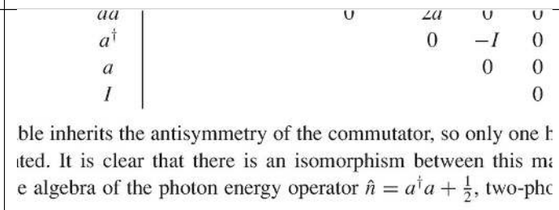
gilmore-lie-groups_F00827	87	1.000	`E<V_{*}`	$E < V_*$	
gilmore-lie-groups_F00828	87	0.978	`*=L, R`	$* = L, R$	
gilmore-lie-groups_F00829	88	0.998	`\operatorname{det}(M) \neq 0`	$\operatorname{det}(M) \neq 0$	(11) are defined by bilinear and quadratic constraints that are linearized by applying
gilmore-lie-groups_F00830	88	1.000	`I+\epsilon A`	$I + \epsilon A$	$(I + \epsilon A)^{\dagger} G (I + \epsilon A) = G$
gilmore-lie-groups_F00831	88	1.000	`\mathfrak{g l}(n ; \mathbb{F})`	$\mathfrak{g l}(n; \mathbb{F})$	
gilmore-lie-groups_F00832	89	1.000	`\mathfrak{u t}(p, q)`	$\mathfrak{u t}(p, q)$	$m_{i\alpha} = 0$ (5.3)
gilmore-lie-groups_F00833	89	0.998	`\mathfrak{h t}(p, q)`	$\mathfrak{h t}(p, q)$	
gilmore-lie-groups_F00834	90	1.000	`(a, b)=(1,0)`	$(a, b) = (1, 0)$	The identity is at $(a, b) = (1, 0)$. Its algebra is spanned by the two operators
gilmore-lie-groups_F00835	90	0.999	`\left[X_{a}, X_{b}\right]=X_{b}`	$\left[X_a, X_b\right] = X_b$	**4** $\mathfrak{ut}(n, q, r)$. This matrix algebra is identical in struct
gilmore-lie-groups_F00836	90	1.000	`\mathfrak{u t}(p, q, r)`	$\mathfrak{u t}(p, q, r)$	**Example** A very useful six-parameter subalgebra of $\mathfrak{ut}(1, 2, 1)$ is given by
gilmore-lie-groups_F00837	90	0.999	`\mathfrak{u t}(1,2,1)`	$\mathfrak{u t}(1, 2, 1)$	$\begin{bmatrix} 0 & l & r & -2\delta \end{bmatrix}$
gilmore-lie-groups_F00838	90	1.000	`j`	j	$\lvert X_\eta \quad X_R \quad X_l \quad X_r \quad X_l \quad X_\delta$
gilmore-lie-groups_F00839	90	1.000	`\left[X_{i}, X_{j}\right]`	$\left[X_i, X_j\right]$	
gilmore-lie-groups_F00840	90	1.000	`X_{\eta}`	X_η	$\begin{array}{c\|ccccc} X_R & 0 & -4X_\eta & 0 & -2X_r & 0 \\ X_L & & 0 & 2X_l & 0 & 0 \\ X_r & & & 0 & -X_\delta & 0 \\ X_l & & & & 0 & 0 \\ X_\delta & & & & & 0 \end{array}$ $\begin{array}{c\|ccccc} & \hat{n} + \frac{1}{2}I & a^\dagger a^\dagger & aa & a^\dagger & a \\ \hline \hat{n} + \frac{1}{2}I & 0 & 2a^\dagger a^\dagger & -2aa & a^\dagger & -a \end{array}$
gilmore-lie-groups_F00841	90	1.000	`X_{R}`	X_R	$\begin{array}{c\|ccccc} X_R & 0 & -4X_\eta & 0 & -2X_r & 0 \\ X_L & & 0 & 2X_l & 0 & 0 \\ X_r & & & 0 & -X_\delta & 0 \\ X_l & & & & 0 & 0 \\ X_\delta & & & & & 0 \end{array}$ $\begin{array}{c\|ccccc} & \hat{n} + \frac{1}{2}I & a^\dagger a^\dagger & aa & a^\dagger & a \\ \hline \hat{n} + \frac{1}{2}I & 0 & 2a^\dagger a^\dagger & -2aa & a^\dagger & -a \end{array}$
gilmore-lie-groups_F00842	90	1.000	`X_{L}`	X_L	$\begin{array}{c\|ccccc} X_R & 0 & -4X_\eta & 0 & -2X_r & 0 \\ X_L & & 0 & 2X_l & 0 & 0 \\ X_r & & & 0 & -X_\delta & 0 \\ X_l & & & & 0 & 0 \\ X_\delta & & & & & 0 \end{array}$ $\begin{array}{c\|ccccc} & \hat{n} + \frac{1}{2}I & a^\dagger a^\dagger & aa & a^\dagger & a \\ \hline \hat{n} + \frac{1}{2}I & 0 & 2a^\dagger a^\dagger & -2aa & a^\dagger & -a \end{array}$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F00843	90	■ 1.000	`X_{r}`	X_r	
gilmore-lie-groups_F00844	90	■ 1.000	`X_{l}`	X_l	
gilmore-lie-groups_F00845	90	■ 1.000	`X_{\delta}`	X_δ	
gilmore-lie-groups_F00846	90	■ 1.000	`2 X_{R}`	$2X_R$	
gilmore-lie-groups_F00847	90	■ 1.000	`-2 X_{L}`	$-2X_L$	
gilmore-lie-groups_F00848	90	■ 1.000	`-X_{l}`	$-X_l$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F00849	90	1.000	`-4 X_{\eta}`	$-4X_\eta$	
gilmore-lie-groups_F00850	90	1.000	`-2 X_{r}`	$-2X_r$	
gilmore-lie-groups_F00851	90	1.000	`2 X_{l}`	$2X_l$	
gilmore-lie-groups_F00852	90	1.000	`-X_{\delta}`	$-X_\delta$	
gilmore-lie-groups_F00853	90	0.600	`\hat{n}+\frac{1}{2} I`	$\hat{n}+\frac{1}{2}I$	
gilmore-lie-groups_F00854	90	0.600	`a^{\dagger} a^{\dagger}`	$a^\dagger a^\dagger$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F00855	90	0.600	`a a`	aa	
gilmore-lie-groups_F00856	90	0.600	`2 a^{\dagger} a^{\dagger}`	$2a^{\dagger}a^{\dagger}$	
gilmore-lie-groups_F00857	90	0.600	`-2 a a`	$-2aa$	
gilmore-lie-groups_F00858	90	0.600	`-a`	$-a$	
gilmore-lie-groups_F00859	90	0.600	`-4\left(\hat{n}+\frac{1}{2} I\right)`	$-4\left(\hat{n}+\frac{1}{2}I\right)$	
gilmore-lie-groups_F00860	90	0.600	`-2 a^{\dagger}`	$-2a^{\dagger}$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F00861	90	0.600	`2 a`	$2a$	aa 0 $2a$ 0 0 $a^\dagger$ 0 $-I$ 0 a 0 0 I 0 ble inherits the antisymmetry of the commutator, so only one h ited. It is clear that there is an isomorphism between this ma e algebra of the photon energy operator $\hat{n} = a^\dagger a + \frac{1}{2}$, two-pho
gilmore-lie-groups_F00862	90	0.600	`-I`	$-I$	aa 0 $2a$ 0 0 $a^\dagger$ 0 $-I$ 0 a 0 0 I 0 ble inherits the antisymmetry of the commutator, so only one h ited. It is clear that there is an isomorphism between this ma e algebra of the photon energy operator $\hat{n} = a^\dagger a + \frac{1}{2}$, two-pho
gilmore-lie-groups_F00863	90	1.000	`\hat{n}=a^{\dagger} a+\frac{1}{2}`	$\hat{n} = a^\dagger a + \frac{1}{2}$	
gilmore-lie-groups_F00864	91	0.996	`I=\left[a, a^{\dagger}\right]`	$I = \left[a, a^\dagger\right]$	operators $a^\dagger$ and a, and the identity operator $I = [a, a^\dagger]$. We observe that the 4×4
gilmore-lie-groups_F00865	91	0.887	`\mathfrak{s o l}(n)=\mathfrak{u t}(1,1,1, \ldots, 1)`	$\mathfrak{sol}(n) = \mathfrak{ut}(1, 1, 1, \ldots, 1)$	its parent group. A very useful four-parameter subalgebra of $\mathfrak{ut}(1, 1, 1)$ is given by
gilmore-lie-groups_F00866	91	1.000	`\mathfrak{u t}(1,1,1)`	$\mathfrak{ut}(1, 1, 1)$	matrices of the following form
gilmore-lie-groups_F00867	91	0.936	`\mathfrak{n i l}(n)`	$\mathfrak{nil}(n)$	erators of the algebra of nilpotent 3×3 matrices have structure and commutation
gilmore-lie-groups_F00868	91	1.000	`\eta=0`	$\eta = 0$	ter 3 (see (3.13)) consists of matrices having the form shown in Fig. 5.1.
gilmore-lie-groups_F00869	91	1.000	`\mathfrak{a}(p, q)`	$\mathfrak{a}(p, q)$	
gilmore-lie-groups_F00870	92	0.998	`O(3)`	$O(3)$	$\begin{bmatrix} 0 & \theta_3 & -\theta_2 \end{bmatrix}$
gilmore-lie-groups_F00871	92	0.998	`U(2)`	$U(2)$	$\begin{bmatrix} 0 & \theta_3 & -\theta_2 \end{bmatrix}$
gilmore-lie-groups_F00872	92	0.728	`\sigma_{\mu}`	σ_μ	groups satisfy
gilmore-lie-groups_F00873	92	1.000	`\mathfrak{s o}(2,1)`	$\mathfrak{so}(2, 1)$	
gilmore-lie-groups_F00874	93	1.000	`\mathfrak{s o}(3,1)`	$\mathfrak{so}(3, 1)$	By an identical argument the matrix Lie algebra for the Lorentz group $\mathfrak{so}(3, 1)$ is
gilmore-lie-groups_F00875	93	1.000	`M=-G^{-1} M^{\dagger} G`	$M = -G^{-1} M^\dagger G$	$\mathrm{tr}\, M = -\mathrm{tr}\, G^{-1} M^\dagger G = -\mathrm{tr}\, M^\dagger$
gilmore-lie-groups_F00876	93	1.000	`(p+q) \times(p+q)`	$(p+q) \times (p+q)$	$\begin{vmatrix} C & D \end{vmatrix} \begin{vmatrix} \tilde{0} & 0 \end{vmatrix} + \begin{vmatrix} \tilde{0} & 0 \end{vmatrix} \begin{vmatrix} B^\dagger & D^\dagger \end{vmatrix} = \begin{vmatrix} 0 & 0 \end{vmatrix}$
gilmore-lie-groups_F00877	93	0.983	`\left[\begin{array}{ll}g & 0 \\ 0 & 0\end{array}\right]`	$\begin{bmatrix} g & 0 \\ 0 & 0 \end{bmatrix}$	$\rightarrow A\sigma + \sigma A^\dagger = 0 \quad C = C^\dagger = 0 \quad B$
gilmore-lie-groups_F00878	93	0.983	`\operatorname{det}(g) \neq 0`	$\det(g) \neq 0$	$\rightarrow A\sigma + \sigma A^\dagger = 0 \quad C = C^\dagger = 0 \quad B$
gilmore-lie-groups_F00879	93	1.000	`\operatorname{diag}(1,1,1,0)`	$\mathrm{diag}(1, 1, 1, 0)$	$\begin{vmatrix} \tilde{0} \end{vmatrix}$

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gilmore-lie-groups_F00880	94	1.000	`\theta_{i}`	θ_i	Here the parameters θ_i describe rotations about the ith coordinate axis and the
gilmore-lie-groups_F00881	94	1.000	`s_{4}`	s_4	parameter s_4 describes "scaling" of the time axis: $t' = e^{s_4}t$. If s_4 is set to zero
gilmore-lie-groups_F00882	94	1.000	`t^{\prime}=e^{s_{4}} t`	$t' = e^{s_4}t$	parameter s_4 describes "scaling" of the time axis: $t' = e^{s_4}t$. If s_4 is set to zero
gilmore-lie-groups_F00883	94	1.000	`E(3)=I S O(3)`	$E(3) = ISO(3)$	Euclidean group $E(3) = ISO(3)$ (inhomogeneous rotation group in R^3). The matrix Lie algebra for the Poincaré group $ISO(3,1)$ (3.26) is obt
gilmore-lie-groups_F00884	94	0.981	`I S O(3,1)(3.26)`	$ISO(3,1)(3.26)$	similar arguments using a singular 5×5 metric $G = \mathrm{diag}(1,1,1,-1,0)$. The Lie
gilmore-lie-groups_F00885	94	0.837	`5 \times 5`	5×5	algebra is (setting the trace equal to zero):
gilmore-lie-groups_F00886	94	0.837	`G=\operatorname{diag}(1,1,1,-1,0)`	$G = \mathrm{diag}(1,1,1,-1,0)$	algebra is (setting the trace equal to zero):
gilmore-lie-groups_F00887	94	0.988	`I S O(3,1)`	$ISO(3,1)$	$\begin{vmatrix} 0 & \theta_3 & -\theta_2 & v_1 & t_1 \end{vmatrix}$
gilmore-lie-groups_F00888	94	1.000	`\mathfrak{s u}(n)`	$\mathfrak{su}(n)$	
gilmore-lie-groups_F00889	94	1.000	`\mathfrak{u}(n)`	$\mathfrak{u}(n)$	
gilmore-lie-groups_F00890	94	1.000	`\mathfrak{s l}(n ; \mathbb{C})`	$\mathfrak{sl}(n;\mathbb{C})$	
gilmore-lie-groups_F00891	95	1.000	`M_{i j}(i<j)(M \in \mathfrak{u}(n))`	$M_{ij}(i < j)(M \in \mathfrak{u}(n))$	diagonal of M by a 2×2 real matrix, and each of the diagonal matrix elements
gilmore-lie-groups_F00892	95	0.588	`M_{i i}`	M_{ii}	b arbitrary in Eq. (3.3)). The matrix elements M_{ij} below the diagonal $(i > j)$
gilmore-lie-groups_F00893	95	0.761	`M_{i j}`	M_{ij}	are obtained from the antihermiticity condition. The result is a real antisymmetric
gilmore-lie-groups_F00894	95	0.761	`(i>j)`	$(i > j)$	are obtained from the antihermiticity condition. The result is a real antisymmetric
gilmore-lie-groups_F00895	95	0.999	`\mathfrak{u}(n) \rightarrow \mathfrak{o u}(2 n) \subset \mathfrak{o}(2 n)`	$\mathfrak{u}(n) \rightarrow \mathfrak{ou}(2n) \subset \mathfrak{o}(2n)$	is the dimension of $\mathfrak{u}(n)$: $2 \times n(n-1)/2 + 1 \times n = n^2$.
gilmore-lie-groups_F00896	95	0.999	`\mathfrak{o} \mathfrak{u}(2 n)`	$\mathfrak{ou}(2n)$	is the dimension of $\mathfrak{u}(n)$: $2 \times n(n-1)/2 + 1 \times n = n^2$.
gilmore-lie-groups_F00897	95	0.640	`\mathcal{u}(n): 2 \times n(n-1) / 2+1 \times n=n^{2}`	$\sqcap(n) : 2 \times n(n-1)/2 + 1 \times n = n^2$	The Lie algebra of $Sp(n)$ consists of $n \times n$ antiherm
gilmore-lie-groups_F00898	95	0.914	`S p(n)`	$Sp(n)$	$M \in \mathfrak{sp}(n) \Rightarrow (M^\dagger)_{ij} = -M^*_{ji}$ (5.31)
gilmore-lie-groups_F00899	95	0.791	`\operatorname{Sp}(n)`	$\mathrm{Sp}(n)$	plex matrix, and each of the diagonal matrix elements M_{ii} by a complex 2×2
gilmore-lie-groups_F00900	95	0.712	`M_{i j}(i<j)(M \in \mathfrak{s p}(n))`	$M_{ij}(i < j)(M \in \mathfrak{sp}(n))$	matrix representing an imaginary quaternion ($q_0 = 0, q_i$ arbitrary in Eq. (3.4)). The
gilmore-lie-groups_F00901	95	0.998	`q_{0}=0, q_{i}`	$q_0 = 0, q_i$	ity condition. The result is a real antihermitian $2n \times 2n$ matrix with the property $\mathfrak{sp}(n) \rightarrow \mathfrak{usp}(2n) \subset \mathfrak{su}(2n)$. The dimension of $\mathfrak{usp}(2n)$ is the dimension of $\mathfrak{sp}(n)$:
gilmore-lie-groups_F00902	95	0.615	`i>j`	$i > j$	$\mathfrak{sp}(n) \rightarrow \mathfrak{usp}(2n) \subset \mathfrak{su}(2n)$. The dimension of $\mathfrak{usp}(2n)$ is the dimension of $\mathfrak{sp}(n)$: $4 \times n(n-1)/2 + n \times 3 = 2n(2n+1)/2$.
gilmore-lie-groups_F00903	95	1.000	`\mathfrak{s p}(n) \rightarrow \mathfrak{u s p}(2 n) \subset \mathfrak{s u}(2 n)`	$\mathfrak{sp}(n) \rightarrow \mathfrak{usp}(2n) \subset \mathfrak{su}(2n)$	**5.8 Modular groups**
gilmore-lie-groups_F00904	95	1.000	`\mathfrak{u s p}(2 n)`	$\mathfrak{usp}(2n)$	**5.8 Modular groups**
gilmore-lie-groups_F00905	95	1.000	`\mathfrak{s p}(n)`	$\mathfrak{sp}(n)$	**5.8 Modular groups**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F00906	95	1.000	`4 \times n(n-1) / 2+n \times 3=2 n(2 n+1) / 2`	$4 \times n(n-1)/2+n \times 3=2n(2n+1)/2$	The modular group $GL(n;\mathbb{Z})$ has no Lie al
gilmore-lie-groups_F00907	96	0.999	`(X, X)=0 \Rightarrow X=`	$(X, X)=0 \Rightarrow X=$	is usually very useful. This inner product is positive–definite: $(X, X)=0 \Rightarrow X=$
gilmore-lie-groups_F00908	96	0.949	`X, X^{\prime}`	$X, X^{\prime}$	0. For example, for the algebra $\mathfrak{so}(2,1)$ (Eq. (5.18)), if X, X' are two 3×3 matrices
gilmore-lie-groups_F00909	96	0.811	`(X, Y)`	(X, Y)	many instances it is very convenient to use the defining matrix representation of
gilmore-lie-groups_F00910	97	1.000	`\exp (\theta X)`	$\exp(\theta X)$	In the compact case, the group element $\exp(\theta X)$ periodically returns to the identity
gilmore-lie-groups_F00911	97	1.000	`-\pi \leq \theta \leq+\pi`	$-\pi \leq \theta \leq+\pi$	parameter values: $-\pi \leq \theta \leq+\pi$, with $-\pi$ and $+\pi$ identified. On the other hand, in
gilmore-lie-groups_F00912	97	1.000	`-\pi`	$-\pi$	parameter values: $-\pi \leq \theta \leq+\pi$, with $-\pi$ and $+\pi$ identified. On the other hand, in
gilmore-lie-groups_F00913	97	1.000	`+\pi`	$+\pi$	parameter values: $-\pi \leq \theta \leq+\pi$, with $-\pi$ and $+\pi$ identified. On the other hand, in
gilmore-lie-groups_F00914	97	1.000	`-\infty<\theta<+\infty`	$-\infty<\theta<+\infty$	the noncompact case the group is parameterized by the entire line $-\infty<\theta<+\infty$.
gilmore-lie-groups_F00915	97	1.000	`S^{1}`	S^{1}	The underlying manifolds for the two groups are the circle S^1 and the line R^1. In the compact case the simplification of parameterizing the group with a bounded
gilmore-lie-groups_F00916	97	1.000	`R^{k}`	R^{k}	generators, to parameterize this piece of the group. This piece of the group is
gilmore-lie-groups_F00917	97	1.000	`G=I_{n}, I_{p, q}`	$G=I_{n}, I_{p, q}$	
gilmore-lie-groups_F00918	97	0.989	`(A, A)=`	$(A, A)=$	$\begin{bmatrix} 0 & 0 & -b \end{bmatrix} X_a$
gilmore-lie-groups_F00919	97	1.000	`\operatorname{tr}(A)^{2}=a^{2}+c^{2}`	$\operatorname{tr}(A)^{2}=a^{2}+c^{2}$	
gilmore-lie-groups_F00920	97	1.000	`\mathfrak{u t}(1,1)`	$\mathfrak{u t}(1,1)$	$\begin{bmatrix} 0 & 0 & a-c \end{bmatrix} X_b$
gilmore-lie-groups_F00921	98	1.000	`(A, A)=\operatorname{tr} R(A)^{2}=(a-c)^{2}`	$(A, A)=\operatorname{tr} R(A)^{2}=(a-c)^{2}$	inner product in the regular representation is $(A, A)=\operatorname{tr} R(A)^{2}=(a-c)^{2}$. The inner
gilmore-lie-groups_F00922	98	0.998	`X_{a}+X_{c}`	$X_{a}+X_{c}$	product in the regular representation suggests that the linear combination X_a+X_c
gilmore-lie-groups_F00923	98	1.000	`\mathfrak{g l}(1 ; \mathbb{R}) \subset \mathfrak{g l}(1 ; \mathbb{C}) \subset \mathfrak{g l}(1 ; \mathbb{Q})`	$\mathfrak{g l}(1;\mathbb{R}) \subset \mathfrak{g l}(1;\mathbb{C}) \subset \mathfrak{g l}(1;\mathbb{Q})$	5. Write down the algebra inclusions $\mathfrak{gl}(1;\mathbb{R}) \subset \mathfrak{gl}(1;\mathbb{C}) \subset \mathfrak{gl}(1;\mathbb{Q})$ explicitly in terms of the 2×2 complex matrices as defined in (3.3) and (3.4).
gilmore-lie-groups_F00924	98	1.000	`X_{\eta}, X_{r}, X_{l}, X_{\delta}`	$X_{\eta}, X_{r}, X_{l}, X_{\delta}$	isomorphic. The photon number operator is $\hat{n}=a^{\dagger} a$ and the photon energy operator
gilmore-lie-groups_F00925	98	1.000	`\hat{E}=\left(a^{\dagger} a+\frac{1}{2}\right) \hbar \omega \rightarrow a^{\dagger} a+\frac{1}{2}`	$\hat{E}=\left(a^{\dagger} a+\frac{1}{2}\right) \hbar \omega \rightarrow a^{\dagger} a+\frac{1}{2}$	5. **Cartan decomposition** Assume a matrix I
gilmore-lie-groups_F00926	98	1.000	`\hbar \omega=1`	$\hbar \omega=1$	5. **Cartan decomposition** Assume a matrix I
gilmore-lie-groups_F00927	98	1.000	`X, X^{\prime} \in \mathfrak{h}`	$X, X^{\prime} \in \mathfrak{h}$	6. Show that an inner product for the Cartan decomposition given in the previous problem
gilmore-lie-groups_F00928	98	1.000	`Y, Y^{\prime} \in \mathfrak{p}`	$Y, Y^{\prime} \in \mathfrak{p}$	6. Show that an inner product for the Cartan decomposition given in the previous problem
gilmore-lie-groups_F00929	98	1.000	`\left[X, X^{\prime}\right] \in \mathfrak{h},[X, Y] \in \mathfrak{p},\left[Y, Y^{\prime}\right] \in \mathfrak{h}`	$\left[X, X^{\prime}\right] \in \mathfrak{h},[X, Y] \in \mathfrak{p},\left[Y, Y^{\prime}\right] \in \mathfrak{h}$	6. Show that an inner product for the Cartan decomposition given in the previous problem
gilmore-lie-groups_F00930	98	1.000	`\mathfrak{h}`	$\mathfrak{h}$	6. Show that an inner product for the Cartan decomposition given in the previous problem is
gilmore-lie-groups_F00931	98	1.000	`\mathfrak{p}`	$\mathfrak{p}$	6. Show that an inner product for the Cartan decomposition given in the previous problem is

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gilmore-lie-groups_F00932	98	0.995	`X=\left[\begin{array}{cc}A & 0 \\ 0 & D\end{array}\right] \in \mathfrak{h}`	$X = \left[\begin{array}{cc}A & 0 \\ 0 & D\end{array}\right] \in \mathfrak{h}$	Show that X and Y are orthogonal under
gilmore-lie-groups_F00933	98	0.995	`Y=\left[\begin{array}{cc}0 & B \\ C & 0\end{array}\right] \in \mathfrak{p}`	$Y = \left[\begin{array}{cc}0 & B \\ C & 0\end{array}\right] \in \mathfrak{p}$	Show that X and Y are orthogonal under
gilmore-lie-groups_F00934	98	1.000	`(X, Y)=0`	$(X, Y)=0$	• $(X, X) \leq 0, \quad (X, X)=0 \Rightarrow X=0$
gilmore-lie-groups_F00935	98	0.970	`\mathfrak{s o}(p, q)`	$\mathfrak{so}(p, q)$	• $(Y, Y) \geq 0, \quad (Y, Y)=0 \Rightarrow Y=0$
gilmore-lie-groups_F00936	98	0.970	`\left[\begin{array}{cc}A & B \\ B^{t} & C\end{array} \right]`	$\left[\begin{array}{cc}A & B \\ B^{t} & C\end{array} \right]$	• $(Y, Y) \geq 0, \quad (Y, Y)=0 \Rightarrow Y=0$
gilmore-lie-groups_F00937	98	0.970	`p \times p`	$p \times p$	• $(Y, Y) \geq 0, \quad (Y, Y)=0 \Rightarrow Y=0$
gilmore-lie-groups_F00938	98	0.970	`q \times q`	$q \times q$	• $(Y, Y) \geq 0, \quad (Y, Y)=0 \Rightarrow Y=0$
gilmore-lie-groups_F00939	98	0.986	`C^{t}=-C`	$C^{t}=-C$	
gilmore-lie-groups_F00940	98	0.986	`X=\left[\begin{array}{cc}A & 0 \\ 0 & C\end{array}\right] \in \mathfrak{h}`	$X = \left[\begin{array}{cc}A & 0 \\ 0 & C\end{array}\right] \in \mathfrak{h}$	
gilmore-lie-groups_F00941	98	0.986	`Y=\left[\begin{array}{cc}0 & B \\ B^{t} & 0\end{array} \right] \in \mathfrak{p}`	$Y = \left[\begin{array}{cc}0 & B \\ B^{t} & 0\end{array} \right] \in \mathfrak{p}$	
gilmore-lie-groups_F00942	98	0.988	`(X, X) \leq 0, \quad(X, X)=0 \Rightarrow X=0`	$(X, X) \leq 0, \quad (X, X)=0 \Rightarrow X=0$	
gilmore-lie-groups_F00943	98	1.000	`(Y, Y) \geq 0, \quad(Y, Y)=0 \Rightarrow Y=0`	$(Y, Y) \geq 0, \quad (Y, Y)=0 \Rightarrow Y=0$	
gilmore-lie-groups_F00944	99	0.818	`\mathfrak{s u}(p, q)`	$\mathfrak{su}(p, q)$	8. The Lie algebra $\mathfrak{su}(p, q)$ has the structure $\left[\begin{array}{c}A \\ B^{\dagger} \\ C\end{array}\right]$ where the $p \times p$ and $q \times q$ matrices A and C satisfy $A^{\dagger}=-A$, $C^{\dagger}=-C$, and $\operatorname{tr}(A+C)=0$. If $X=\left[\begin{array}{cc}A & 0 \\ 0 & C\end{array}\right] \in \mathfrak{h}$ and
gilmore-lie-groups_F00945	99	0.818	`\left[\begin{array}{c}A \\ B^{\dagger} \\ C\end{array} \right]`	$\left[\begin{array}{c}A \\ B^{\dagger} \\ C\end{array} \right]$	8. The Lie algebra $\mathfrak{su}(p, q)$ has the structure $\left[\begin{array}{c}A \\ B^{\dagger} \\ C\end{array}\right]$ where the $p \times p$ and $q \times q$ matrices A and C satisfy $A^{\dagger}=-A$, $C^{\dagger}=-C$, and $\operatorname{tr}(A+C)=0$. If $X=\left[\begin{array}{cc}A & 0 \\ 0 & C\end{array}\right] \in \mathfrak{h}$ and
gilmore-lie-groups_F00946	99	0.999	`A^{\dagger}=-A, C^{\dagger}=-C`	$A^{\dagger}=-A, C^{\dagger}=-C$	A and C satisfy $A^{\dagger}=-A$, $C^{\dagger}=-C$, and $\operatorname{tr}(A+C)=0$. If $X=\left[\begin{array}{cc}A & 0 \\ 0 & C\end{array}\right] \in \mathfrak{h}$ and $Y=\left[\begin{array}{cc}0 & B \\ B^{\dagger} & 0\end{array}\right] \in \mathfrak{p}$, then show once again that
gilmore-lie-groups_F00947	99	0.999	`\operatorname{tr}(A+C)=0`	$\operatorname{tr}(A+C)=0$	A and C satisfy $A^{\dagger}=-A$, $C^{\dagger}=-C$, and $\operatorname{tr}(A+C)=0$. If $X=\left[\begin{array}{cc}A & 0 \\ 0 & C\end{array}\right] \in \mathfrak{h}$ and $Y=\left[\begin{array}{cc}0 & B \\ B^{\dagger} & 0\end{array}\right] \in \mathfrak{p}$, then show once again that
gilmore-lie-groups_F00948	99	1.000	`Y=\left[\begin{array}{cc}0 & B \\ B^{\dagger} & 0 \end{array}\right] \in \mathfrak{p}`	$Y = \left[\begin{array}{cc}0 & B \\ B^{\dagger} & 0\end{array}\right] \in \mathfrak{p}$	
gilmore-lie-groups_F00949	99	1.000	`(X, X)=0 \Rightarrow X=0`	$(X, X)=0 \Rightarrow X=0$	The Lie algebra for $\mathfrak{sl}(n ; \mathbb{R})$ has a decomposition in terms of real
gilmore-lie-groups_F00950	99	1.000	`(Y, Y)=0 \Rightarrow Y=0`	$(Y, Y)=0 \Rightarrow Y=0$	The Lie algebra for $\mathfrak{sl}(n ; \mathbb{R})$ has a decomposition in terms of real
gilmore-lie-groups_F00951	99	1.000	`\mathfrak{s l}(n ; \mathbb{R})`	$\mathfrak{sl}(n ; \mathbb{R})$	traceless symmetric matrices $A=A^{t}$ and $B=B^{t}$ with $\operatorname{tr} B=0$.
gilmore-lie-groups_F00952	99	1.000	`B^{t}=B`	$B^{t}=B$	$\mathfrak{sl}(n ; \mathbb{R})=A+B$
gilmore-lie-groups_F00953	99	1.000	`\operatorname{tr} B=0`	$\operatorname{tr} B=0$	$\mathfrak{sl}(n ; \mathbb{R})=A+B$
gilmore-lie-groups_F00954	99	1.000	`(A, A)=0 \Rightarrow A=0`	$(A, A)=0 \Rightarrow A=0$	matrices $A^{\dagger}=-A$ and traceless hermitian matrices $H^{\dagger}=H$:
gilmore-lie-groups_F00955	99	1.000	`(B, B)=0 \Rightarrow B=0`	$(B, B)=0 \Rightarrow B=0$	matrices $A^{\dagger}=-A$ and traceless hermitian matrices $H^{\dagger}=H$:
gilmore-lie-groups_F00956	99	1.000	`A^{\dagger}=-A`	$A^{\dagger}=-A$	$\mathfrak{g} = \mathfrak{h} + \mathfrak{p}$

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gilmore-lie-groups_F00957	99	1.000	`H^{\dagger}=H`	$H^{\dagger} = H$	$\mathfrak{g} = \mathfrak{h} + \mathfrak{p}$
gilmore-lie-groups_F00958	99	1.000	`(H, H)=0 \Rightarrow H=0`	$(H, H) = 0 \Rightarrow H = 0$	$[\mathfrak{h}, \mathfrak{h}] \subseteq \mathfrak{h}$ $(\mathfrak{h}, \mathfrak{h}) \leq 0$
gilmore-lie-groups_F00959	99	1.000	`\mathfrak{g}=\mathfrak{h}+\mathfrak{p}`	$\mathfrak{g} = \mathfrak{h} + \mathfrak{p}$	$[\mathfrak{p}, \mathfrak{p}] \subseteq \mathfrak{h}$ $(\mathfrak{p}, \mathfrak{p}) \geq 0$
gilmore-lie-groups_F00960	100	1.000	`\mathfrak{g}^{\prime}=\mathfrak{h}+i \mathfrak{p}= \mathfrak{h}+\mathfrak{p}^{\prime}`	$\mathfrak{g}' = \mathfrak{h} + i\mathfrak{p} = \mathfrak{h} + \mathfrak{p}'$	defined by $\mathfrak{g}' = \mathfrak{h} + i\mathfrak{p} = \mathfrak{h} + \mathfrak{p}'$ t
gilmore-lie-groups_F00961	100	1.000	`\mathfrak{g}=\mathfrak{s l}(n ; \mathbb{Q})`	$\mathfrak{g} = \mathfrak{sl}(n; \mathbb{Q})$	13 A matrix Lie algebra has the form
gilmore-lie-groups_F00962	100	1.000	`\mathfrak{h}=\mathfrak{s l}(n ; \mathbb{C})`	$\mathfrak{h} = \mathfrak{sl}(n; \mathbb{C})$	13 A matrix Lie algebra has the form
gilmore-lie-groups_F00963	100	0.817	`\mu`	μ	-1 -1 $\mathfrak{so}(5)$ $+1$ 0 Poincare translations t_μ 0 0 Galilei translations t_μ, boosts $\mathbf{b}$ t $\mathfrak{g} = A$, where A is a Lie algebra of $n \times n$ matrices is negative-definite: tr $A^2 \leq 0$, $= 0 \Rightarrow A = 0$. Then sl ıy neighborhood of the identity I_n if t becomes large en
gilmore-lie-groups_F00964	100	0.817	`\sigma`	σ	-1 -1 $\mathfrak{so}(5)$ $+1$ 0 Poincare translations t_μ 0 0 Galilei translations t_μ, boosts $\mathbf{b}$ t $\mathfrak{g} = A$, where A is a Lie algebra of $n \times n$ matrices is negative-definite: tr $A^2 \leq 0$, $= 0 \Rightarrow A = 0$. Then sl ıy neighborhood of the identity I_n if t becomes large en
gilmore-lie-groups_F00965	100	0.817	`\mathfrak{s} \mathfrak{o}(3,2)`	$\mathfrak{so}(3, 2)$	-1 -1 $\mathfrak{so}(5)$ $+1$ 0 Poincare translations t_μ 0 0 Galilei translations t_μ, boosts $\mathbf{b}$ t $\mathfrak{g} = A$, where A is a Lie algebra of $n \times n$ matrices is negative-definite: tr $A^2 \leq 0$, $= 0 \Rightarrow A = 0$. Then sl ıy neighborhood of the identity I_n if t becomes large en
gilmore-lie-groups_F00966	100	0.817	`\mathfrak{s} \mathfrak{o}(4,1)`	$\mathfrak{so}(4, 1)$	-1 -1 $\mathfrak{so}(5)$ $+1$ 0 Poincare translations t_μ 0 0 Galilei translations t_μ, boosts $\mathbf{b}$ t $\mathfrak{g} = A$, where A is a Lie algebra of $n \times n$ matrices is negative-definite: tr $A^2 \leq 0$, $= 0 \Rightarrow A = 0$. Then sl ıy neighborhood of the identity I_n if t becomes large en
gilmore-lie-groups_F00967	100	0.817	`\mathfrak{s} \mathfrak{o}(5)`	$\mathfrak{so}(5)$	-1 -1 $\mathfrak{so}(5)$ $+1$ 0 Poincare translations t_μ 0 0 Galilei translations t_μ, boosts $\mathbf{b}$ t $\mathfrak{g} = A$, where A is a Lie algebra of $n \times n$ matrices is negative-definite: tr $A^2 \leq 0$, $= 0 \Rightarrow A = 0$. Then sl ıy neighborhood of the identity I_n if t becomes large en
gilmore-lie-groups_F00968	100	0.817	`t_{\mu}`	t_μ	-1 -1 $\mathfrak{so}(5)$ $+1$ 0 Poincare translations t_μ 0 0 Galilei translations t_μ, boosts $\mathbf{b}$ t $\mathfrak{g} = A$, where A is a Lie algebra of $n \times n$ matrices is negative-definite: tr $A^2 \leq 0$, $= 0 \Rightarrow A = 0$. Then sl ıy neighborhood of the identity I_n if t becomes large en

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gilmore-lie-groups_F00969	100	1.000	`\mathfrak{g}=A`	$\mathfrak{g} = A$	values of A are rationally related ($\lambda_i = \gamma n_i$, n_i are integers, $\gamma \neq 0$ is rational or
gilmore-lie-groups_F00970	100	1.000	`\operatorname{tr} A^{2} \leq 0,=0 \Rightarrow A=0`	$\operatorname{tr} A^{2} \leq 0, = 0 \Rightarrow A = 0$	irrational), $\mathrm{EXP}(tA)$ returns periodically to I_n. What is t_0, the minimum period in t?
gilmore-lie-groups_F00971	100	1.000	`\operatorname{EXP}(t A)`	$\operatorname{EXP}(tA)$	irrational), $\mathrm{EXP}(tA)$ returns periodically to I_n. What is t_0, the minimum period in t?
gilmore-lie-groups_F00972	100	1.000	`t`	t	15. Use the parameterization of $\mathfrak{so}(3)$ given in Problem 3.14. Show that the differentials
gilmore-lie-groups_F00973	100	1.000	`\lambda_{i}=\gamma n_{i}, n_{i}`	$\lambda_i = \gamma n_i, n_i$	(dx, dy, dz) of a point in the neighborhood of (x, y, z) are related to the displacements
gilmore-lie-groups_F00974	100	1.000	`\gamma \neq 0`	$\gamma \neq 0$	(dx, dy, dz) of a point in the neighborhood of (x, y, z) are related to the displacements
gilmore-lie-groups_F00975	100	1.000	`t_{0}`	t_0	$(\delta x, \delta y, \delta z)$ in the neighborhood of the identity by
gilmore-lie-groups_F00976	100	0.979	`\mathfrak{s o}(3)`	$\mathfrak{so}(3)$	
gilmore-lie-groups_F00977	100	1.000	`(\delta x, \delta y, \delta z)`	$(\delta x, \delta y, \delta z)$	
gilmore-lie-groups_F00978	100	1.000	`g(x, y, z)`	$g(x, y, z)$	
gilmore-lie-groups_F00979	100	1.000	`d \mu(x, y, z)`	$d\mu(x, y, z)$	
gilmore-lie-groups_F00980	101	1.000	`(\mathfrak{g} \cap \mathfrak{h}=\mathfrak{h}, \mathfrak{g} \cap \mathfrak{p}=\mathfrak{p})`	$(\mathfrak{g} \cap \mathfrak{h} = \mathfrak{h}, \mathfrak{g} \cap \mathfrak{p} = \mathfrak{p})$	exist in the algebra $(\mathfrak{g} \cap \mathfrak{h} = \mathfrak{h}, \mathfrak{g} \cap \mathfrak{p} = \mathfrak{p})$,
gilmore-lie-groups_F00981	102	0.987	`b_{i}^{\dagger}`	$b_i^{\dagger}$	$[b_i, b_j^{\dagger}] = I\delta_{ij}$ (6.1)
gilmore-lie-groups_F00982	102	0.987	`b_{j}`	b_j	$[b_i, b_j^{\dagger}] = I\delta_{ij}$ (6.1)
gilmore-lie-groups_F00983	102	0.971	`\left[b_{i}, b_{j}\right],\left[b_{i}^{\dagger}, b_{j}^{\dagger}\right],\left[b_{i}, I\right],\left[b_{j}^{\dagger}, I\right]`	$\left[b_i, b_j\right], \left[b_i^{\dagger}, b_j^{\dagger}\right], \left[b_i, I\right], \left[b_j^{\dagger}, I\right]$	operators:
gilmore-lie-groups_F00984	102	1.000	`\mathcal{A}`	$\mathcal{A}$	$A \Rightarrow \mathcal{A} = b^{\dagger} A b = \sum_i \sum_j b_i^{\dagger} A_{ij} b_j$ (6.2)
gilmore-lie-groups_F00985	103	1.000	`[A, B]=C`	$[A, B] = C$	where $[A, B] = C$. This argument is invertible. An algebra of operators bilinear in
gilmore-lie-groups_F00986	103	0.999	`2 n+1`	$2n + 1$	**Remark** The $2n + 1$ operators $b_i^{\dagger}, b_j, I$ $(1 \leq i, j \leq n)$ span the Heisenberg algebra.
gilmore-lie-groups_F00987	103	0.999	`b_{i}, b_{j}^{\dagger}, I(1 \leq i, j \leq n)`	$b_i, b_j^{\dagger}, I(1 \leq i, j \leq n)$	**Remark** The $2n + 1$ operators $b_i^{\dagger}, b_j, I$ $(1 \leq i, j \leq n)$ span the Heisenberg algebra.
gilmore-lie-groups_F00988	103	1.000	`X_{i j}`	X_{ij}	$[X_{ij}, X_{rs}] = X_{is}\delta_{jr} - X_{rj}\delta_{si}$ (6
gilmore-lie-groups_F00989	103	1.000	`b_{i}^{\dagger} b_{j}`	$b_i^{\dagger} b_j$	$A \Rightarrow \mathcal{A} = \sum_{ij} A_{ij} X_{ij}$
gilmore-lie-groups_F00990	103	0.970	`f_{i}^{\dagger}`	$f_i^{\dagger}$	$[f_i, f_j^{\dagger}] = f_i f_j^{\dagger} + f_j^{\dagger} f_i = I\delta_{ij}$ (6.9)
gilmore-lie-groups_F00991	103	0.970	`f_{j}`	f_j	$[f_i, f_j^{\dagger}] = f_i f_j^{\dagger} + f_j^{\dagger} f_i = I\delta_{ij}$ (6.9)
gilmore-lie-groups_F00992	103	1.000	`\left\{f_{i}, f_{j}\right\},\left\{f_{i}^{\dagger}, f_{j}^{\dagger}\right\}`	$\left\{f_i, f_j\right\}, \left\{f_i^{\dagger}, f_j^{\dagger}\right\}$	$[f_i^{\dagger} f_j, f_r^{\dagger} f_s] = f_i^{\dagger} f_j f_r^{\dagger} f_s - f_r^{\dagger} f_s f_i^{\dagger} f_j$
gilmore-lie-groups_F00993	104	1.000	`S U(n)`	$SU(n)$	construction of the symmetric representations of $U(n)$. The mapping to a fermion

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gilmore-lie-groups_F00994	104	1.000	`\mathcal{L}_{1}=x_{2} \partial_{3}-x_{3} \partial_{2}, \mathcal{L}_{2}=x_{3} \partial_{1}-x_{1} \partial_{3}, \mathcal{L}_{3}=x_{1} \partial_{2}-x_{2} \partial_{1}`	$\mathcal{L}_1 = x_2\partial_3 - x_3\partial_2, \mathcal{L}_2 = x_3\partial_1 - x_1\partial_3, \mathcal{L}_3 = x_1\partial_2 - x_2\partial_1$	where L_i are 3×3 matrices and $\mathcal{L}_i$ are first order differential operators.
gilmore-lie-groups_F00995	104	0.705	`L_{i}`	L_i	
gilmore-lie-groups_F00996	104	0.705	`\mathcal{L}_{i}`	$\mathcal{L}_i$	
gilmore-lie-groups_F00997	105	1.000	`E(2)=I S O(2)`	$E(2) = ISO(2)$	As another example, we treat the Lie algebra for the group $E(2) = ISO(2)$ of
gilmore-lie-groups_F00998	105	1.000	`x-y`	$x - y$	rigid motions (translations and rotations) in the x–y plane, whose matrix algebra
gilmore-lie-groups_F00999	105	1.000	`t_{1}`	t_1	operator algebra is
gilmore-lie-groups_F01000	105	1.000	`t_{2}`	t_2	operator algebra is
gilmore-lie-groups_F01001	105	1.000	`\mathcal{L}_{z}=x_{1} \partial_{2}-x_{2} \partial_{1}`	$\mathcal{L}_z = x_1\partial_2 - x_2\partial_1$	Differential operator realizations of Lie algebras come about in a natural way.
gilmore-lie-groups_F01002	105	1.000	`\mathcal{T}_{i}=\partial_{i}`	$\mathcal{T}_i = \partial_i$	Differential operator realizations of Lie algebras come about in a natural way.
gilmore-lie-groups_F01003	105	0.867	`(a, b)`	(a, b)	$(a, b) \to \begin{vmatrix} \\ 0 & 1 \end{vmatrix}$
gilmore-lie-groups_F01004	105	1.000	`x(p)`	$x(p)$	
gilmore-lie-groups_F01005	105	1.000	`S^{\prime}`	S'	group transformation
gilmore-lie-groups_F01006	105	1.000	`p, x^{\prime}(p)`	$p, x'(p)$	
gilmore-lie-groups_F01007	105	1.000	`f_{S}`	f_S	$\begin{vmatrix} x \\ 1 \end{vmatrix} = \begin{vmatrix} 1+ad & ab \\ 0 & 1 \end{vmatrix} \begin{vmatrix} x \\ 1 \end{vmatrix}$
gilmore-lie-groups_F01008	105	1.000	`f_{S^{\prime}}`	$f_{S'}$	$\begin{vmatrix} x \\ 1 \end{vmatrix} = \begin{vmatrix} 1+ad & ab \\ 0 & 1 \end{vmatrix} \begin{vmatrix} x \\ 1 \end{vmatrix}$
gilmore-lie-groups_F01009	105	1.000	`x^{\prime}(p)`	$x'(p)$	
gilmore-lie-groups_F01010	106	1.000	`G(x, y)`	$G(x, y)$	
gilmore-lie-groups_F01011	106	1.000	`\left(x^{\prime}, y^{\prime}\right)`	(x', y')	$\begin{vmatrix} 0 & 1 \end{vmatrix} =$
gilmore-lie-groups_F01012	107	1.000	`\mathcal{A}=\sum_{i} \sum_{j} A_{i j} X_{i j}`	$\mathcal{A} = \sum_i \sum_j A_{ij} X_{ij}$	tion relations of the matrix Lie algebra and the operator algebra are isomorphic:
gilmore-lie-groups_F01013	107	1.000	`[A, B]=C \Leftrightarrow[\mathcal{A}, \mathcal{B}]= \mathcal{C}`	$[A, B] = C \Leftrightarrow [\mathcal{A}, \mathcal{B}] = \mathcal{C}$	erators can be replaced by products of exponentials of the corresponding matrices
gilmore-lie-groups_F01014	107	1.000	`e^{A} e^{B}=e^{D} \Leftrightarrow e^{\mathcal{A}} e^{ \mathcal{B}}=e^{\mathcal{D}}`	$e^A e^B = e^D \Leftrightarrow e^{\mathcal{A}} e^{\mathcal{B}} = e^{\mathcal{D}}$	1. Bilinear products involving one creation and on
gilmore-lie-groups_F01015	107	1.000	`a_{i}^{\dagger} a_{j}, 1 \leq i, j \leq 2`	$a_i^\dagger a_j, 1 \leq i, j \leq 2$	commutation relations.
gilmore-lie-groups_F01016	107	1.000	`\hat{n}=a_{1}^{\dagger} a_{1}+a_{2}^{\dagger} a_{2}`	$\hat{n} = a_1^\dagger a_1 + a_2^\dagger a_2$	**c.** These calculations simplify considerably under the operator to matrix mapping
gilmore-lie-groups_F01017	107	1.000	`\hat{n}`	$\hat{n}$	
gilmore-lie-groups_F01018	107	1.000	`a_{1}^{\dagger} a_{1}-a_{2}^{\dagger} a_{2}, a_{1}^{ \dagger} a_{2}`	$a_1^\dagger a_1 - a_2^\dagger a_2, a_1^\dagger a_2$	

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gilmore-lie-groups_F01019	107	1.000	a_{2}^{\dagger} a_{1}	$a_2^\dagger a_1$	$a_1^\dagger a_1 + a_2^\dagger a_2$ $a_1^\dagger a_1$ $a_2^\dagger a_2$ $a_1^\dagger a_2$ $a_2^\dagger a_1$ ↓ ↓ ↓ ↓
gilmore-lie-groups_F01020	108	0.999	\frac{1}{2}\left(a_{1}^{\dagger} a_{1}-a_{2}^{\dagger} a_{2}\right), a_{1}^{\dagger} a_{2}	$\frac{1}{2}\left(a_1^\dagger a_1 - a_2^\dagger a_2\right), a_1^\dagger a_2$	**d.** Show that the three operators $\frac{1}{2}(a_1^\dagger a_1 - a_2^\dagger a_2)$, $a_1^\dagger a_2$, and $a_2^\dagger a_1$ satisfy commutation
gilmore-lie-groups_F01021	108	1.000	J_{z}, J_{ \pm}	$J_z, J_\pm$	$J_z, J_\pm$. In particular, s
gilmore-lie-groups_F01022	108	1.000	J^{2}=J_{x}^{2}+J_{y}^{2}+J_{z}^{2}	$J^2 = J_x^2 + J_y^2 + J_z^2$	and show
gilmore-lie-groups_F01023	108	1.000	i(i=1,2)	$i(i=1,2)$	operators $a_i^\dagger$ and a_i act on state $\|n_i\rangle$ in the usual way:
gilmore-lie-groups_F01024	108	1.000	\left|n_{i}\right\rangle	$\left\|n_i\right\rangle$	operators $a_i^\dagger$ and a_i act on state $\|n_i\rangle$ in the usual way:
gilmore-lie-groups_F01025	108	1.000	n_{i}	n_i	operators $a_i^\dagger$ and a_i act on state $\|n_i\rangle$ in the usual way:
gilmore-lie-groups_F01026	108	1.000	a_{i}^{\dagger}	$a_i^\dagger$	$a_i^\dagger\|n_i\rangle = \sqrt{n_i+1}\,\|n_i+1\rangle$ $a_i\|n$
gilmore-lie-groups_F01027	108	1.000	a_{i}	a_i	$a_i^\dagger\|n_i\rangle = \sqrt{n_i+1}\,\|n_i+1\rangle$ $a_i\|n$
gilmore-lie-groups_F01028	108	1.000	\left|n_{1}\right\rangle \otimes\left|n_{2}\right\rangle= \left|n_{1}, n_{2}\right\rangle	$\left\|n_1\right\rangle \otimes \left\|n_2\right\rangle = \left\|n_1, n_2\right\rangle$	$\|{}_m^{\cdot}\rangle = \|n_1, n_2\rangle$ $j = \frac{1}{2}(n_1+n_2),\ m = \frac{1}{2}(n_1-n_2)$
gilmore-lie-groups_F01029	108	1.000	\left|n_{1}, n_{2}\right\rangle=|j m\rangle	$\left\|n_1, n_2\right\rangle = \|jm\rangle$	**b.** Show that the four operators $a_i^\dagger a_j$ leave invariant the sum $n_1 + n_2$.
gilmore-lie-groups_F01030	108	0.994	\frac{1}{2}\left(a_{1}^{\dagger} a_{1}-a_{2}^{\dagger} a_{2}\right)	$\frac{1}{2}\left(a_1^\dagger a_1 - a_2^\dagger a_2\right)$	**c.** $J^2\|jm\rangle = j(j+1)\|jm\rangle$.
gilmore-lie-groups_F01031	108	0.994	J_{z}	J_z	**c.** $J^2\|jm\rangle = j(j+1)\|jm\rangle$.
gilmore-lie-groups_F01032	108	0.994	a_{1}^{\dagger} a_{2}, a_{2}^{\dagger} a_{1}	$a_1^\dagger a_2, a_2^\dagger a_1$	**c.** $J^2\|jm\rangle = j(j+1)\|jm\rangle$.
gilmore-lie-groups_F01033	108	1.000	J_{+}	J_+	**d.** $J_z\|jm\rangle =$
gilmore-lie-groups_F01034	108	1.000	J_{-}	J_-	**d.** $J_z\|jm\rangle =$
gilmore-lie-groups_F01035	108	1.000	a_{i}^{\dagger} a_{j}	$a_i^\dagger a_j$	**e.** $J_+\|jm\rangle = a_1^\dagger a_2\|n_1, n_2\rangle = \sqrt{n_1+1}\,\sqrt{n_2}\,\|n_1+1, n_2-1\rangle =$
gilmore-lie-groups_F01036	108	1.000	n_{1}+n_{2}	$n_1 + n_2$	**e.** $J_+\|jm\rangle = a_1^\dagger a_2\|n_1, n_2\rangle = \sqrt{n_1+1}\,\sqrt{n_2}\,\|n_1+1, n_2-1\rangle =$
gilmore-lie-groups_F01037	108	1.000	J^{2}|j m\rangle=j(j+1)|j m\rangle	$J^2\|jm\rangle = j(j+1)\|jm\rangle$	$\|j, m+1\rangle\sqrt{j+m+1}$
gilmore-lie-groups_F01038	108	1.000	J_{z}|j m\rangle=m|j m\rangle	$J_z\|jm\rangle = m\|jm\rangle$	$\|j, m-1\rangle$
gilmore-lie-groups_F01039	108	1.000	J_{+}|j m\rangle=a_{1}^{\dagger} a_{2}\left|n_{1}, n_{2}\right\rangle=\sqrt{n_{1}+1} \sqrt{n_{2}}\left|n_{1}+1, n_{2}-1\right\rangle=	$J_+\|jm\rangle = a_1^\dagger a_2\,\|n_1, n_2\rangle = \sqrt{n_1+1}\sqrt{n_2}\,\|n_1+1, n_2-1\rangle =$	**g.** $J_+\|jm\rangle = \|j, m\pm1\rangle\sqrt{(j\pm m+1)(j\mp m)}$. Note that $J_+\|j$
gilmore-lie-groups_F01040	108	0.999	|j, m+1\rangle \sqrt{j+m+1} \sqrt{j-m}	$\|j, m+1\rangle\sqrt{j+m+1}\sqrt{j-m}$	0.
gilmore-lie-groups_F01041	108	1.000	J_{-}|j m\rangle=a_{2}^{\dagger} a_{1}\left|n_{1}, n_{2}\right\rangle=\sqrt{n_{1}} \sqrt{n_{2}+1}\left|n_{1}-1, n_{2}+1\right\rangle=	$J_-\|jm\rangle = a_2^\dagger a_1\,\|n_1, n_2\rangle = \sqrt{n_1}\sqrt{n_2+1}\,\|n_1-1, n_2+1\rangle =$	**h.** $\langle j'm'\|J_\pm\|jm\rangle = \sqrt{(j'\pm m')(j\mp m)}\ \delta_{j'j}\,\delta_{m',m\pm1}$.
gilmore-lie-groups_F01042	108	0.999	|j, m-1\rangle \sqrt{j+m} \sqrt{j-m+1}	$\|j, m-1\rangle\sqrt{j+m}\sqrt{j-m+1}$	3 Basis vectors in the Lie algebra
gilmore-lie-groups_F01043	108	1.000	J_{ \pm}|j m\rangle=|j, m \pm 1\rangle \sqrt{(j \pm m+1)(j \mp m)}	$J_\pm\|jm\rangle = \|j, m\pm1\rangle\sqrt{(j\pm m+1)(j\mp m)}$	that are isomorphic to the commutation relations of the nine boson operators $a_i^\dagger a_i$.

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gilmore-lie-groups_F01044	108	1.000	`J_{+}|j, j\rangle=0, J_{-}|j,-j\rangle=`	$J_+\|j,j\rangle = 0, J_-\|j,-j\rangle =$	that are isomorphic to the commutation relations of the nine boson operators $a_i^\dagger a_i$.
gilmore-lie-groups_F01045	108	1.000	`\left\langle j^{\prime} m^{\prime}\right| J_{ \pm}|j m \rangle=\sqrt{\left(j^{\prime} \pm m^{\prime}\right)(j \mp m)} \delta_{j^{\prime} j} \delta_{m^{\prime}, m \pm 1}`	$\left\langle j^{\prime} m^{\prime}\right\| J_{\pm}\|jm\rangle = \sqrt{\left(j^{\prime} \pm m^{\prime}\right)(j \mp m)} \delta_{j^{\prime} j} \delta_{m^{\prime}, m \pm 1}$	the form $\|n_1, n_2, n_3\rangle = \|n_1\rangle \otimes \|n_2\rangle \otimes \|n_3\rangle$, where fc
gilmore-lie-groups_F01046	108	0.999	`\mathfrak{u}(3)`	$\mathfrak{u}(3)$	
gilmore-lie-groups_F01047	108	0.999	`U(3)`	$U(3)$	
gilmore-lie-groups_F01048	108	1.000	`1 \leq i, j \leq 3`	$1 \leq i, j \leq 3$	
gilmore-lie-groups_F01049	108	1.000	`\left|n_{1}, n_{2}, n_{3}\right\rangle=\left|n_{1} \right\rangle \otimes\left|n_{2}\right\rangle \otimes \left|n_{3}\right\rangle`	$\left\|n_1, n_2, n_3\right\rangle = \left\|n_1\right\rangle \otimes \left\|n_2\right\rangle \otimes \left\|n_3\right\rangle$	
gilmore-lie-groups_F01050	108	1.000	`b_{i}\left|n_{i}\right\rangle=\left|n_{i}-1\right\rangle \sqrt{n_{i}}`	$b_i \left\|n_i\right\rangle = \left\|n_i - 1\right\rangle \sqrt{n_i}$	
gilmore-lie-groups_F01051	109	1.000	`N=\sum_{i=1}^{3} n_{i}`	$N = \sum_{i=1}^{3} n_i$	**b.** Show that the dimension, D, of this representation is $D = (N+3-1)!/N!(3-$ 1)! This is the number of ways three nonnegative integers can be chosen whose
gilmore-lie-groups_F01052	109	1.000	`D=(N+3-1)!/ N!(3-`	$D = (N+3-1)!/N!(3-$	n. D is also the number of monomials of degree N in the Taylor series expansion
gilmore-lie-groups_F01053	109	0.953	`N`	N	. Compute the matrix elements of all operators $b_i^\dagger b_j$ in this representation:
gilmore-lie-groups_F01054	109	0.953	`(n)`	(n)	. Compute the matrix elements of all operators $b_i^\dagger b_j$ in this representation:
gilmore-lie-groups_F01055	109	0.852	`n . D`	$n.D$	$\langle n_1', n_2', n_3' \|b_i^\dagger b_j\|n_1, n_2, n_3\rangle$ (6.31)
gilmore-lie-groups_F01056	109	0.999	`f\left(x_{1}, x_{2}, \ldots, x_{n}\right)`	$f\left(x_1, x_2, \ldots, x_n\right)$	
gilmore-lie-groups_F01057	109	1.000	`I_{D}`	I_D	What is $\mathcal{O}$?
gilmore-lie-groups_F01058	109	1.000	`\mathcal{O}`	$\mathcal{O}$	onstruct oper
gilmore-lie-groups_F01059	109	1.000	`f_{i}^{\dagger} f_{j}`	$f_i^\dagger f_j$	$\begin{vmatrix} a \\ d^\dagger \end{vmatrix} = \begin{vmatrix} A & B \\ C & D \end{vmatrix} \begin{vmatrix} a \\ a^\dagger \end{vmatrix}$
gilmore-lie-groups_F01060	109	1.000	`d, d^{\dagger}`	$d, d^\dagger$	
gilmore-lie-groups_F01061	109	0.996	`a, a^{\dagger}`	$a, a^\dagger$	
gilmore-lie-groups_F01062	110	0.996	`\left[d, d^{\dagger}\right]=1`	$\left[d, d^\dagger\right] = 1$	$[d, d^\dagger] = 1$ and $[d, d] = [d^\dagger, d^\dagger] = 0$, the four matrix elements must satisfy $AD -$
gilmore-lie-groups_F01063	110	0.996	`[d, d]=\left[d^{\dagger}, d^{\dagger}\right]=0`	$[d, d] = \left[d^\dagger, d^\dagger\right] = 0$	$[d, d^\dagger] = 1$ and $[d, d] = [d^\dagger, d^\dagger] = 0$, the four matrix elements must satisfy $AD -$
gilmore-lie-groups_F01064	110	0.996	`A D`	AD	$[d, d^\dagger] = 1$ and $[d, d] = [d^\dagger, d^\dagger] = 0$, the four matrix elements must satisfy $AD -$
gilmore-lie-groups_F01065	110	1.000	`B C=1`	$BC = 1$	BC
gilmore-lie-groups_F01066	110	0.998	`\operatorname{Sp}(2 ; \mathbb{R})=`	$\operatorname{Sp}(2; \mathbb{R}) =$	**D.** Argue that the commutation relations are invariant under the group $Sp(2; \mathbb{R}) =$ $GL(2, \mathbb{R})$.
gilmore-lie-groups_F01067	110	0.982	`\operatorname{Sp}(2 ; \mathbb{R})`	$\operatorname{Sp}(2; \mathbb{R})$	**c.** Show that under $Sp(2; \mathbb{R})$, linear combinations of the coordinate and differential operators x, ∂ preserve the commutation relations. In particular, show that
gilmore-lie-groups_F01068	110	1.000	`x, \partial`	x, ∂	

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gilmore-lie-groups_F01069	110	0.946	`a_{1}, a_{2}, \ldots, a_{n}`	$a_1, a_2, \ldots, a_n$	some linear transformation as given above, with A, B, C, D now $n \times n$ matrices.
gilmore-lie-groups_F01070	110	1.000	`\left|n_{1}, n_{2}, \ldots, n_{N}\right\rangle`	$\left\|n_1, n_2, \ldots, n_N\right\rangle$	counting problem is exact
gilmore-lie-groups_F01071	110	1.000	`\hbar \omega(n+`	$\hbar\omega(n+$	Taylor series expansion of a function of N variables: $f(x_1, x_2, \ldots, x_N)$.
gilmore-lie-groups_F01072	110	0.531	`\frac{N}{2}`	$\frac{N}{2}$	**b.** Show that the symmetry group of this hamiltonian has Lie algebra spanned by the
gilmore-lie-groups_F01073	110	0.531	`\operatorname{deg}(N, n)=(n+N-1)!/ n!(N-1)!`	$\operatorname{deg}(N, n)=(n+N-1)!/n!(N-1)!$	**b.** Show that the symmetry group of this hamiltonian has Lie algebra spanned by the
gilmore-lie-groups_F01074	110	0.999	`f\left(x_{1}, x_{2}, \ldots, x_{N}\right)`	$f\left(x_1, x_2, \ldots, x_N\right)$	this algebra is a direct sum of a simple Lie algebra, $\mathfrak{su}(N)$, plus the one-dim
gilmore-lie-groups_F01075	110	1.000	`N^{2}`	N^2	**c.** If the generators $a_i a_j$ that span the invariance algebra are supplemented with the single creation and annihilation operators $a_i^\dagger$ and a_i, as well as their commutator I,
gilmore-lie-groups_F01076	110	1.000	`\mathfrak{u}(N)`	$\mathfrak{u}(N)$	**c.** If the generators $a_i a_j$ that span the invariance algebra are supplemented with the single creation and annihilation operators $a_i^\dagger$ and a_i, as well as their commutator I,
gilmore-lie-groups_F01077	110	1.000	`\left[\mathcal{H}, a_{i}^{\dagger} a_{j}\right]=0`	$\left[\mathcal{H}, a_i^\dagger a_j\right]=0$	**c.** If the generators $a_i a_j$ that span the invariance algebra are supplemented with the single creation and annihilation operators $a_i^\dagger$ and a_i, as well as their commutator I,
gilmore-lie-groups_F01078	110	1.000	`\mathfrak{s u}(N)`	$\mathfrak{su}(N)$	the resulting set of operators closes to form an $(N+1)^2$ dimensional Lie algebra
gilmore-lie-groups_F01079	110	1.000	`\mathcal{H}`	$\mathcal{H}$	that is nonsemisi
gilmore-lie-groups_F01080	110	1.000	`a_{j}`	a_j	from this algebra that transform any state in a multiplet with n excitations to any
gilmore-lie-groups_F01081	110	1.000	`(N+1)^{2}`	$(N+1)^2$	state in a multiplet with n' excitations.
gilmore-lie-groups_F01082	110	1.000	`n^{\prime}`	n'	
gilmore-lie-groups_F01083	110	1.000	`R, S, T, U, \ldots`	$R, S, T, U, \ldots$	
gilmore-lie-groups_F01084	110	1.000	`a^{\dagger}=`	$a^\dagger=$	
gilmore-lie-groups_F01085	110	0.999	`a_{1}^{\dagger}, a_{2}^{\dagger}, \ldots, a_{n}^{\dagger}`	$a_1^\dagger, a_2^\dagger, \ldots, a_n^\dagger$	
gilmore-lie-groups_F01086	111	1.000	`\mathcal{R}=a^{\dagger} R a=a_{i}^{\dagger} R_{i j} a_{j}`	$\mathcal{R}=a^\dagger R a=a_i^\dagger R_{ij} a_j$	adjoint, a column vector of annihilation operators. Define $\mathcal{R}=a^\dagger R a=a_i^\dagger R_{ij} a_j$, and
gilmore-lie-groups_F01087	111	1.000	`\mathcal{S}, T, U, \ldots`	$\mathcal{S}, T, U, \ldots$	similarly for $\mathcal{S}, T, U, \ldots$.
gilmore-lie-groups_F01088	111	1.000	`[R, S]=T \Leftrightarrow[\mathcal{R}, S]=\mathcal{T}`	$[R, S]=T \Leftrightarrow[\mathcal{R}, S]=\mathcal{T}$	**a.** $[R, S]=T \Leftrightarrow[\mathcal{R}, S]=\mathcal{T}$
gilmore-lie-groups_F01089	111	1.000	`e^{R} e^{S}=e^{U} \Leftrightarrow e^{\mathcal{R}} e^{ \mathcal{S}}=e^{\mathcal{U}}`	$e^R e^S=e^U \Leftrightarrow e^{\mathcal{R}} e^{\mathcal{S}}=e^{\mathcal{U}}$	**b.** $e^R e^S=e^U \Leftrightarrow e^{\mathcal{R}} e^{\mathcal{S}}=e^{\mathcal{U}}$
gilmore-lie-groups_F01090	111	0.994	`\left[\frac{d}{d x}, e^{-x^{2} / 2}\right]=-x e^{-x^{2} / 2}`	$\left[\frac{d}{dx}, e^{-x^2/2}\right]=-x e^{-x^2/2}$	**b.** Use this result to show
gilmore-lie-groups_F01091	111	1.000	`a=\frac{1}{\sqrt{2}}\left(x+\frac{d}{d x}\right)`	$a=\frac{1}{\sqrt{2}}\left(x+\frac{d}{dx}\right)$	**e.** Introduce the creation operator $a^\dagger=\frac{1}{\sqrt{2}}(x-\frac{d}{dx})$ and show
gilmore-lie-groups_F01092	111	1.000	`\langle x \mid 0\rangle`	$\langle x \mid 0\rangle$	
gilmore-lie-groups_F01093	111	1.000	`a\langle x \mid 0\rangle=0`	$a\langle x \mid 0\rangle=0$	
gilmore-lie-groups_F01094	111	0.990	`\langle x \mid 0\rangle=e^{-x^{2} / 2} / \sqrt{1 \sqrt{ \pi}}`	$\langle x \mid 0\rangle=e^{-x^2/2}/\sqrt{1\sqrt{\pi}}$	

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gilmore-lie-groups_F01095	111	1.000	a^{\dagger}=\frac{1}{\sqrt{2}}\left(x-\frac{d}{d x}\right)	$a^{\dagger}=\frac{1}{\sqrt{2}}\left(x-\frac{d}{d x}\right)$	$\langle x\|n\rangle=\frac{}{\sqrt{2^n n!}}\langle x\|0\rangle=\frac{}{\sqrt{2^n n!\sqrt{\pi}}}=\psi_n(x)$
gilmore-lie-groups_F01096	111	1.000	\psi_{n}(x)	$\psi_n(x)$	$_{ij}=a_i^{\dagger}a_j-a_j^{\dagger}a_i)$ and a quadrupole interaction ($Q_{ij}=a_i^{\dagger}a_j+a_i^{\dagger}a_i$).
gilmore-lie-groups_F01097	111	1.000	\langle x \mid n\rangle=	$\langle x \mid n\rangle=$	$_{ij}=a_i^{\dagger}a_j-a_j^{\dagger}a_i)$ and a quadrupole interaction ($Q_{ij}=a_i^{\dagger}a_j+a_i^{\dagger}a_i$).
gilmore-lie-groups_F01098	111	0.999	\frac{\left(a^{\dagger}\right)^{n}}{\sqrt{n!}}\langle x \mid 0\rangle	$\frac{\left(a^{\dagger}\right)^{n}}{\sqrt{n!}}\langle x \mid 0\rangle$	Show that
gilmore-lie-groups_F01099	111	0.749	L_{i j}=a_{i}^{\dagger} a_{j}-a_{j}^{\dagger} a_{i}	$L_{ij}=a_i^{\dagger}a_j-a_j^{\dagger}a_i$	$H=\sum_{i=1}\hbar\omega_i\left(a_i^{\dagger}a_i+\frac{}{2}\right)+\sum_{i<j}\sigma_{ij}(a_i^{\dagger}a_j-a_j^{\dagger}a_i)+\sum_{i\leq j}q_{ij}(a_i^{\dagger}a_j+a_j^{\dagger}a_i$
gilmore-lie-groups_F01100	111	0.749	Q_{i j}=a_{i}^{\dagger} a_{j}+a_{j}^{\dagger} a_{i}	$Q_{ij}=a_i^{\dagger}a_j+a_j^{\dagger}a_i$	$H=\sum_{i=1}\hbar\omega_i\left(a_i^{\dagger}a_i+\frac{}{2}\right)+\sum_{i<j}\sigma_{ij}(a_i^{\dagger}a_j-a_j^{\dagger}a_i)+\sum_{i\leq j}q_{ij}(a_i^{\dagger}a_j+a_j^{\dagger}a_i$
gilmore-lie-groups_F01101	111	1.000	i \leq j	$i \leq j$	
gilmore-lie-groups_F01102	111	0.999	\Gamma_{j i}^{*}=\Gamma_{i j}	$\Gamma_{ji}^{*}=\Gamma_{ij}$	
gilmore-lie-groups_F01103	112	0.992	b_{i}=m_{i j} a_{j}: H=\sum_{i=1}^{n} \hbar \omega_{i}^{\prime}\left(b_{i}^{\dagger} b_{i}+\frac{1}{2}\right)+	$b_i=m_{ij}a_j: H=\sum_{i=1}^{n}\hbar\omega_i^{\prime}\left(b_i^{\dagger}b_i+\frac{1}{2}\right)+$	annihilation operators $b_i=m_{ij}a_j$: $H=\sum_{i=1}^{n}\hbar\omega_i^{\prime}(b_i^{\dagger}b_i+\frac{1}{2})+$ constant. Express
gilmore-lie-groups_F01104	112	1.000	\Gamma(H)	$\Gamma(H)$	the amplitudes m_{ij} in terms of the eigenvectors of $\Gamma(H)$ d. Compute the shift in the zero point energy ("constant")
gilmore-lie-groups_F01105	114	1.000	\operatorname{EXP}(X)	$\operatorname{EXP}(X)$	We consider the Lie group $SL(2;\mathbb{R})$ with Lie algebra $\mathfrak{sl}(2;\mathbb{R})$:
gilmore-lie-groups_F01106	114	1.000	\operatorname{Tr} X=0	$\operatorname{Tr} X=0$	$\operatorname{tr} e^{\ldots} \longrightarrow \begin{cases} 2\cos\theta \geq -2 & \text{imaginary eigenvalues} \end{cases}$ (7.6)
gilmore-lie-groups_F01107	114	1.000	\pm \theta	$\pm\theta$	
gilmore-lie-groups_F01108	114	1.000	\pm i \theta	$\pm i\theta$	
gilmore-lie-groups_F01109	116	0.997	a=b=0	$a=b=0$	To see this most easily set $a=b=0$. Points on the c-axis map onto
gilmore-lie-groups_F01110	116	1.000	2 \pi n	$2\pi n$	and therefore points separated by $2\pi n$ along the c-axis map onto the same group operation in $SO(2)\subset SL(2;R)$. The complementary subspace $(a,b,0)$ maps onto
gilmore-lie-groups_F01111	116	0.651	S O(2) \subset S L(2 ; R)	$SO(2)\subset SL(2;R)$	noncompact group operations in $SL(2;\mathbb{R})$
gilmore-lie-groups_F01112	116	0.651	a, b, 0	$a,b,0$	noncompact group operations in $SL(2;\mathbb{R})$
gilmore-lie-groups_F01113	116	1.000	z=\cosh r \geq 1	$z=\cosh r\geq 1$	which is just the upper sheet of the two-sheeted hyperboloid H_{2+}^2, shown in
gilmore-lie-groups_F01114	116	1.000	(x, y)=(b, a) \sinh (r) / r, r^{2}=a^{2}+	$(x,y)=(b,a)\sinh(r)/r, r^2=a^2+$	which is just the upper sheet of the two-sheeted hyperboloid H_{2+}^2, shown in
gilmore-lie-groups_F01115	116	1.000	b^{2}	b^2	Fig. 7.2(a). T
gilmore-lie-groups_F01116	116	1.000	H_{2+}^{2}	H_{2+}^2	
gilmore-lie-groups_F01117	116	1.000	-\pi \leq c \leq+\pi	$-\pi\leq c\leq+\pi$	
gilmore-lie-groups_F01118	117	0.999	S O(1,1)	$SO(1,1)$	
gilmore-lie-groups_F01119	117	1.000	H_{1}^{2}	H_1^2	algebra into the product of the associated group operations (cf. (7.11) and (7.13)).
gilmore-lie-groups_F01120	118	1.000	c, 0 \leq c<2 \pi	$c, 0\leq c<2\pi$	and coset representatives are usually interesting spaces. From this discussion we conclude that the group $SL(2;\mathbb{R})$ can be viewed in var

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gilmore-lie-groups_F01121	118	0.999	`S L(2 ; \mathbb{R}) / S O(2)`	$SL(2;\mathbb{R})/SO(2)$	with a circle. Since the upper sheet of a two-sheeted hyperboloid is topologically
gilmore-lie-groups_F01122	118	0.996	`R^{2} \times S^{1}`	$R^2 \times S^1$	manifold underlying $SL(2;\mathbb{R})$ is the direct product of the single-sheeted hyper-
gilmore-lie-groups_F01123	118	1.000	`[S L(2 ; \mathbb{R}) / S O(1,1)] \times S O(1,1)\left(S O(1,1) \simeq R^{1}\right)`	$[SL(2;\mathbb{R})/SO(1,1)] \times SO(1,1)\left(SO(1,1) \simeq R^1\right)$	Since matrix Lie groups are defined by algebraic constraints, so are their sub-
gilmore-lie-groups_F01124	118	1.000	`R^{1} \times S^{1}`	$R^1 \times S^1$	matrix Lie group is an algebraic manifold. For example, for subgroups of $GL(n$
gilmore-lie-groups_F01125	118	1.000	`R^{N}, N=n^{2}`	$R^N, N = n^2$	We conclude this discussion of the covering problem by stating a theorem due to
gilmore-lie-groups_F01126	119	1.000	`R^{m}`	R^m	generators is R^m, for suitable m (m is the number of noncompact generators). The
gilmore-lie-groups_F01127	119	0.943	`S O(2,1)`	$SO(2,1)$	
gilmore-lie-groups_F01128	119	0.993	`S O(2,1) / S O(2)`	$SO(2,1)/SO(2)$	2π does not change the 3×3 rotation matrix in (7.18). The 2:1 correspondence
gilmore-lie-groups_F01129	119	0.993	`S U(1,1) / U(1)`	$SU(1,1)/U(1)$	2π does not change the 3×3 rotation matrix in (7.18). The 2:1 correspondence
gilmore-lie-groups_F01130	119	0.969	`U(1)`	$U(1)$	can be seen in a better and simpler way. One can ask: how far along a straight line
gilmore-lie-groups_F01131	119	0.969	`2: 1`	$2:1$	can be seen in a better and simpler way. One can ask: how far along a straight line
gilmore-lie-groups_F01132	119	0.936	`b_{3}`	b_3	through the origin does one have to go to return to the identity? For the subgroup
gilmore-lie-groups_F01133	119	1.000	`U\left(b_{3}+2 \pi\right)=-U\left(b_{3}\right)`	$U\left(b_3+2\pi\right)=-U\left(b_3\right)$	
gilmore-lie-groups_F01134	119	1.000	`a_{3}`	a_3	
gilmore-lie-groups_F01135	120	0.984	`U(1) \subset S U(1,1)`	$U(1) \subset SU(1,1)$	$U(1) \subset SU(1,1)$ the result is 4π; for the subgroup $SO(2) \subset SO(2,1)$ the result is
gilmore-lie-groups_F01136	120	0.984	`4 \pi`	4π	$U(1) \subset SU(1,1)$ the result is 4π; for the subgroup $SO(2) \subset SO(2,1)$ the result is
gilmore-lie-groups_F01137	120	0.984	`S O(2) \subset S O(2,1)`	$SO(2) \subset SO(2,1)$	$U(1) \subset SU(1,1)$ the result is 4π; for the subgroup $SO(2) \subset SO(2,1)$ the result is
gilmore-lie-groups_F01138	120	0.811	`\operatorname{SO}(2,1)`	$\operatorname{SO}(2,1)$	2π. Therefore, $SU(1,1)$ is "twice as large" as $SO(2,1)$. More formally, there is a
gilmore-lie-groups_F01139	120	0.992	`2 \rightarrow 1`	$2 \rightarrow 1$	$2 \rightarrow 1$ homomorphism of $SU(1,1)$ onto $SO(2,1$
gilmore-lie-groups_F01140	120	1.000	`\sqrt{a_{1}^{2}+a_{2}^{2}+a_{3}^{2}} \leq`	$\sqrt{a_1^2+a_2^2+a_3^2} \leq$	π) map onto $SO(3)$ provided antipodal points at $\lvert\mathbf{a}\rvert = \pi$ are identified
gilmore-lie-groups_F01141	120	0.994	`|\mathbf{a}|=\pi`	$\lvert\mathbf{a}\rvert = \pi$	$\pi(\sin\theta\cos\phi, \sin\theta\sin\phi, \cos\theta) \sim -\pi(\sin\theta\cos\phi, \sin\theta\sin\phi, \text{co}$
gilmore-lie-groups_F01142	120	0.999	`\operatorname{SU}(2)`	$\operatorname{SU}(2)$	$SU(2)$ and all points at a radius of 2π are mapped onto $-I_2$. There is an easier way
gilmore-lie-groups_F01143	120	0.998	`2 \pi\left(\sqrt{b_{1}^{2}+b_{2}^{2}+b_{3}^{2}}<2 \pi \right)`	$2\pi\left(\sqrt{b_1^2+b_2^2+b_3^2}<2\pi\right)$	to verify the $2 \rightarrow 1$ nature of the map $SU(2)$ to $SO(3)$. All straight lines through the origin of the Lie algebra are equivalent (since the algebra has rank 1, see Chapter
gilmore-lie-groups_F01144	120	0.986	`-I_{2}`	$-I_2$	8). Therefore, we can compare how a convenient line (z-axis) maps onto the two
gilmore-lie-groups_F01145	121	0.652	`x^{2}+y^{2}+z^{2}=1`	$x^2+y^2+z^2=1$	numbers (x', y', z') subject to $x'^2+y'^2+z'^2=1$, are in 1:1 correspondence with
gilmore-lie-groups_F01146	121	0.652	`S U(2) / U(1)`	$SU(2)/U(1)$	numbers (x', y', z') subject to $x'^2+y'^2+z'^2=1$, are in 1:1 correspondence with

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gilmore-lie-groups_F01147	121	0.989	x^{\prime}, y^{\prime}, z^{\prime}	x', y', z'	points in the same geometric space – a sphere in this case. As a result, the 2:1 nature
gilmore-lie-groups_F01148	121	0.989	x^{\prime 2}+y^{\prime 2}+z^{\prime 2}=1	$x'^2 + y'^2 + z'^2 = 1$	points in the same geometric space – a sphere in this case. As a result, the 2:1 nature
gilmore-lie-groups_F01149	121	0.604	S U(2) \rightarrow S O(3)	$SU(2) \rightarrow SO(3)$	Yet another result of Cartan establishes a unique connection between Lie groups
gilmore-lie-groups_F01150	121	1.000	\bar{G}	$\bar{G}$	identity. Moveover, every other Lie group with this Lie algebra is either identical to
gilmore-lie-groups_F01151	121	1.000	\bar{G} / D	$\bar{G}/D$	
gilmore-lie-groups_F01152	121	1.000	\bar{G}: g d_{i}=d_{i} g	$\bar{G} : gd_i = d_i g$	$\overline{G}$ are obtained by "dividing" $\overline{G}$ by all possible subgroups of D_{MAX}, as shown in
gilmore-lie-groups_F01153	121	1.000	d_{i} \in D	$d_i \in D$	Fig. 7.3.
gilmore-lie-groups_F01154	121	0.863	D_{\mathrm{MAX}}	D_{MAX}	For simple matrix Lie groups G, computation of the discrete invariant subgroup
gilmore-lie-groups_F01155	121	0.979	D_{\text {MAX }}	D_{MAX}	D is a simple matter. The only discrete group operations d_i that commute with all
gilmore-lie-groups_F01156	121	1.000	d_{i}	d_i	
gilmore-lie-groups_F01157	121	1.000	G_{1}=\bar{G} / D_{1}	$G_1 = \bar{G}/D_1$	
gilmore-lie-groups_F01158	121	0.848	\bar{G} / D_{\mathrm{MAX}}	$\bar{G}/D_{\mathrm{MAX}}$	
gilmore-lie-groups_F01159	122	1.000	S G=\bar{G}	$SG = \bar{G}$	discrete invariant subgroups D_i of $\overline{G}$.
gilmore-lie-groups_F01160	122	1.000	D_{i}	D_i	
gilmore-lie-groups_F01161	122	1.000	\lambda I_{2}	λI_2	with $\lambda = +1$. As a result $SU(2)/\{I_2, -I_2\} = SO(3)/I_3 = SO(3)$. For each group
gilmore-lie-groups_F01162	122	1.000	\lambda^{*} \lambda=1	$\lambda^* \lambda = 1$	with $\lambda = +1$. As a result $SU(2)/\{I_2, -I_2\} = SO(3)/I_3 = SO(3)$. For each group
gilmore-lie-groups_F01163	122	1.000	\operatorname{det}\left(\lambda I_{2}\right)=+1	$\operatorname{det}(\lambda I_2) = +1$	with $\lambda = +1$. As a result $SU(2)/\{I_2, -I_2\} = SO(3)/I_3 = SO(3)$. For each group
gilmore-lie-groups_F01164	122	1.000	\lambda= \pm 1 . D	$\lambda = \pm 1 . D$	with $\lambda = +1$. As a result $SU(2)/\{I_2, -I_2\} = SO(3)/I_3 = SO(3)$. For each group
gilmore-lie-groups_F01165	122	1.000	D=\left\{I_{2},-I_{2}\right\}	$D = \{I_2, -I_2\}$	operation in $SO(3)$ there are two matrices in $SU(2)$ that differ in sign.
gilmore-lie-groups_F01166	122	1.000	S O(3), D=\lambda I_{3}	$SO(3), D = \lambda I_3$	operation in $SO(3)$ there are two matrices in $SU(2)$ that differ in sign.
gilmore-lie-groups_F01167	122	0.874	\lambda=+1	$\lambda = +1$	**Remark** The maximal compact subgroups $SO(2)$ of $SO(2,1)$ and $U(1)$ of
gilmore-lie-groups_F01168	122	0.874	S U(2) /\left\{I_{2},-I_{2}\right\}=S O(3) / I_{3}=S O(3)	$SU(2)/\{I_2, -I_2\} = SO(3)/I_3 = SO(3)$	**Remark** The maximal compact subgroups $SO(2)$ of $SO(2,1)$ and $U(1)$ of
gilmore-lie-groups_F01169	122	1.000	\overline{S O(2,1)}=	$\overline{SO(2,1)} =$	$SO(2) = SU(1,1)/U(1) \times U(1) = R^2 \times R^1$. It is the only group we will encounter
gilmore-lie-groups_F01170	122	1.000	\overline{S U(1,1)}	$\overline{SU(1,1)}$	in this book that is not a matrix group. The covering group $SU(2,1) = SU(1,1)$ has
gilmore-lie-groups_F01171	122	1.000	\overline{S O(2,1) / S O(2)} \times \overline{S O(2)}= \overline{S U(1,1) / U(1)} \times \overline{U(1)}=[S O(2,1) / S O(2)] \times	$\overline{SO(2,1)/SO(2)} \times \overline{SO(2)} = \overline{SU(1,1)/U(1)} \times \overline{U(1)} = [SO(2,1)/SO(2)] \times$	many discrete invariant subgroups but does not have a maximal discrete invariant

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gilmore-lie-groups_F01172	122	1.000	`\overline{S O(2)}=S U(1,1) / U(1) \times \overline{U(1)}=R^{2} \times R^{1}`	$\overline{SO(2)} = SU(1,1)/U(1) \times \overline{U(1)} = R^2 \times R^1$	subgroup.
gilmore-lie-groups_F01173	122	1.000	`\overline{S O(2,1)}=\overline{S U(1,1)}`	$\overline{SO(2,1)} = \overline{SU(1,1)}$	[illegible]
gilmore-lie-groups_F01174	123	1.000	`R_{+}^{2}`	R^2_+	right half plane R_+ like the group operator.
gilmore-lie-groups_F01175	123	0.974	`(w, z)`	(w, z)	[illegible]
gilmore-lie-groups_F01176	123	1.000	`R_{+}^{2}(x>0, y)`	$R^2_+(x > 0, y)$	[illegible] from them, equivalent? The transformation between these two parameterizations is
gilmore-lie-groups_F01177	123	1.000	`R^{2}(w, z)`	$R^2(w, z)$	[illegible] from them, equivalent? The transformation between these two parameterizations is
gilmore-lie-groups_F01178	123	0.995	`x>0`	$x > 0$	[illegible]
gilmore-lie-groups_F01179	124	0.981	`a, a^{\dagger}, I`	$a, a^\dagger, I$	The single-mode photon operators $a, a^\dagger, I$ obey isomorphic commutation relations
gilmore-lie-groups_F01180	124	1.000	`l=l^{\prime}=l^{\prime \prime}, r=r^{\prime}=r^{\prime \prime}, \delta^{\prime}=\delta+\frac{1}{2} l r=\delta^{\prime \prime}+l^{\prime \prime} r^{\prime \prime}`	$l = l' = l'', r = r' = r'', \delta' = \delta + \frac{1}{2} lr = \delta'' + l''r''$	As a third example we treat the four-parameter Lie group of solvable 3×3
gilmore-lie-groups_F01181	124	1.000	`\delta=0`	$\delta = 0$	matrices with Lie algebra
gilmore-lie-groups_F01182	125	1.000	`\hat{n}=a^{\dagger} a, a, a^{\dagger}, I`	$\hat{n} = a^\dagger a, a, a^\dagger, I$	photon operators $\hat{n} = a^\dagger a, a, a^\dagger, I$ under the identification
gilmore-lie-groups_F01183	125	1.000	`\operatorname{EXP}\left(\eta a^{\dagger} a+r a^{\dagger}+l a\right)`	$\mathrm{EXP}\left(\eta a^\dagger a + r a^\dagger + l a\right)$	veniently ordered form $\mathrm{EXP}(r'a^\dagger)\mathrm{EXP}(\eta' a^\dagger a + \delta' I)\mathrm{EXP}(l'a)$, then the reparame-
gilmore-lie-groups_F01184	125	1.000	`\operatorname{EXP}\left(r^{\prime} a^{\dagger}\right) \operatorname{EXP}\left(\eta^{\prime} a^{\dagger} a+ \delta^{\prime} I\right) \operatorname{EXP}\left(l^{ \prime} a\right)`	$\mathrm{EXP}\left(r'a^\dagger\right) \mathrm{EXP}\left(\eta' a^\dagger a + \delta' I\right) \mathrm{EXP}\left(l'a\right)$	terization computation could be carried out in the 3×3 matrix representation
gilmore-lie-groups_F01185	125	0.948	`e^{l^{\prime} a}|0\rangle=|0\rangle,\langle 0| e^{r^{ \prime} a^{\dagger}}=\langle 0|`	$e^{l'a}\|0\rangle = \|0\rangle, \langle 0\|e^{r'a^\dagger} = \langle 0\|$	[illegible]
gilmore-lie-groups_F01186	125	0.948	`e^{\eta^{\prime} a^{\dagger} a}|0\rangle=|0\rangle`	$e^{\eta' a^\dagger a}\|0\rangle = \|0\rangle$	[illegible]
gilmore-lie-groups_F01187	125	1.000	`\mathfrak{s u}(2)`	$\mathfrak{su}(2)$	[illegible] (7.42)
gilmore-lie-groups_F01188	125	1.000	`(|j,-j\rangle)`	$(\|j, -j\rangle)$	
gilmore-lie-groups_F01189	126	1.000	`\theta_{z}^{\prime}`	θ'_z	we carry out the operator disentangling calculations in the fundamental 2×2 matrix representation $\mathbf{J} \to \frac{1}{2}\sigma$, where σ are the Pauli spin matrices (5.14):
gilmore-lie-groups_F01190	126	1.000	`\mathbf{J} \rightarrow \frac{1}{2} \sigma`	$\mathbf{J} \to \frac{1}{2}\sigma$	$e^{i\theta\cdot\mathbf{J}} \to \mathrm{EXP}\frac{i}{2}\left[\begin{array}{c} \theta_z \quad \theta_x - i\theta_y \end{array}\right]$
gilmore-lie-groups_F01191	126	1.000	`\theta_{ \pm}=\theta_{1} \pm i \theta_{2}`	$\theta_\pm = \theta_1 \pm i\theta_2$	As a result, we find
gilmore-lie-groups_F01192	127	1.000	`e^{\alpha J_{+}} e^{\beta J_{-}}`	$e^{\alpha J_+} e^{\beta J_-}$	$\mathrm{EXP}(n'J_z)\mathrm{EXP}(\alpha' J_+)$ and the parameters α', β', n' computed. We find
gilmore-lie-groups_F01193	127	1.000	`\operatorname{EXP}\left(\beta^{\prime} J_{-}\right)`	$\mathrm{EXP}\left(\beta' J_-\right)$	$\mathrm{EXP}(n'J_z)\mathrm{EXP}(\alpha' J_+)$ and the parameters α', β', n' computed. We find
gilmore-lie-groups_F01194	127	0.999	`\operatorname{EXP}\left(n^{\prime} J_{z}\right) \operatorname{EXP}\left(\alpha^{\prime} J_{+}\right)`	$\mathrm{EXP}\left(n' J_z\right) \mathrm{EXP}\left(\alpha' J_+\right)$	[illegible]
gilmore-lie-groups_F01195	127	0.999	`\alpha^{\prime}, \beta^{\prime}, n^{\prime}`	α', β', n'	[illegible]

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gilmore-lie-groups_F01196	127	■1.000	(1+\alpha \beta)^{2 j}	$(1+\alpha\beta)^{2j}$	$\left\langle j \middle\vert J^r J^s \middle\vert j \right\rangle = \frac{(2j)!r!}{\quad}\delta_{rs}$
gilmore-lie-groups_F01197	127	■1.000	\mathcal{A}, \mathcal{B}	$\mathcal{A}, \mathcal{B}$	(i) finding a faithful matrix representation of the operator algebra
gilmore-lie-groups_F01198	127	■0.995	e^{\mathcal{A}} e^{\mathcal{B}}	$e^{\mathcal{A}} e^{\mathcal{B}}$	(i) finding a faithful matrix representation of the operator algebra, (ii) identifying the operators $\mathcal{A}, \mathcal{B}$ with matrices A, B,
gilmore-lie-groups_F01199	127	■0.999	e^{\mathcal{B}^{\prime}} e^{\mathcal{A}^{\prime}}\left(\mathcal{A}^{\prime}, \mathcal{B}^{\prime}\right.	$e^{\mathcal{B}^{\prime}} e^{\mathcal{A}^{\prime}} \left(\mathcal{A}^{\prime}, \mathcal{B}^{\prime}\right.$	(iii) Carrying out the matrix calculations $e^A e^B$ and $e^{B'} e^{A'}$,
gilmore-lie-groups_F01200	127	■0.999	\left.\mathcal{A}, \mathcal{B}\right)	$\left.\mathcal{A}, \mathcal{B}\right)$	(iii) Carrying out the matrix calculations $e^A e^B$ and $e^{B'} e^{A'}$,
gilmore-lie-groups_F01201	127	■1.000	e^{A} e^{B}	$e^{A} e^{B}$	This procedure will produce a local analytic repara
gilmore-lie-groups_F01202	127	■1.000	e^{B^{\prime}} e^{A^{\prime}}	$e^{B^{\prime}} e^{A^{\prime}}$	This procedure will produce a local analytic repara
gilmore-lie-groups_F01203	127	■1.000	A^{\prime}, B^{\prime}	$A^{\prime}, B^{\prime}$	$(\mathcal{A}', \mathcal{B}')$. If the matrix group used to construct this reparameterization
gilmore-lie-groups_F01204	127	■1.000	A^{\prime} \leftrightarrow \mathcal{A}^{\prime} B^{ \prime} \leftrightarrow \mathcal{B}^{\prime}	$A^{\prime} \leftrightarrow \mathcal{A}^{\prime} B^{\prime} \leftrightarrow \mathcal{B}^{\prime}$	connected (the covering group) the analytic rep
gilmore-lie-groups_F01205	127	■1.000	(\mathcal{A}, \mathcal{B}) \leftrightarrow	$(\mathcal{A}, \mathcal{B}) \leftrightarrow$	groups of the operator group and the matrix group. When the operators $\mathcal{A}, \mathcal{B}, \ldots$ are
gilmore-lie-groups_F01206	127	■0.998	\left(\mathcal{A}^{\prime}, \mathcal{B}^{\prime}\right)	$\left(\mathcal{A}^{\prime}, \mathcal{B}^{\prime}\right)$	
gilmore-lie-groups_F01207	127	■1.000	\mathcal{A}, \mathcal{B}, \ldots	$\mathcal{A}, \mathcal{B}, \ldots$	
gilmore-lie-groups_F01208	128	■1.000	A, B, \ldots	$A, B, \ldots$	related to matrices $A, B, \ldots$ by a matrix–operator mapping (see Chapter 6) $\mathcal{A} \leftrightarrow A$,
gilmore-lie-groups_F01209	128	■1.000	\mathcal{A} \leftrightarrow A	$\mathcal{A} \leftrightarrow A$	related to matrices $A, B, \ldots$ by a matrix–operator mapping (see Chapter 6) $\mathcal{A} \leftrightarrow A$,
gilmore-lie-groups_F01210	128	■1.000	t+\delta t	$t+\delta t$	$\lvert\psi(t+\delta t)\rangle = \left(I - \frac{}{\hbar} H \delta t\right) \lvert\psi(t)\rangle = e^{-\frac{i}{\hbar} H \delta t} \lvert\psi(t)\rangle$
gilmore-lie-groups_F01211	128	■1.000	\left|\psi\left(t_{f}\right)\right\rangle	$\left\vert\psi\left(t_{f}\right)\right\rangle$	
gilmore-lie-groups_F01212	128	■1.000	t_{f}	t_{f}	
gilmore-lie-groups_F01213	128	■1.000	\left|\psi\left(t_{f}\right)\right\rangle=	$\left\vert\psi\left(t_{f}\right)\right\rangle =$	
gilmore-lie-groups_F01214	128	■0.996	U\left(t_{f}, t_{i}\right)\left|\psi\left(t_{i}\right) \right\rangle	$U\left(t_{f}, t_{i}\right)\left\vert\psi\left(t_{i}\right)\right\rangle$	$U(t_f, t_i) = U(t_f, t_f - \delta t) \cdots U(t_i + 2\delta t, t_i + \delta t) U(t_i + \delta t, t_i)$
gilmore-lie-groups_F01215	128	■1.000	H\left(t^{\prime}\right)	$H\left(t^{\prime}\right)$	Riemann integral.
gilmore-lie-groups_F01216	128	■1.000	H(t), t^{\prime} \neq t	$H(t), t^{\prime} \neq t$	
gilmore-lie-groups_F01217	129	■1.000	2 j+1	$2j+1$	three operators $J_z, J_\pm$ that obey angular momentum commutation relations. We
gilmore-lie-groups_F01218	129	■1.000	\left|j, m_{j}\right\rangle	$\left\vert j, m_{j}\right\rangle$	is
gilmore-lie-groups_F01219	129	■1.000	g(t) \in S U(2)	$g(t) \in SU(2)$	the equation of motion *in the group* is
gilmore-lie-groups_F01220	129	■1.000	(2 j+1) \times(2 j+1)	$(2j+1) \times (2j+1)$	$d \begin{bmatrix} a(t) & b(t) \end{bmatrix} = i \begin{bmatrix} \frac{1}{2}\epsilon(t) & \alpha(t) \end{bmatrix} \begin{bmatrix} a(t) & b(t) \end{bmatrix}$ (7.59)
gilmore-lie-groups_F01221	129	■1.000	a(t)	$a(t)$	$1, b(t_i) = 0$. The final 2×2 unitary matrix is determined by $a(t_f), b(t_f)$. This is

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gilmore-lie-groups_F01222	129	1.000	`b(t)`	$b(t)$	$1, b(t_i) = 0$. The final 2×2 unitary matrix is determined by $a(t_f), b(t_f)$. This is
gilmore-lie-groups_F01223	129	1.000	`\sigma_{1}, \sigma_{2}, \sigma_{3}`	$\sigma_1, \sigma_2, \sigma_3$	a group operation in $SU(2)$ that can subsequently be mapped into the $(2j+1) \times$
gilmore-lie-groups_F01224	129	1.000	`a\left(t_{i}\right)=`	$a\left(t_i\right) =$	$(2j+1)$ unitary irreducible representation of this group. At this point the problem
gilmore-lie-groups_F01225	129	0.999	`1, b\left(t_{i}\right)=0`	$1, b\left(t_i\right) = 0$	
gilmore-lie-groups_F01226	129	0.999	`a\left(t_{f}\right), b\left(t_{f}\right)`	$a\left(t_f\right), b\left(t_f\right)$	
gilmore-lie-groups_F01227	129	0.971	`(2 j+1) \times`	$(2j+1)\times$	**Example 2.** As a second example we treat a hamiltonain that is a linear combination
gilmore-lie-groups_F01228	129	1.000	`(2 j+1)`	$(2j+1)$	of the boson number, creation, and annihilation operators (and their commutator):
gilmore-lie-groups_F01229	129	1.000	`\left|\psi\left(t_{i}\right)\right\rangle`	$\left\|\psi\left(t_i\right)\right\rangle$	⌈
gilmore-lie-groups_F01230	130	1.000	`|n\rangle, n=0,1,2, \ldots`	$\|n\rangle, n = 0, 1, 2, \ldots$	space with basis vectors $\|n\rangle$, $n = 0, 1, 2, \ldots$. The matrix on the right is a faith-
gilmore-lie-groups_F01231	130	1.000	`U=`	$U =$	general unitary operator that can be constructed from these operators is $U =$
gilmore-lie-groups_F01232	130	1.000	`\operatorname{EXP}\left(i\left[n(t) a^{\dagger} a+r(t) a^{\dagger}+r^{*}(t) a+d(t) I\right]\right)`	$\operatorname{EXP}\left(i\left[n(t) a^{\dagger} a+r(t) a^{\dagger}+r^{*}(t) a+d(t) I\right]\right)$	$\operatorname{EXP}(i[n(t)a^\dagger a + r(t)a^\dagger + r^*(t)a + d(t)I])$. This exponential is easy to compute in the faithful 3×3 nonunitary representation. The matrix equation of motion
gilmore-lie-groups_F01233	130	0.982	`\left(n, r, r^{*}, d\right)`	$\left(n, r, r^{*}, d\right)$	be solved by inspection.
gilmore-lie-groups_F01234	130	1.000	`d \omega(t) / d t=0`	$d\omega(t)/dt = 0$	
gilmore-lie-groups_F01235	130	1.000	`\rho`	ρ	In thermody
gilmore-lie-groups_F01236	130	1.000	`\rho=e^{-\beta H} / Z`	$\rho = e^{-\beta H}/Z$	pectation values occur. Again, we give two examples.
gilmore-lie-groups_F01237	130	1.000	`Z=\operatorname{tr} e^{-\beta H}`	$Z = \operatorname{tr} e^{-\beta H}$	
gilmore-lie-groups_F01238	130	1.000	`\beta=1 / k_{B} T, k_{B}`	$\beta = 1/k_B T, k_B$	
gilmore-lie-groups_F01239	131	1.000	`\left\langle e^{\Lambda}\right\rangle`	$\left\langle e^{\Lambda}\right\rangle$	*generating functions* for these expectation values. To do this we compute $\langle e^\Lambda \rangle$,
gilmore-lie-groups_F01240	131	1.000	`\Lambda=\lambda \cdot \mathbf{J}`	$\Lambda = \lambda \cdot \mathbf{J}$	where $\Lambda = \lambda \cdot \mathbf{J}$. All symmetric moments can be constructed by taking derivatives
gilmore-lie-groups_F01241	131	1.000	`H \cdot \Lambda=(H, \Lambda)=\frac{1}{2} \operatorname{tr} H \Lambda`	$H \cdot \Lambda = (H, \Lambda) = \frac{1}{2} \operatorname{tr} H\Lambda$	The trace of this 2×2 matrix can be written in another useful way after a
gilmore-lie-groups_F01242	131	1.000	`|H|=\sqrt{(H, H)}`	$\|H\| = \sqrt{(H, H)}$	The trace of this 2×2 matrix can be written in another useful way after a
gilmore-lie-groups_F01243	131	1.000	`|\Lambda|=\sqrt{(\Lambda, \Lambda)}`	$\|\Lambda\| = \sqrt{(\Lambda, \Lambda)}$	similarity transform t
gilmore-lie-groups_F01244	131	1.000	`2^{N}`	2^N	ver these states is (Arecchi *et al.*, 1972)
gilmore-lie-groups_F01245	131	1.000	`2 J+1`	$2J+1$	$\chi(H, \Lambda, J) =$ (7.66)
gilmore-lie-groups_F01246	131	1.000	`N=2 J`	$N = 2J$	$\chi(H, \Lambda, J) =$ (7.66)
gilmore-lie-groups_F01247	131	1.000	`\mu(H, \Lambda, T)`	$\mu(H, \Lambda, T)$	

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gilmore-lie-groups_F01248	131	1.000	`\left\langle J_{-}\right\rangle`	$\left\langle J_{-}\right\rangle$	
gilmore-lie-groups_F01249	131	1.000	`\frac{\partial}{\partial \lambda^{*}}\left\langle e^{\Lambda}\right\rangle /\left\langle e^{0}\right\rangle`	$\frac{\partial}{\partial \lambda^{*}}\left\langle e^{\Lambda}\right\rangle /\left\langle e^{0}\right\rangle$	
gilmore-lie-groups_F01250	131	1.000	`\Lambda=0`	$\Lambda=0$	
gilmore-lie-groups_F01251	131	1.000	`\left.\frac{\partial}{\partial \lambda^{*}} \log \left(\left\langle e^{\Lambda}\right\rangle\right)\right|_{\Lambda=0}`	$\left.\frac{\partial}{\partial \lambda^{*}} \log \left(\left\langle e^{\Lambda}\right\rangle\right)\right\|_{\Lambda=0}$	
gilmore-lie-groups_F01252	132	0.999	`\rho=e^{-\beta\left(\hbar \omega a^{\dagger} a+\alpha a^{\dagger}+\alpha^{*} a+\delta I\right)} / Z`	$\rho=e^{-\beta\left(\hbar \omega a^{\dagger} a+\alpha a^{\dagger}+\alpha^{*} a+\delta I\right)} / Z$	operator expectation values is $\chi(H, \Lambda, T)=\operatorname{tr} e^{-\beta H} e^{\lambda_n a^{\dagger} a+\lambda a^{\dagger}+\lambda^{*} a+d I} / Z=\left\langle e^{\Lambda}\right\rangle$.
gilmore-lie-groups_F01253	132	1.000	`\chi(H, \Lambda, T)=\operatorname{tr} e^{-\beta H} e^{\lambda_{n} a^{\dagger} a+\lambda a^{\dagger}+\lambda^{*} a+d I} / Z=\left\langle e^{\Lambda}\right\rangle`	$\chi(H, \Lambda, T)=\operatorname{tr} e^{-\beta H} e^{\lambda_{n} a^{\dagger} a+\lambda a^{\dagger}+\lambda^{*} a+d I} / Z=\left\langle e^{\Lambda}\right\rangle$	The trace is taken in the infinite-dimensional Hilbert space with Fock basis
gilmore-lie-groups_F01254	132	0.967	`|0\rangle,|1\rangle,|2\rangle, \ldots`	$\|0\rangle,\|1\rangle,\|2\rangle, \ldots$	without exploiting opportunities allowed by choice of a smaller, more convenient
gilmore-lie-groups_F01255	132	0.989	`H, \Lambda`	H, Λ	(ii) Compute the exponential of each. For example
gilmore-lie-groups_F01256	132	0.999	`Z_{l}`	Z_{l}	⌊0 0 1⌋ ⌊0 0
gilmore-lie-groups_F01257	132	0.999	`Z_{r}`	Z_{r}	⌊0 0 1⌋ ⌊0 0
gilmore-lie-groups_F01258	133	1.000	`A<0`	$A<0$	(vi) Take the trace. Assuming $A<0$ the sum converges to
gilmore-lie-groups_F01259	133	1.000	`\lambda_{n}=`	$\lambda_{n}=$	
gilmore-lie-groups_F01260	133	1.000	`d=0`	$d=0$	
gilmore-lie-groups_F01261	133	1.000	`D=\mathrm{Id}, G`	$D=\mathrm{Id}, G$	each other.
gilmore-lie-groups_F01262	133	1.000	`\lambda I_{n}`	λI_{n}	ful ones typically involve a sequence of exponential mappings of linear vector
gilmore-lie-groups_F01263	134	0.940	`i t / \hbar \leftrightarrow 1 / k_{B} T`	$i t / \hbar \leftrightarrow 1 / k_{B} T$	mapping, and suitable stepping back and forth through large and small unitary or
gilmore-lie-groups_F01264	134	1.000	`\phi\left(\left(x_{1}, y_{1}\right),\left(x_{2}, y_{2}\right)\right)`	$\phi\left(\left(x_{1}, y_{1}\right),\left(x_{2}, y_{2}\right)\right)$	2. Show that a straight line through the origin of the parameter space (a, b, c) that is
gilmore-lie-groups_F01265	134	1.000	`\phi\left(\left(w_{1}, z_{1}\right),\left(w_{2}, z_{2}\right)\right)`	$\phi\left(\left(w_{1}, z_{1}\right),\left(w_{2}, z_{2}\right)\right)$	inside the light cone $a^{2}+b^{2}-c^{2}<0$ (Eq. (7.7)) maps onto the subgroup $SO(2) \subset$
gilmore-lie-groups_F01266	134	1.000	`a^{2}+b^{2}-c^{2}<0`	$a^{2}+b^{2}-c^{2}<0$	$\beta^{2}=(a^{2}+b^{2}) / c^{2}$. Compare this renormalization of periodicity with "time dilation."
gilmore-lie-groups_F01267	134	1.000	`S O(2) \subset`	$S O(2) \subset$	$\beta^{2}=(a^{2}+b^{2}) / c^{2}$. Compare this renormalization of periodicity with "time dilation."
gilmore-lie-groups_F01268	134	0.999	`c_{T}`	c_{T}	3. Compute the maximal discrete invariant subgroup D_{MAX} of $SU(3)$ and show that it
gilmore-lie-groups_F01269	134	0.999	`a^{2}+b^{2}>0\left(\sqrt{a^{2}+b^{2}}=\beta \times c,|\beta|<1\right)`	$a^{2}+b^{2}>0\left(\sqrt{a^{2}+b^{2}}=\beta \times c,\|\beta\|<1\right)$	3. Compute the maximal discrete invariant subgroup D_{MAX} of $SU(3)$ and show that it
gilmore-lie-groups_F01270	134	0.999	`2 \pi \gamma`	$2 \pi \gamma$	the group of real 8×8 matrices EXP[9Reg(su(3))] ("eight-fold way")
gilmore-lie-groups_F01271	134	0.999	`\gamma=1 / \sqrt{1-\beta^{2}}`	$\gamma=1 / \sqrt{1-\beta^{2}}$	the group of real 8×8 matrices EXP[9Reg(su(3))] ("eight-fold way")
gilmore-lie-groups_F01272	134	1.000	`\beta^{2}=\left(a^{2}+b^{2}\right) / c^{2}`	$\beta^{2}=\left(a^{2}+b^{2}\right) / c^{2}$	

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gilmore-lie-groups_F01273	134	0.947	`S U(3)`	$SU(3)$	and show that it is the cyclic group of order n generated by $\epsilon I_n, \epsilon = e^{2\pi i/n}$. What real
gilmore-lie-groups_F01274	134	0.954	`\left\{I_{3}, \lambda I_{3}, \lambda^{2} I_{3}\right\}`	$\left\{I_3, \lambda I_3, \lambda^2 I_3\right\}$	matrix group is $SU(n)/D_{\text{MAX}}$ equivalent to?
gilmore-lie-groups_F01275	134	0.954	`\lambda=e^{2 \pi i / 3}`	$\lambda = e^{2\pi i/3}$	matrix group is $SU(n)/D_{\text{MAX}}$ equivalent to?
gilmore-lie-groups_F01276	134	0.954	`\operatorname{SU}(3) / D_{\text {MAX }}`	$\operatorname{SU}(3)/D_{\text{MAX}}$	matrix group is $SU(n)/D_{\text{MAX}}$ equivalent to?
gilmore-lie-groups_F01277	134	0.229	`[\Re e g(\mathfrak{s u}(3))]`	$[\Re e g(\mathfrak{su}(3))]$	
gilmore-lie-groups_F01278	134	1.000	`\epsilon I_{n}, \epsilon=e^{2 \pi i / n}`	$\epsilon I_n, \epsilon = e^{2\pi i/n}$	
gilmore-lie-groups_F01279	134	0.988	`S U(n) / D_{\text {MAX }}`	$SU(n)/D_{\text{MAX}}$	
gilmore-lie-groups_F01280	135	1.000	`a^{\dagger}, a`	$a^{\dagger}, a$	6. It is convenient to introduce the creation and annihilation operators $a^\dagger, a$ to study the
gilmore-lie-groups_F01281	135	1.000	`\left\langle n^{\prime}\right| x^{k}|n\rangle`	$\left\langle n^{\prime}\right\| x^{k}\|n\rangle$	indicates how.
gilmore-lie-groups_F01282	135	1.000	`e^{\lambda x}`	$e^{\lambda x}$	d^k
gilmore-lie-groups_F01283	135	1.000	`x^{k}`	x^k	d^k
gilmore-lie-groups_F01284	135	1.000	`\left[a, a^{\dagger}\right]=I`	$\left[a, a^{\dagger}\right]=I$	λx $\lambda(a^\dagger+a)/\sqrt{2}$ $\lambda \begin\|0 & 1 & 0\end\|$
gilmore-lie-groups_F01285	135	0.955	`e^{r a^{\dagger}} e^{\delta I} e^{l a}`	$e^{r a^{\dagger}} e^{\delta I} e^{l a}$	$e^{ra^\dagger} e^{\delta I} e^{la} = \begin\|0 & 1 & r\end\| \begin\|0 & 1 & 0\end\| \begin\|0 & 1 & 0\end\| = \begin\|0 & 1 & r\end\|$
gilmore-lie-groups_F01286	135	0.999	`\left\langle n^{\prime}\right| x^{4}|n\rangle`	$\left\langle n^{\prime}\right\| x^{4}\|n\rangle$	$\frac{\ldots}{4!}$ $\langle n'\|(a^\dagger)^p(a)^q\|n\rangle$
gilmore-lie-groups_F01287	135	1.000	`\left\langle e^{i k x}\right\rangle`	$\left\langle e^{ikx}\right\rangle$	
gilmore-lie-groups_F01288	136	1.000	`P_{n} \simeq e^{-n \beta \hbar \omega}`	$P_n \simeq e^{-n\beta\hbar\omega}$	thermal: $P_n \simeq e^{-n\beta\hbar\omega}$. This expectation value can be written in algebraic form as
gilmore-lie-groups_F01289	136	1.000	`k \rightarrow 0`	$k \rightarrow 0$	We concentrate on the numerator, as the denominator is obtained in the limit $k \rightarrow 0$.
gilmore-lie-groups_F01290	136	1.000	`\left\langle e^{i k x}\right\rangle=e^{\delta}`	$\left\langle e^{ikx}\right\rangle = e^{\delta}$	**c.** Compute δ using
gilmore-lie-groups_F01291	136	0.976	`\delta`	δ	group.
gilmore-lie-groups_F01292	136	1.000	`\infty \times \infty`	$\infty \times \infty$	
gilmore-lie-groups_F01293	136	0.999	`\omega^{\prime}=\omega`	$\omega' = \omega$	8. A finite set of operators X_i closes under commutation: $[X_i$
gilmore-lie-groups_F01294	136	0.999	`\alpha, \beta`	α, β	8. A finite set of operators X_i closes under commutation: $[X_i$
gilmore-lie-groups_F01295	136	0.999	`\gamma`	γ	8. A finite set of operators X_i closes under commutation: $[X_i$
gilmore-lie-groups_F01296	136	1.000	`\left[X_{i}, X_{j}\right]=\sum_{k=1}^{N} C_{i j}{ }^{k} X_{k}`	$\left[X_i, X_j\right] = \sum_{k=1}^{N} C_{ij}{}^{k} X_k$	• R is hermitian: $(R(a^i X_i))^\dagger = (a^i R(X_i))^\dagger = (a^i)^* R^\dagger(X_i)$. • S is faithful: $S(a^i X_i) = 0 \Rightarrow a^i = 0$.
gilmore-lie-groups_F01297	136	1.000	`R`	R	ble. We require R to be hermitian to make an immediate connection with quantum
gilmore-lie-groups_F01298	136	1.000	`\left(R\left(a^{i} X_{i}\right)\right)^{\dagger}= \left(a^{i} R\left(X_{i}\right)\right)^{\dagger}= \left(a^{i}\right)^{*} R^{\dagger}\left(X_{i}\right)`	$\left(R\left(a^i X_i\right)\right)^\dagger = \left(a^i R\left(X_i\right)\right)^\dagger = \left(a^i\right)^* R^\dagger\left(X_i\right)$	mechanics.

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gilmore-lie-groups_F01299	136	1.000	S\left(a^{i} X_{i}\right)=0 \Rightarrow a^{i}=0	$S\left(a^{i} X_{i}\right)=0 \Rightarrow a^{i}=0$	**a.** It happens frequently that $\mathcal{H}=R$
gilmore-lie-groups_F01300	136	1.000	\mathcal{H}=R\left(a^{i} X_{i}\right)	$\mathcal{H}=R\left(a^{i} X_{i}\right)$	representation: $[R(H_i)]_{\alpha\beta} = r_\alpha(i)\delta_{\alpha\beta}$.
gilmore-lie-groups_F01301	136	0.999	H_{1}, H_{2}, \ldots, H_{r} \in \mathfrak{g}	$H_{1}, H_{2}, \ldots, H_{r} \in \mathfrak{g}$	
gilmore-lie-groups_F01302	136	1.000	\left[H_{i}, H_{j}\right]=0,1 \leq i, j \leq r	$\left[H_{i}, H_{j}\right]=0,1 \leq i, j \leq r$	
gilmore-lie-groups_F01303	136	1.000	R\left(H_{i}\right)	$R\left(H_{i}\right)$	
gilmore-lie-groups_F01304	136	1.000	\left[R\left(H_{i}\right)\right]_{\alpha \beta}=r_{\alpha}(i) \delta_{\alpha \beta}	$\left[R\left(H_{i}\right)\right]_{\alpha \beta}=r_{\alpha}(i) \delta_{\alpha \beta}$	
gilmore-lie-groups_F01305	137	1.000	\left[S\left(H_{i}\right), S\left(H_{j}\right)\right]=0	$\left[S\left(H_{i}\right), S\left(H_{j}\right)\right]=0$	**b.** Show that $[S(H_i), S(H_j)] = 0$, but show by example that the r matrices $S(H_i)$
gilmore-lie-groups_F01306	137	1.000	r	r	**b.** Show that $[S(H_i), S(H_j)] = 0$, but show by example that the r matrices $S(H_i)$
gilmore-lie-groups_F01307	137	1.000	S\left(H_{i}\right)	$S\left(H_{i}\right)$	**b.** Show that $[S(H_i), S(H_j)] = 0$, but show by example that the r matrices $S(H_i)$
gilmore-lie-groups_F01308	137	1.000	U(t)=R\left(e^{-\frac{i}{\hbar} \mathcal{H} t} \right)=e^{-\frac{i}{\hbar} R(\mathcal{H}) t}	$U(t)=R\left(e^{-\frac{i}{\hbar} \mathcal{H} t}\right)=e^{-\frac{i}{\hbar} R(\mathcal{H}) t}$	$U(t) = R(e^{-\frac{i}{\hbar}\mathcal{H}t}) = e^{-\frac{i}{\hbar}R(\mathcal{H})t}$.
gilmore-lie-groups_F01309	137	1.000	\rho(T)=e^{-\beta \mathcal{H}} / Z=	$\rho(T)=e^{-\beta \mathcal{H}} / Z=$	**d.** Show that the density operator for thermal expectation values is $\rho(T) = e^{-\beta\mathcal{H}}/Z =$ $R(e^{-\beta\mathcal{H}})/Z = e^{-\beta R(\mathcal{H})}/Z$. What is Z?
gilmore-lie-groups_F01310	137	0.975	R\left(e^{-\beta \mathcal{H}}\right) / Z=e^{-\beta R(\mathcal{H})} / Z	$R\left(e^{-\beta \mathcal{H}}\right) / Z=e^{-\beta R(\mathcal{H})} / Z$	$R(e^{-\beta\mathcal{H}})/Z = e^{-\beta R(\mathcal{H})}/Z$. What is Z? Show that the unitary time evolution op
gilmore-lie-groups_F01311	137	1.000	U(t)	$U(t)$	operator $\rho(T)$ are related by a Wick rotation $it/\hbar \leftrightarrow \beta = 1/k_B T$.
gilmore-lie-groups_F01312	137	1.000	\rho(T)	$\rho(T)$	. A generating function for thermal expectation values has the form
gilmore-lie-groups_F01313	137	1.000	i t / \hbar \leftrightarrow \beta=1 / k_{B} T	$i t / \hbar \leftrightarrow \beta=1 / k_{B} T$	. A generating function for thermal expectation values has the form
gilmore-lie-groups_F01314	137	1.000	G=e^{\mathfrak{g}}	$G=e^{\mathfrak{g}}$	sion. If this operator product can be transformed to "diagonal" form (i.e., expressed in terms of the operators H_i) the trace can easily be constructed. Show that for
gilmore-lie-groups_F01315	137	1.000	H_{i}	H_{i}	$S=e^{y^k X_k}$ with the property
gilmore-lie-groups_F01316	137	1.000	x^{i}	x^{i}	
gilmore-lie-groups_F01317	137	1.000	S=e^{y^{k} X_{k}}	$S=e^{y^{k} X_{k}}$	$Se^{x^j X_j}\epsilon$
gilmore-lie-groups_F01318	137	1.000	e^{x^{i} X_{i}}	$e^{x^{i} X_{i}}$	he unitary transformation has the form U
gilmore-lie-groups_F01319	137	1.000	U(\alpha)=e^{\left(\alpha a^{\dagger}-\alpha^{*} a \right)}	$U(\alpha)=e^{\left(\alpha a^{\dagger}-\alpha^{*} a\right)}$	$U(\alpha)\lvert 0\rangle = e^{(\alpha a^\dagger - \alpha^* a)}\lvert 0\rangle = e^{\beta a^\dagger} e^{\delta I} e^{\beta' a}\lvert 0\rangle$ (7.80)
gilmore-lie-groups_F01320	138	0.896	a^{\dagger}|n\rangle=	$a^{\dagger}\|n\rangle=$	∞ n
gilmore-lie-groups_F01321	138	1.000	|n+1\rangle \sqrt{n+1}	$\|n+1\rangle \sqrt{n+1}$	$\lvert\alpha\rangle$
gilmore-lie-groups_F01322	138	1.000	\langle\beta \mid \alpha\rangle	$\langle\beta \mid \alpha\rangle$	**8.** Show $\langle\alpha\lvert x\rvert\alpha\rangle = (\alpha^* + \alpha)/\sqrt{2}$.
gilmore-lie-groups_F01323	138	1.000	\langle\alpha \mid \alpha\rangle=1	$\langle\alpha \mid \alpha\rangle=1$	**8.** Show $\langle\alpha\lvert x\rvert\alpha\rangle = (\alpha^* + \alpha)/\sqrt{2}$.
gilmore-lie-groups_F01324	138	1.000	a|\alpha\rangle=\alpha|\alpha\rangle	$a\|\alpha\rangle=\alpha\|\alpha\rangle$	**9.** An $SU(2)$ coher
gilmore-lie-groups_F01325	138	1.000	\langle\alpha| x|\alpha\rangle=\left(\alpha^{*}+\alpha \right) / \sqrt{2}	$\langle\alpha\| x\|\alpha\rangle=\left(\alpha^{*}+\alpha \right) / \sqrt{2}$	action of an arbitrary $SU(2)$

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gilmore-lie-groups_F01326	138	0.966	e^{i \phi J_{z}}\left|{ }_{-j}^{j}\right\rangle=\left|{ }_{-j}^{j}\right\rangle e^{-i j \phi}	$e^{i\phi J_z}\left\|{}^{j}_{-j}\right\rangle=\left\|{}^{j}_{-j}\right\rangle e^{-ij\phi}$	coherent states parameterized by coset representatives in SU(2)/U(1).
gilmore-lie-groups_F01327	138	1.000	e^{i\left(\theta_{x} J_{x}+\theta_{y} J_{y}\right)}	$e^{i(\theta_x J_x+\theta_y J_y)}$	
gilmore-lie-groups_F01328	138	1.000	e^{i \alpha_{+} J_{+}} e^{i \alpha_{z} J_{z}} e^{i \alpha_{-} J_{-}}	$e^{i\alpha_+ J_+}e^{i\alpha_z J_z}e^{i\alpha_- J_-}$	
gilmore-lie-groups_F01329	138	0.859	e^{i \alpha_{-} J_{-}}\left|{ }_{-j}^{j}\right\rangle=\left|{ }_{-j}^{j}\right\rangle	$e^{i\alpha_- J_-}\left\|{}^{j}_{-j}\right\rangle=\left\|{}^{j}_{-j}\right\rangle$	
gilmore-lie-groups_F01330	138	0.952	e^{i \alpha_{z} J_{z}}\left|{ }_{-j}^{j}\right\rangle=\left|{ }_{-j}^{j}\right\rangle e^{-i j \alpha_{z}}	$e^{i\alpha_z J_z}\left\|{}^{j}_{-j}\right\rangle=\left\|{}^{j}_{-j}\right\rangle e^{-ij\alpha_z}$	
gilmore-lie-groups_F01331	139	0.815	\left.\left.J_{-}\right|_{\theta_{x} \theta_{y}} ^{j} \right\rangle	$J_-\left\|{}^{j}_{\theta_x\theta_y}\right\rangle$	g. Show that $J_-\|{}^{j}_{\theta_x\theta_y}\rangle$ cannot be proportional to $\|{}^{j}_{\theta_x\theta_y}\rangle$ because the state $\|{}^{j}_{+j}\rangle$ is not occupied. This is different from the harmonic oscillator (photon operator) case.
gilmore-lie-groups_F01332	139	0.815	\left|\begin{array}{c}j \\ \theta_{x} \theta_{y} \end{array}\right\rangle	$\left\|\begin{array}{c}j \\ \theta_x\theta_y\end{array}\right\rangle$	g. Show that $J_-\|{}^{j}_{\theta_x\theta_y}\rangle$ cannot be proportional to $\|{}^{j}_{\theta_x\theta_y}\rangle$ because the state $\|{}^{j}_{+j}\rangle$ is not occupied. This is different from the harmonic oscillator (photon operator) case.
gilmore-lie-groups_F01333	139	0.815	\left|\begin{array}{c}j \\ +j\end{array}\right\rangle	$\left\|\begin{array}{c}j \\ +j\end{array}\right\rangle$	g. Show that $J_-\|{}^{j}_{\theta_x\theta_y}\rangle$ cannot be proportional to $\|{}^{j}_{\theta_x\theta_y}\rangle$ because the state $\|{}^{j}_{+j}\rangle$ is not occupied. This is different from the harmonic oscillator (photon operator) case.
gilmore-lie-groups_F01334	139	1.000	H_{4}	H_4	with only an infinite-dimensional unitary irreducible representation of interest.
gilmore-lie-groups_F01335	139	1.000	e^{-i \phi}=\left(\theta_{x}-i \theta_{y}\right) / \theta	$e^{-i\phi}=(\theta_x-i\theta_y)/\theta$	A number of important quantum eigenvalue equations can be expresse
gilmore-lie-groups_F01336	139	1.000	\theta^{\prime}	θ'	A number of important quantum eigenvalue equations can be expresse
gilmore-lie-groups_F01337	139	1.000	|u\rangle	$\|u\rangle$	**a.** Show that a unitary transformation U transforms this equation to the diagonal form
gilmore-lie-groups_F01338	139	1.000	J_{3}	J_3	$(E'J_3-Z)\|v\rangle=0$, where $E'=\sqrt{E^2+p^2}$ and $\|v\rangle=U\|u\rangle$.
gilmore-lie-groups_F01339	139	1.000	\left(E^{\prime} J_{3}-Z\right)|v\rangle=0	$(E'J_3-Z)\|v\rangle=0$	. Under what conditions on j, p, Z are these solutions valid?
gilmore-lie-groups_F01340	139	1.000	E^{\prime}=\sqrt{E^{2}+p^{2}}	$E'=\sqrt{E^2+p^2}$	. Under what conditions on j, p, Z are these solutions valid?
gilmore-lie-groups_F01341	139	1.000	|v\rangle=U|u\rangle	$\|v\rangle=U\|u\rangle$	. Under what conditions on j, p, Z are these solutions valid?
gilmore-lie-groups_F01342	139	1.000	E= \pm \sqrt{(Z / m)^{2}-p^{2}}	$E=\pm\sqrt{(Z/m)^2-p^2}$	**e.** Construct the unitary transformation
gilmore-lie-groups_F01343	139	0.871	(p \rightarrow 0)	$(p\rightarrow 0)$	and show that $\|u\rangle=e^{\ldots}\|{}^{j}_{m}\rangle$. Compute U for each E.
gilmore-lie-groups_F01344	139	1.000	j, p, Z	j, p, Z	Compute the matrix elements of the rotation matrices in the $2j+1$ uni
gilmore-lie-groups_F01345	139	0.986	\left.|u\rangle=\left.e^{i \theta J_{2}}\right|_{m} ^{j} \right\rangle	$\|u\rangle=e^{i\theta J_2}\left\|{}^{j}_{m}\right\rangle$	$(-)^{j-m}$ $\Gamma(j-n)!($
gilmore-lie-groups_F01346	139	1.000	z=\cos (\beta)	$z=\cos(\beta)$	
gilmore-lie-groups_F01347	139	1.000	D_{m n}^{j}	D^j_{mn}	
gilmore-lie-groups_F01348	139	1.000	j=l	$j=l$	
gilmore-lie-groups_F01349	140	1.000	I_{2} \in S U(2)	$I_2\in SU(2)$	**a.** Geodesics through $I_2\in SU(2)$ focus at $-I_2$ and geodesics through $I_3\in SO(3)$
gilmore-lie-groups_F01350	140	1.000	I_{3} \in S O(3)	$I_3\in SO(3)$	**a.** Geodesics through $I_2\in SU(2)$ focus at $-I_2$ and geodesics through $I_3\in SO(3)$

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gilmore-lie-groups_F01351	140	0.835	`I_{3}`	I_3	focus at I_3. Conclude that $SU(2)$ is a two-fold covering group of $SO(3)$.
gilmore-lie-groups_F01352	140	0.999	`S U(2) / U(1)(z=1, x=y=0)`	$SU(2)/U(1)(z=1, x=y=0)$	D. Geodesics through the "north pole" of $SU(2)/U(1)$ $(z=1, x=y=0)$ focus at
gilmore-lie-groups_F01353	140	0.793	`z=-1, x=y=0`	$z=-1, x=y=0$	its "south pole" $(z=-1, x=y=0)$ and geodesics through the north pole of
gilmore-lie-groups_F01354	140	0.701	`S O(3) / S O(2)(z=1, x=y=0)`	$SO(3)/SO(2)(z=1, x=y=0)$	e. Conclude that $SU(2)/U(1) = S^2 = SO(3)/SO(2)$ and the 2 → 1 nature of the
gilmore-lie-groups_F01355	140	0.701	`(z=-1, x=y=0)`	$(z=-1, x=y=0)$	e. Conclude that $SU(2)/U(1) = S^2 = SO(3)/SO(2)$ and the 2 → 1 nature of the
gilmore-lie-groups_F01356	140	1.000	`S U(2) / U(1)=S^{2}=S O(3) / S O(2)`	$SU(2)/U(1) = S^2 = SO(3)/SO(2)$	covering $SU(2) \downarrow SO(3)$ is contained in the subgroup of rotations about the z-
gilmore-lie-groups_F01357	140	0.986	`S U(2) \downarrow S O(3)`	$SU(2) \downarrow SO(3)$	axis $U(1) \downarrow SO(2)$:
gilmore-lie-groups_F01358	140	0.918	`U(1) \downarrow S O(2)`	$U(1) \downarrow SO(2)$	
gilmore-lie-groups_F01359	140	1.000	`e^{2 \pi i k / r} I_{n}`	$e^{2\pi ik/r} I_n$	How are the loci related to the group operations of the form e I_n?
gilmore-lie-groups_F01360	140	1.000	`n / r`	n/r	How are the loci related to the group operations of the form e I_n?
gilmore-lie-groups_F01361	140	1.000	`e^{2 \pi i k / n} I_{n}`	$e^{2\pi ik/n} I_n$	14. Show that the matrix $\left[\begin{array}{cc}-\lambda & 0 \\ 0 & -1/\lambda \end{array}\right]$ in $SL(2;\mathbb{R})$ cannot be reached by ex
gilmore-lie-groups_F01362	140	0.999	`\left[\begin{array}{cc}-\lambda & 0 \\ 0 & -1 / \lambda \end{array}\right]`	$\left[\begin{array}{cc}-\lambda & 0 \\ 0 & -1/\lambda \end{array}\right]$	"broken geodesic" $e^A e^B$. Find matrices A and B that do this. (Hint: do not work too
gilmore-lie-groups_F01363	140	1.000	`\lambda>1`	$\lambda > 1$	hard.)
gilmore-lie-groups_F01364	140	1.000	`\hbar \omega`	$\hbar\omega$	$\sum_{i=1} 2$ $\sqrt{N}$
gilmore-lie-groups_F01365	140	1.000	`\sigma_{z}^{(i)}`	$\sigma_z^{(i)}$	transition is accompanied by the absorption (annihilation) of a single photon. The
gilmore-lie-groups_F01366	140	1.000	`a^{\dagger} a`	$a^\dagger a$	transition is accompanied by the absorption (annihilation) of a single photon. The
gilmore-lie-groups_F01367	140	0.999	`\sigma_{+}^{(j)}\left(\sigma_{ \pm}^{(j)}=\frac{1}{2} \left(\sigma_{x}^{(j)} \pm i \sigma_{y}^{(j)}\right) \right)`	$\sigma_+^{(j)} \left(\sigma_\pm^{(j)} = \frac{1}{2}\left(\sigma_x^{(j)} \pm i\sigma_y^{(j)}\right)\right)$	operator $\sigma_-^{(j)} a^\dagger$, describes deexcitation of an atom with emission (creation, $a^\dagger$) of a photon. The strength of interaction of the atom with the electromagnetic field (the
gilmore-lie-groups_F01368	140	1.000	`\sigma_{-}^{(j)} a^{\dagger}`	$\sigma_-^{(j)} a^\dagger$	
gilmore-lie-groups_F01369	140	1.000	`\sum_{i=1}^{N} \frac{1}{2} \sigma_{z}^{(i)} \rightarrow J_{z}`	$\sum_{i=1}^{N} \frac{1}{2}\sigma_z^{(i)} \rightarrow J_z$	ical operators $J_z, J_\pm$ can be replaced by their c-number expectation values:
gilmore-lie-groups_F01370	140	0.999	`\sum_{i=1}^{N} \sigma_{ \pm}^{(i)} \rightarrow J_{ \pm}`	$\sum_{i=1}^{N} \sigma_\pm^{(i)} \rightarrow J_\pm$	
gilmore-lie-groups_F01371	140	0.999	`\mathfrak{s} \mathfrak{u}(2)`	$\mathfrak{su}(2)$	
gilmore-lie-groups_F01372	141	1.000	`J_{z} \rightarrow\left\langle J_{z}(t)\right\rangle, J_{+} \rightarrow\left\langle J_{+}(t)\right\rangle, J_{-} \rightarrow\left\langle J_{-}(t)\right\rangle=\left \langle J_{+}(t)\right\rangle^{*}`	$J_z \rightarrow \langle J_z(t)\rangle, J_+ \rightarrow \langle J_+(t)\rangle, J_- \rightarrow \langle J_-(t)\rangle = \langle J_+(t)\rangle^*$	$J_z \rightarrow \langle J_z(t)\rangle$, $J_+ \rightarrow \langle J_+(t)\rangle$, $J_- \rightarrow \langle J_-(t)\rangle = \langle J_+(t)\rangle^*$. Show that this semiclas-
gilmore-lie-groups_F01373	141	1.000	`|\alpha(t)\rangle=U(\alpha(t))|0\rangle=e^{\alpha a^{ \dagger}-\alpha^{*} a}|0\rangle`	$\|\alpha(t)\rangle = U(\alpha(t))\|0\rangle = e^{\alpha a^\dagger - \alpha^* a}\|0\rangle$	gling theorems to compute the relation between the coherent state parameter $\alpha(t)$
gilmore-lie-groups_F01374	141	1.000	`\alpha(t)`	$\alpha(t)$	and the classical driving fields $\langle J_z(t)\rangle$ and $\langle J_+(t)\rangle = \langle J_-(t)\rangle^*$.

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gilmore-lie-groups_F01375	141	1.000	`\left\langle J_{z}(t)\right\rangle`	$\left\langle J_{z}(t)\right\rangle$	. Show that if the initial state of the field is not the ground state, but rath
gilmore-lie-groups_F01376	141	1.000	`\left\langle J_{+}(t)\right\rangle=\left\langle J_{-}(t)\right\rangle^{*}`	$\left\langle J_{+}(t)\right\rangle=\left\langle J_{-}(t)\right\rangle^{*}$	. Show that if the initial state of the field is not the ground state, but rath
gilmore-lie-groups_F01377	141	1.000	`|\beta\rangle`	$\|\beta\rangle$	state. How are the parameters β, describing the initial condition, and α, describing
gilmore-lie-groups_F01378	141	1.000	`\beta`	β	the unitary evolution of the field, related?
gilmore-lie-groups_F01379	141	1.000	`a^{\dagger} \rightarrow\langle a(t)\rangle^{*}`	$a^{\dagger} \rightarrow\langle a(t)\rangle^{*}$	. Show that the resulting semiclassical hamiltonian is
gilmore-lie-groups_F01380	141	1.000	`a \rightarrow\langle a(t)\rangle`	$a \rightarrow\langle a(t)\rangle$	.
gilmore-lie-groups_F01381	141	1.000	`a^{\dagger} a \rightarrow\langle a(t)\rangle^{*}\langle a(t)\rangle`	$a^{\dagger} a \rightarrow\langle a(t)\rangle^{*}\langle a(t)\rangle$	.
gilmore-lie-groups_F01382	141	1.000	`m=-\frac{1}{2}`	$m=-\frac{1}{2}$	parameterized by a point in the coset $SO(2)/O(1)$. . Show that, under the action of this semiclassical Hamiltonian a coherent state will
gilmore-lie-groups_F01383	141	1.000	`M=-J, J=N / 2`	$M=-J, J=N / 2$	parameterized by a point in the coset $SO(2)/O(1)$. . Show that, under the action of this semiclassical Hamiltonian a coherent state will
gilmore-lie-groups_F01384	141	0.997	`|\theta(t)\rangle=e^{i \theta(t) \cdot \mathbf{J}}|J,-J \rangle`	$\|\theta(t)\rangle=e^{i \theta(t) \cdot \mathbf{J}}\|J,-J \rangle$	a classical current will produce a coherent state of the electromagnetic field; a
gilmore-lie-groups_F01385	141	0.997	`J=N / 2`	$J=N / 2$	a classical current will produce a coherent state of the electromagnetic field; a
gilmore-lie-groups_F01386	141	1.000	`\theta(t)`	$\theta(t)$	classical electromagnetic field will produce a coherent atomic state.
gilmore-lie-groups_F01387	141	1.000	`\langle a(t)\rangle`	$\langle a(t)\rangle$	classical electromagnetic field will produce a coherent atomic state.
gilmore-lie-groups_F01388	141	1.000	`\langle a(t)\rangle^{*}`	$\langle a(t)\rangle^{*}$	classical electromagnetic field will produce a coherent atomic state.
gilmore-lie-groups_F01389	141	1.000	`\langle a\rangle`	$\langle a\rangle$	
gilmore-lie-groups_F01390	141	1.000	`\langle a\rangle^{*}`	$\langle a\rangle^{*}$	
gilmore-lie-groups_F01391	141	1.000	`\left\langle J_{+}\right\rangle=\left\langle J_{-}\right\rangle^{*}`	$\left\langle J_{+}\right\rangle=\left\langle J_{-}\right\rangle^{*}$	milibrium at temperature T $(\beta=1/k_{B}T)$
gilmore-lie-groups_F01392	141	1.000	`T\left(\beta=1 / k_{B} T\right)`	$T\left(\beta=1 / k_{B} T\right)$	
gilmore-lie-groups_F01393	141	1.000	`\left\langle\sigma_{+}^{(i)}\right\rangle_{T}`	$\left\langle\sigma_{+}^{(i)}\right\rangle_{T}$	
gilmore-lie-groups_F01394	141	1.000	`a^{\dagger}, a, a^{\dagger} a`	$a^{\dagger}, a, a^{\dagger} a$	
gilmore-lie-groups_F01395	142	1.000	`\sigma_{z}, \sigma_{+}, \sigma_{-}`	$\sigma_{z}, \sigma_{+}, \sigma_{-}$	operators σ_z, σ_+
gilmore-lie-groups_F01396	142	1.000	`\epsilon, \hbar \omega, \lambda, N`	$\epsilon, \hbar \omega, \lambda, N$	**e.** Show that a thermodynamic phase transition occurs as $\lambda^2/$
gilmore-lie-groups_F01397	142	1.000	`\left\langle J_{+}\right\rangle_{T} \neq 0`	$\left\langle J_{+}\right\rangle_{T} \neq 0$	**e.** Show that a thermodynamic phase transition occurs as $\lambda^2/$
gilmore-lie-groups_F01398	142	1.000	`\lambda^{2} / \epsilon \hbar \omega`	$\lambda^{2} / \epsilon \hbar \omega$	$+1$. Is this a first or second order phase transition?
gilmore-lie-groups_F01399	142	1.000	`a(t), b(t)`	$a(t), b(t)$	(unitarity condition). This condition simply reflects that the state of the system is given
gilmore-lie-groups_F01400	142	1.000	`a_{r}^{2}+a_{i}^{2}+b_{r}^{2}+b_{i}^{2}=1`	$a_{r}^{2}+a_{i}^{2}+b_{r}^{2}+b_{i}^{2}=1$	by a unit quaternion. As numerical integration proceeds, imprecisions may cause these

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gilmore-lie-groups_F01401	142	0.542	`\left(a_{r}, a_{i}, b_{r}, b_{i}\right)`	$\left(a_{r}, a_{i}, b_{r}, b_{i}\right)$	(7.67) and (7.70) simplify considerably if the "diagonal operator" is not include
gilmore-lie-groups_F01402	142	1.000	`\lambda_{3} \rightarrow 0`	$\lambda_{3} \rightarrow 0$	19. For many reasons it is less desirable to compute thermal expectation values for *sym-*
gilmore-lie-groups_F01403	142	1.000	`\lambda_{n} \rightarrow 0`	$\lambda_{n} \rightarrow 0$	19. For many reasons it is less desirable to compute thermal expectation values for *sym-*
gilmore-lie-groups_F01404	142	1.000	`d=\delta=0`	$d=\delta=0$	generating functi
gilmore-lie-groups_F01405	142	1.000	`\left\langle J_{+} J_{-}+J_{-} J_{+}\right\rangle`	$\left\langle J_{+} J_{-}+J_{-} J_{+}\right\rangle$	ric operator products in (7.67) and (7.70), or their simplified forms constructed in the
gilmore-lie-groups_F01406	142	1.000	`\left\langle a a^{\dagger}+a^{\dagger} a\right\rangle`	$\left\langle a a^{\dagger}+a^{\dagger} a\right\rangle$	ric operator products in (7.67) and (7.70), or their simplified forms constructed in the
gilmore-lie-groups_F01407	142	1.000	`\left\langle J_{+} J_{-}\right\rangle`	$\left\langle J_{+} J_{-}\right\rangle$	previous problem, into generating functions for ordered products of operators.
gilmore-lie-groups_F01408	142	1.000	`\left\langle a^{\dagger} a\right\rangle`	$\left\langle a^{\dagger} a\right\rangle$	previous problem, into generating functions for ordered products of operators.
gilmore-lie-groups_F01409	143	0.749	`X_{j}=A_{j}^{s} Y_{s}`	$X_{j}=A_{j}^{s} Y_{s}$	
gilmore-lie-groups_F01410	144	1.000	`N=p q`	$N=p q$	operation is equivalent to addition of the $p \times q$ matrices. The regular representation
gilmore-lie-groups_F01411	144	1.000	`\mathfrak{s o l}(n)`	$\mathfrak{s o l}(n)$	
gilmore-lie-groups_F01412	145	1.000	`\hat{n}=`	$\hat{n}=$	$\frac{1}{2}\{a, a^{\dagger}\}=a^{\dagger} a+\frac{1}{2}, a^{\dagger 2}, a^{2}, a^{\dagger}, a, I=[a, a^{\dagger}]$. This is isomorphic to the algebra of six 4×4 matrices presented in (5.7). The algebra of 4×4 matrices (the "defin-
gilmore-lie-groups_F01413	145	0.993	`\frac{1}{2}\left\{a, a^{\dagger}\right\}=a^{\dagger} a+ \frac{1}{2}, a^{\dagger 2}, a^{2}, a^{\dagger}, a, I= \left[a, a^{\dagger}\right]`	$\frac{1}{2}\left\{a, a^{\dagger}\right\}=a^{\dagger} a+\frac{1}{2}, a^{\dagger 2}, a^{2}, a^{\dagger}, a, I=\left[a, a^{\dagger}\right]$	of six 4×4 matrices presented in (5.7). The algebra of 4×4 matrices (the "defin- ing" representation) and the regular representation of this algebra are given below:
gilmore-lie-groups_F01414	145	1.000	`X_{i j}=-X_{j i}, 1 \leq i, j \leq 4`	$X_{i j}=-X_{j i}, 1 \leq i, j \leq 4$	
gilmore-lie-groups_F01415	146	1.000	`\mathfrak{s o}(n), n>4`	$\mathfrak{s o}(n), n>4$	algebra is simple.
gilmore-lie-groups_F01416	146	0.999	`\mathfrak{s u}(n)(n \geq 2), \mathfrak{s o}(n)(n>4)`	$\mathfrak{s u}(n)(n \geq 2), \mathfrak{s o}(n)(n>4)$	
gilmore-lie-groups_F01417	146	0.999	`\mathfrak{s p}(n)(n \geq 1)`	$\mathfrak{s p}(n)(n \geq 1)$	
gilmore-lie-groups_F01418	147	0.999	`\left[Z, X_{i}\right]`	$\left[Z, X_{i}\right]$	itself by every element Z in the original algebra, each subalgebra is an invariant
gilmore-lie-groups_F01419	147	1.000	`X_{j}`	X_{j}	subalgebra. The result is shown schematically in Fig. 8.2 and is summarized by
gilmore-lie-groups_F01420	147	1.000	`j \geq i`	$j \geq i$	subalgebra. The result is shown schematically in Fig. 8.2 and is summarized by
gilmore-lie-groups_F01421	147	1.000	`X_{i}, X_{i+1}, \ldots, X_{n}`	$X_{i}, X_{i+1}, \ldots, X_{n}$	subalgebra. The result is shown schematically in Fig. 8.2 and is summarized by
gilmore-lie-groups_F01422	147	0.593	`i=1,2, \ldots, n`	$i=1,2, \ldots, n$	
gilmore-lie-groups_F01423	147	1.000	`V_{i}`	V_{i}	
gilmore-lie-groups_F01424	147	1.000	`V_{j}, i>j`	$V_{j}, i>j$	
gilmore-lie-groups_F01425	148	1.000	`\left[V_{2}, V_{2}\right] \subseteq V_{2}, V_{2}`	$\left[V_{2}, V_{2}\right] \subseteq V_{2}, V_{2}$	**invariant** subalgebra. The complementary subspace V_{1} is not generally even a
gilmore-lie-groups_F01426	148	1.000	`V_{2}, V_{2}`	V_{2}, V_{2}	subalgebra of the original algebra.

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gilmore-lie-groups_F01427	149	1.000	`\mathfrak{g}^{\prime}=\mathfrak{g}-V_{0}`	$\mathfrak{g}^{\prime}=\mathfrak{g}-V_{0}$	
gilmore-lie-groups_F01428	149	1.000	`\mathfrak{g}^{\prime}`	$\mathfrak{g}^{\prime}$	) The original Lie algebra has the follow
gilmore-lie-groups_F01429	150	1.000	`V_{0}^{\prime}=0`	$V_{0}^{\prime}=0$	su(1,1) nilpotent invariant subalgebra
gilmore-lie-groups_F01430	150	1.000	`a^{\dagger 2}`	$a^{\dagger 2}$	
gilmore-lie-groups_F01431	150	1.000	`a^{2}`	a^{2}	
gilmore-lie-groups_F01432	150	1.000	`a^{\dagger 2}+a^{2}`	$a^{\dagger 2}+a^{2}$	
gilmore-lie-groups_F01433	150	1.000	`a^{\dagger} a+\frac{1}{2}`	$a^{\dagger} a+\frac{1}{2}$	**8.6 Conclusion**
gilmore-lie-groups_F01434	150	1.000	`a^{\dagger 2}-a^{2}`	$a^{\dagger 2}-a^{2}$	
gilmore-lie-groups_F01435	151	1.000	`\hat{n}, a^{\dagger}, a, I`	$\hat{n}, a^{\dagger}, a, I$	**a.** The photon algebra $\hat{n}, a^{\dagger}, a, I$ (Eq. (8.5)).
gilmore-lie-groups_F01436	151	0.786	`\left[b_{i}, b_{j}^{\dagger}\right]=I \delta_{i j}, 1 \leq i, j \leq n`	$\left[b_{i}, b_{j}^{\dagger}\right]=I \delta_{i j}, 1 \leq i, j \leq n$	are computed in the usual way.
gilmore-lie-groups_F01437	151	1.000	`b_{i}, b_{j}^{\dagger}, I`	$b_{i}, b_{j}^{\dagger}, I$	**b.** $b_{i}^{\dagger} b_{j}$.
gilmore-lie-groups_F01438	151	1.000	`b_{i}^{\dagger} b_{j}, b_{i}, b_{j}^{\dagger}, I`	$b_{i}^{\dagger} b_{j}, b_{i}, b_{j}^{\dagger}, I$	**d.** $b_{i}^{\dagger} b_{j}, b_{i}^{\dagger} b_{j}+\frac{1}{2} \delta_{i}$
gilmore-lie-groups_F01439	151	1.000	`b_{i}^{\dagger} b_{j}^{\dagger}, b_{i}^{\dagger} b_{j}+\frac{1}{2} \delta_{i j}, b_{i} b_{j}`	$b_{i}^{\dagger} b_{j}^{\dagger}, b_{i}^{\dagger} b_{j}+\frac{1}{2} \delta_{i j}, b_{i} b_{j}$	**e.** $b_{i}^{\dagger} b_{j}^{\dagger}, b_{i}^{\dagger} b_{j}+\frac{1}{2} \delta_{ij}, b_{i} b_{j}, I$ **f.** $b, b^{\dagger} b, b^{\dagger} b^{\dagger} b$
gilmore-lie-groups_F01440	151	0.998	`b_{i}^{\dagger} b_{j}^{\dagger}, b_{i}^{\dagger} b_{j}+\frac{1}{2} \delta_{i j}, b_{i} b_{j}, b_{i}, b_{j}^{\dagger}, I`	$b_{i}^{\dagger} b_{j}^{\dagger}, b_{i}^{\dagger} b_{j}+\frac{1}{2} \delta_{i j}, b_{i} b_{j}, b_{i}, b_{j}^{\dagger}, I$	**g.** $b^{\dagger}, b^{\dagger} b, b^{\dagger} b b$.
gilmore-lie-groups_F01441	151	1.000	`b, b^{\dagger} b, b^{\dagger} b^{\dagger} b`	$b, b^{\dagger} b, b^{\dagger} b^{\dagger} b$	Fermion creation
gilmore-lie-groups_F01442	151	0.788	`b^{\dagger}`	$b^{\dagger}$	$\{f_i, f_i^{\dagger}\} = \delta_{ii}$, but
gilmore-lie-groups_F01443	151	0.788	`b^{\dagger} b, b^{\dagger} b b`	$b^{\dagger} b, b^{\dagger} b b$	$\{f_i, f_i^{\dagger}\} = \delta_{ii}$, but
gilmore-lie-groups_F01444	151	1.000	`\left\{f_{i}, f_{j}^{\dagger}\right\}=\delta_{i j}`	$\left\{f_{i}, f_{j}^{\dagger}\right\}=\delta_{i j}$	**a.** $f_i^{\dagger} f_j$. **b.** $f_i^{\dagger} f_j^{\dagger}$, $f_i^{\dagger} f_j + \frac{1}{2}\delta_{ij}$, $f_i f_j$.
gilmore-lie-groups_F01445	151	0.985	`f_{i}^{\dagger} f_{j}^{\dagger}`	$f_{i}^{\dagger} f_{j}^{\dagger}$	of the position (x_i) and momenti **a.** x_i, ∂_i, I
gilmore-lie-groups_F01446	151	0.985	`f_{i}^{\dagger} f_{j}+\frac{1}{2} \delta_{i j}`	$f_{i}^{\dagger} f_{j}+\frac{1}{2} \delta_{i j}$	of the position (x_i) and momenti **a.** x_i, ∂_i, I
gilmore-lie-groups_F01447	151	0.985	`f_{i} f_{j}`	$f_{i} f_{j}$	of the position (x_i) and momenti **a.** x_i, ∂_i, I
gilmore-lie-groups_F01448	151	1.000	`\left(x_{i}\right)`	$\left(x_{i}\right)$	**c.** $x_i \partial_j$, x_i, ∂_j, I.
gilmore-lie-groups_F01449	151	1.000	`\left(\partial_{j}\right)`	$\left(\partial_{j}\right)$	**c.** $x_i \partial_j$, x_i, ∂_j, I.
gilmore-lie-groups_F01450	151	1.000	`x_{i}, \partial_{j}, I`	x_{i}, ∂_{j}, I	**d.** $x_i x_j$, $x_i \partial$
gilmore-lie-groups_F01451	151	1.000	`x_{i} \partial_{j}`	$x_{i} \partial_{j}$	**e.** $x_i x_j$

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gilmore-lie-groups_F01452	151	1.000	`x_{i} \partial_{j}, x_{i}, \partial_{j}, I`	$x_i\partial_j, x_i, \partial_j, I$	
gilmore-lie-groups_F01453	151	0.991	`x_{i} x_{j}, x_{i} \partial_{j}+\frac{1}{2} I \delta_{ij}, \partial_{i} \partial_{j}`	$x_ix_j, x_i\partial_j + \frac{1}{2}I\delta_{ij}, \partial_i\partial_j$	
gilmore-lie-groups_F01454	151	1.000	`x_{i} x_{j}, x_{i} \partial_{j}, \partial_{i} \partial_{j}, x_{i}, \partial_{j}, I`	$x_ix_j, x_i\partial_j, \partial_i\partial_j, x_i, \partial_j, I$	What is the relation between the
gilmore-lie-groups_F01455	151	1.000	`\frac{d}{d x}, x \frac{d}{d x}, x^{2} \frac{d}{d x}`	$\frac{d}{dx}, x\frac{d}{dx}, x^2\frac{d}{dx}$	defining matrix repr
gilmore-lie-groups_F01456	151	1.000	`x, x \frac{d}{d x}, x \frac{d^{2}}{d x^{2}}`	$x, x\frac{d}{dx}, x\frac{d^2}{dx^2}$	representation of t
gilmore-lie-groups_F01457	151	0.799	`2+1`	$2+1$	(8.25)
gilmore-lie-groups_F01458	151	0.799	`(x, y`	$(x, y$	(8.25)
gilmore-lie-groups_F01459	151	0.799	`t)`	$t)$	(8.25)
gilmore-lie-groups_F01460	151	1.000	`\left[\begin{array}{cc|c}0 & \theta & v_{1} \\ -\theta & 0 & v_{2} \\ \hline v_{1} & v_{2} & 0\end{array}\right]`	$\left[\begin{array}{cc\|c}0 & \theta & v_{1} \\ -\theta & 0 & v_{2} \\ \hline v_{1} & v_{2} & 0\end{array}\right]$	
gilmore-lie-groups_F01461	151	1.000	`\left[\begin{array}{cc|cc}0 & \theta & v_{1} & t_{1} \\ -\theta & 0 & v_{2} & t_{2} \\ \hline v_{1} & v_{2} & 0 & t_{3} \\ 0 & 0 & 0 & 0\end{array}\right]`	$\left[\begin{array}{cc\|cc}0 & \theta & v_{1} & t_{1} \\ -\theta & 0 & v_{2} & t_{2} \\ \hline v_{1} & v_{2} & 0 & t_{3} \\ 0 & 0 & 0 & 0\end{array}\right]$	
gilmore-lie-groups_F01462	151	1.000	`\left[\begin{array}{cc|cc}0 & \theta & v_{1} & t_{1} \\ -\theta & 0 & v_{2} & t_{2} \\ \hline 0 & 0 & 0 & t_{3} \\ 0 & 0 & 0 & 0\end{array}\right]`	$\left[\begin{array}{cc\|cc}0 & \theta & v_{1} & t_{1} \\ -\theta & 0 & v_{2} & t_{2} \\ \hline 0 & 0 & 0 & t_{3} \\ 0 & 0 & 0 & 0\end{array}\right]$	
gilmore-lie-groups_F01463	152	1.000	`x_{i}, \partial_{j}`	x_i, ∂_j	**d.** For each Lie algebra, express the generators in terms of the operators x_i, ∂_j.
gilmore-lie-groups_F01464	152	0.781	`b_{i}^{\dagger}, b_{j}`	$b_i^\dagger, b_j$	**e.** For each Lie algebra, express the generators in terms of the boson operators $b_i^\dagger$, b_j,
gilmore-lie-groups_F01465	152	1.000	`g_{i j}=C_{i r}{ }^{s} C_{j s}{ }^{r}`	$g_{ij} = C_{ir}{}^{s}C_{js}{}^{r}$	therefore the contravariant metric g^{ij} is well defined. Show that the bilinear operator
gilmore-lie-groups_F01466	152	1.000	`g^{i j}`	g^{ij}	$\mathcal{C}^2 = g^{ij}X_iX_j$ satisfies $[\mathcal{C}^2, X_k] = 0$. If there is one quadratic Casimir operator, it must
gilmore-lie-groups_F01467	152	0.940	`\mathcal{C}^{2}=g^{i j} X_{i} X_{j}`	$\mathcal{C}^2 = g^{ij}X_iX_j$	therefore be proportional to $\mathcal{C}^2$.
gilmore-lie-groups_F01468	152	0.940	`\left[\mathcal{C}^{2}, X_{k}\right]=0`	$\left[\mathcal{C}^2, X_k\right] = 0$	therefore be proportional to $\mathcal{C}^2$.
gilmore-lie-groups_F01469	152	1.000	`\mathcal{C}^{2}`	$\mathcal{C}^2$	8. Show that $C_{ijk} = C_{ij}{}^r g_{rk}$ is
gilmore-lie-groups_F01470	152	1.000	`C_{i j k}=C_{i j}{ }^{r} g_{r k}`	$C_{ijk} = C_{ij}{}^{r}g_{rk}$	$-C_{kji} = -C_{jik} = -C_{ikj}$. (Hint: use the Jacobi identity.)
gilmore-lie-groups_F01471	152	1.000	`C_{i j k}=C_{j k i}=C_{k i j}=`	$C_{ijk} = C_{jki} = C_{kij} =$	$-C_{kji} = -C_{jik} = -C_{ikj}$. (Hint: use the Jacobi identity.)

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gilmore-lie-groups_F01472	152	1.000	`-C_{k j i}=-C_{j i k}=-C_{i k j}`	$-C_{kji} = -C_{jik} = -C_{ikj}$	9. Determine the structure of the Lie algebra defined by
gilmore-lie-groups_F01473	154	0.989	`\mathfrak{s u}(1,1)`	$\mathfrak{su}(1,1)$	$\mathfrak{su}(1,1)$) have the same complex extension and have their different commutation relations cast into the same canonical form. We return to this question in Chapter 11
gilmore-lie-groups_F01474	154	1.000	`Z, X`	Z, X	"eigenoperator" commutation relations
gilmore-lie-groups_F01475	154	1.000	`X=\sum_{i=1}^{N} a^{i} X_{i}`	$X = \sum_{i=1}^{N} a^i X_i$	$\left[Z, \sum a^i X_i\right] = \lambda \sum$
gilmore-lie-groups_F01476	154	1.000	`a^{i}`	a^i	$\parallel R(Z) - \lambda I_N \parallel = 0$ (9.3)
gilmore-lie-groups_F01477	154	1.000	`\phi_{j}(Z)`	$\phi_j(Z)$	**Example** The regular representation for the three-dimensional Lie algebra
gilmore-lie-groups_F01478	154	0.973	`z^{i}\left(Z=\sum z^{i} X_{i}\right)`	$z^i \left(Z = \sum z^i X_i\right)$	**Example** The regular repr spanned by the photon creati
gilmore-lie-groups_F01479	155	1.000	`a^{\dagger}, a, I=\left[a, a^{\dagger}\right]`	$a^\dagger, a, I = \left[a, a^\dagger\right]$	$a^\dagger, a, I = [a, a^\dagger]$ is
gilmore-lie-groups_F01480	155	1.000	`(-\lambda)^{N}=0`	$(-\lambda)^N = 0$	a basis can be found in which the matrix has strictly upper (or lower) triangular form. Therefore, there is a permutation transformation of the basis vectors that brings the
gilmore-lie-groups_F01481	155	0.852	`X=\sum a_{i} X_{i} \in \mathfrak{s u}(2)`	$X = \sum a_i X_i \in \mathfrak{su}(2)$	[illegible]
gilmore-lie-groups_F01482	155	0.953	`\mathfrak{d e f}(X)`	$\mathfrak{def}(X)$	$\mathfrak{def}(X) = \frac{1}{2}\Big\vert$ [illegible] ia_3 [illegible] $i(a_1 - ia_2)$ [illegible] $\Big\vert$
gilmore-lie-groups_F01483	155	0.953	`\mathfrak{R e g}(X)`	$\mathfrak{Reg}(X)$	$\mathfrak{def}(X) = \frac{1}{2}\Big\vert$ [illegible] ia_3 [illegible] $i(a_1 - ia_2)$ [illegible] $\Big\vert$
gilmore-lie-groups_F01484	155	1.000	`\phi_{2}(\mathbf{a}) \geq 0`	$\phi_2(\mathbf{a}) \geq 0$	
gilmore-lie-groups_F01485	155	0.760	`\mathfrak{s} \mathfrak{u}(2))`	$\mathfrak{su}(2))$	
gilmore-lie-groups_F01486	155	0.760	`\lambda=0, \lambda= \pm i a`	$\lambda = 0, \lambda = \pm ia$	
gilmore-lie-groups_F01487	155	0.999	`a^{2}=+a_{1}^{2}+a_{2}^{2}+a_{3}^{2}`	$a^2 = +a_1^2 + a_2^2 + a_3^2$	
gilmore-lie-groups_F01488	156	0.861	`Y=\sum b_{i} Y_{i} \in \mathfrak{s u}(1,1)`	$Y = \sum b_i Y_i \in \mathfrak{su}(1,1)$	**Example** For $Y = \sum b_i Y_i \in$ su(1, 1) the defining 2×2 matrix representation
gilmore-lie-groups_F01489	156	0.976	`\mathfrak{d e f}(Y)`	$\mathfrak{def}(Y)$	$\mathfrak{def}(Y)$ and the regular 3×3 matrix representation $\mathfrak{Reg}(Y)$ are
gilmore-lie-groups_F01490	156	0.976	`\mathfrak{R e g}(Y)`	$\mathfrak{Reg}(Y)$	$\mathfrak{def}(Y)$ and the regular 3×3 matrix representation $\mathfrak{Reg}(Y)$ are
gilmore-lie-groups_F01491	156	0.999	`\left(a_{1}, a_{2}, a_{3}\right) \rightarrow\left(i b_{1}, i b_{2}, b_{3}\right)`	$(a_1, a_2, a_3) \rightarrow (ib_1, ib_2, b_3)$	of coordinates maps the Lie algebra su(2) to the Lie algebra su(1, 1).
gilmore-lie-groups_F01492	156	0.999	`\phi_{2}(\mathbf{a})=a_{1}^{2}+a_{2}^{2}+a_{3}^{2}`	$\phi_2(\mathbf{a}) = a_1^2 + a_2^2 + a_3^2$	of coordinates maps the Lie algebra su(2) to the Lie algebra su(1, 1).
gilmore-lie-groups_F01493	156	0.953	`\phi_{2}(\mathbf{b})=-b_{1}^{2}-b_{2}^{2}+b_{3}^{2}`	$\phi_2(\mathbf{b}) = -b_1^2 - b_2^2 + b_3^2$	The secular equation was written down for the regular representation, since it
gilmore-lie-groups_F01494	156	1.000	`\phi_{2}`	ϕ_2	
gilmore-lie-groups_F01495	157	0.515	`\Re e g`	$\Re eg$	equation of its regular representation, $\mathfrak{Reg}$. Since the number of independent roots
gilmore-lie-groups_F01496	157	1.000	`\phi_{j}\left(z^{i}\right)`	$\phi_j\left(z^i\right)$	of the secular equation is equal to the number of independent coefficients $\varphi_j(z^i)$, the rank is also the number of independent roots of the secular equation. The rank
gilmore-lie-groups_F01497	157	1.000	`X=Z`	$X = Z$	$l^2 \sim N$, so describing commutation relations in terms of rank rather than dimension

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gilmore-lie-groups_F01498	157	1.000	`l^{2} \sim N`	$l^{2} \sim N$	effects a big simplification.
gilmore-lie-groups_F01499	157	1.000	`\mathfrak{m}`	$\mathfrak{m}$	$M = \sum a_j M_j$ (9.18)
gilmore-lie-groups_F01500	158	1.000	`\phi_{j}(X)`	$\phi_{j}(X)$	
gilmore-lie-groups_F01501	158	0.955	`a^{r}{ }_{s}`	$a^{r}{}_{s}$	In this figure the vertical symbol is the Levi–Civita symbol for n dimensio
gilmore-lie-groups_F01502	158	0.955	`X^{r}{ }_{s}`	$X^{r}{}_{s}$	In this figure the vertical symbol is the Levi–Civita symbol for n dimensio
gilmore-lie-groups_F01503	158	0.955	`\phi_{j}`	ϕ_{j}	In this figure the vertical symbol is the Levi–Civita symbol for n dimensio
gilmore-lie-groups_F01504	158	0.836	`X=a_{s}^{r} X^{r}{ }_{s}`	$X = a_{s}^{r} X^{r}{}_{s}$	(e.g., in R^3, $= \epsilon_{ijk} = +1$ for (ijk) a cyclic permutation
gilmore-lie-groups_F01505	158	0.751	`R^{3},=\epsilon_{i j k}=+1`	$R^{3}, = \epsilon_{ijk} = +1$	operators depends only on the commutation relations of the Lie algebra. Therefore
gilmore-lie-groups_F01506	158	0.751	`(i j k)`	(ijk)	operators depends only on the commutation relations of the Lie algebra. Therefore
gilmore-lie-groups_F01507	159	1.000	`\phi_{j}\left(X^{r}{ }_{s}\right)`	$\phi_{j}\left(X^{r}{}_{s}\right)$	these invariant operators $\phi_j(X^r{}_s)$ remain invariant when the matrices are replaced
gilmore-lie-groups_F01508	159	1.000	`O(n)`	$O(n)$	**Example** The orthogonal groups $O(n)$ and their subgroups $SO(n)$ have Lie alge-
gilmore-lie-groups_F01509	159	0.651	`d \times d`	$d \times d$	
gilmore-lie-groups_F01510	159	0.651	`\mathfrak{s o}(n)`	$\mathfrak{so}(n)$	
gilmore-lie-groups_F01511	159	0.651	`d=n(n-1) / 2)`	$d = n(n-1)/2)$	
gilmore-lie-groups_F01512	159	1.000	`\mathfrak{d e f}(X)^{t}=-\mathfrak{d e f}(X)`	$\mathfrak{def}(X)^{t} = -\mathfrak{def}(X)$	(9.20)
gilmore-lie-groups_F01513	159	0.986	`[n / 2]`	$[n/2]$	**Example** The second order Casimir invariant operator for $\mathfrak{so}(n)$
gilmore-lie-groups_F01514	159	0.996	`j=2`	$j = 2$	antisymmetric tensors, as shown in Fig. 9.3.
gilmore-lie-groups_F01515	159	0.996	`X_{i j}=-X_{j i}`	$X_{ij} = -X_{ji}$	antisymmetric tensors, as shown in Fig. 9.3.
gilmore-lie-groups_F01516	159	1.000	`\mathfrak{s o}(5)`	$\mathfrak{so}(5)$	
gilmore-lie-groups_F01517	159	1.000	`X^{r}{ }_{s}=-X^{s}{ }_{r}`	$X^{r}{}_{s} = -X^{s}{}_{r}$	
gilmore-lie-groups_F01518	160	0.940	`v^{m}=\epsilon^{i j k l m} X_{i j} X_{k l}`	$v^{m} = \epsilon^{ijklm} X_{ij} X_{kl}$	where the components of the five-vector v are $v^m = \epsilon^{ijklm} X_{ij} X_{kl}$, for example
gilmore-lie-groups_F01519	160	1.000	`n / 2`	$n/2$	independent Casimir operator. The existence of two second-order Casimir operators
gilmore-lie-groups_F01520	160	1.000	`Z=0`	$Z = 0$	We do this by choosing a Z for which we:
gilmore-lie-groups_F01521	160	1.000	`[Z, X]=0 X`	$[Z, X] = 0X$	1. maximize the number of nonzer
gilmore-lie-groups_F01522	160	1.000	`\hat{n}+\frac{1}{2}=\frac{1}{2}\left\{a, a^{\dagger} \right\}`	$\hat{n} + \frac{1}{2} = \frac{1}{2}\left\{a, a^{\dagger}\right\}$	$= \frac{1}{2}\left(\ldots + 2\right)$ (9.22)
gilmore-lie-groups_F01523	160	1.000	`a^{\dagger 2}, a^{\dagger}, I=\left[a, a^{\dagger} \right], a, a^{2}`	$a^{\dagger 2}, a^{\dagger}, I = \left[a, a^{\dagger}\right], a, a^{2}$	The secular equations for the 6×6 regular repre

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gilmore-lie-groups_F01524	161	1.000	`\pm 2 z_{1}, \pm z_{1}, 0,0`	$\pm 2z_1, \pm z_1, 0, 0$	From this diagram we learn
gilmore-lie-groups_F01525	161	0.999	`X_{(2,0)}=a^{\dagger 2}, X_{(1,0)}=a^{\dagger}, X_{(0,0)}=\hat{n}+\frac{1}{2} I, I, X_{(-1,0)}=a, X_{(-2,0)}=a^{2}`	$X_{(2,0)} = a^{\dagger 2}, X_{(1,0)} = a^{\dagger}, X_{(0,0)} = \hat{n} + \frac{1}{2} I, I, X_{(-1,0)} = a, X_{(-2,0)} = a^2$	$[X_{(k,0)}, X_{(l,0)}] \sim X_{(k+l,0)}$ (9.30)
gilmore-lie-groups_F01526	161	1.000	`k, l \in\{-2,-1,0,+1,+2\}`	$k, l \in \{-2, -1, 0, +1, +2\}$	if $k + l$ is in the set $\{-2, -1, 0, +1, +2\}$ a
gilmore-lie-groups_F01527	161	1.000	`k+l`	$k + l$	
gilmore-lie-groups_F01528	161	1.000	`\{-2,-1,0,+1,+2\}`	$\{-2, -1, 0, +1, +2\}$	
gilmore-lie-groups_F01529	161	1.000	`k+l=0`	$k + l = 0$	
gilmore-lie-groups_F01530	161	0.968	`(0,0): \hat{n}+\frac{1}{2}`	$(0, 0) : \hat{n} + \frac{1}{2}$	For simple and sem
gilmore-lie-groups_F01531	162	1.000	`\alpha_{1}, \alpha_{2}, \ldots, \alpha_{l}`	$\alpha_1, \alpha_2, \ldots, \alpha_l$	pendent roots can be collected together as the components of an l-dimensional vector
gilmore-lie-groups_F01532	162	0.570	`\left(\alpha_{1}, \alpha_{2}, \ldots, \alpha_{l}\right)`	$(\alpha_1, \alpha_2, \ldots, \alpha_l)$	(iii) the dimension of the subspa
gilmore-lie-groups_F01533	162	1.000	`V_{\beta}`	V_β	
gilmore-lie-groups_F01534	162	1.000	`V_{\alpha+\beta}`	$V_{\alpha+\beta}$	
gilmore-lie-groups_F01535	162	1.000	`\alpha+\beta`	$\alpha + \beta$	$[H_i, H_j] = 0$
gilmore-lie-groups_F01536	162	1.000	`H_{1}, H_{2}, \ldots, H_{l}`	$H_1, H_2, \ldots, H_l$	(iii) Each subspace V_α $(\alpha \neq 0)$ is one dimensional. Therefore each subspace V_α is span
gilmore-lie-groups_F01537	162	1.000	`V_{\alpha}(\alpha \neq 0)`	$V_\alpha(\alpha \neq 0)$	$[H_i, E_\alpha] = \alpha_i E_\alpha$
gilmore-lie-groups_F01538	162	0.995	`E_{\alpha}`	E_α	(9.33)
gilmore-lie-groups_F01539	162	0.995	`\left[V_{0}, V_{\alpha}\right] \subset V_{\alpha}`	$[V_0, V_\alpha] \subset V_\alpha$	(9.33)
gilmore-lie-groups_F01540	162	1.000	`-\alpha`	$-\alpha$	of the H_i:
gilmore-lie-groups_F01541	162	1.000	`c \alpha`	$c\alpha$	of the H_i:
gilmore-lie-groups_F01542	162	1.000	`|c|=1`	$\|c\| = 1$	of the H_i:
gilmore-lie-groups_F01543	162	1.000	`E_{-\alpha}`	$E_{-\alpha}$	(vi) An inner product relating α^i and α_j by $\alpha^i = h^{ij}\alpha_j$ can be introduced in this root space
gilmore-lie-groups_F01544	162	1.000	`\alpha^{i}`	α^i	
gilmore-lie-groups_F01545	162	1.000	`\alpha_{j}`	α_j	
gilmore-lie-groups_F01546	162	1.000	`\alpha^{i}=h^{i j} \alpha_{j}`	$\alpha^i = h^{ij}\alpha_j$	
gilmore-lie-groups_F01547	163	1.000	`h^{i j}=\delta^{i j}`	$h^{ij} = \delta^{ij}$	) It remains to compute
gilmore-lie-groups_F01548	163	1.000	`\alpha_{i}: \alpha^{i}=\alpha_{i}`	$\alpha_i : \alpha^i = \alpha_i$	) It remains to compute
gilmore-lie-groups_F01549	163	1.000	`N_{\alpha, \beta}`	$N_{\alpha,\beta}$	

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gilmore-lie-groups_F01550	163	1.000	E_{\alpha}, E_{\beta}, E_{\gamma}	$E_\alpha, E_\beta, E_\gamma$	$[[E_\alpha, E_\beta], E_\gamma] + [[E_\beta, E_\gamma], E_\alpha] + [[E_\gamma,$
gilmore-lie-groups_F01551	163	1.000	\alpha, \beta+k \alpha	$\alpha, \beta + k\alpha$	
gilmore-lie-groups_F01552	164	1.000	\left[E_{\alpha}, E_{\beta}\right]=N_{\alpha, \beta} E_{\alpha+\beta}	$[E_\alpha, E_\beta] = N_{\alpha,\beta} E_{\alpha+\beta}$	
gilmore-lie-groups_F01553	164	1.000	N_{\alpha, \beta+n \alpha}=0	$N_{\alpha,\beta+n\alpha} = 0$	$N^2 \ldots - (n - k +$
gilmore-lie-groups_F01554	164	1.000	N_{-\alpha, \beta-m \alpha}^{2}=N_{\alpha, \beta-(m+1) \alpha}^{2}=0	$N^2_{-\alpha,\beta-m\alpha} = N^2_{\alpha,\beta-(m+1)\alpha} = 0$	$N^2_{\alpha,\beta-(m+1)\alpha} = (n+m+1)\left(\alpha\cdot\beta + \frac{1}{2}(n-m)\alpha\cdot\alpha\right) = 0$
gilmore-lie-groups_F01555	164	1.000	N_{\alpha, \beta+k \alpha}^{2}=(n-k)(m+k+1)(\alpha \cdot \alpha) / 2 \geq 0	$N^2_{\alpha,\beta+k\alpha} = (n-k)(m+k+1)(\alpha\cdot\alpha)/2 \geq 0$	(ii) The inner products obey
gilmore-lie-groups_F01556	164	1.000	\alpha \cdot \beta>0	$\alpha \cdot \beta > 0$	$-n < \frac{2\alpha\cdot\beta}{\ldots} = -n + m < m$ (9.44)
gilmore-lie-groups_F01557	164	1.000	m-	$m-$	$-n < \frac{2\alpha\cdot\beta}{\ldots} = -n + m < m$ (9.44)
gilmore-lie-groups_F01558	164	1.000	n>0	$n > 0$	
gilmore-lie-groups_F01559	164	1.000	\alpha \cdot \beta<0	$\alpha \cdot \beta < 0$	
gilmore-lie-groups_F01560	164	1.000	m-n<0	$m - n < 0$	
gilmore-lie-groups_F01561	165	0.998	A_{2}, B_{2}, C_{2}	A_2, B_2, C_2	The root space diagram encapsulates in a very convenient way all the structure
gilmore-lie-groups_F01562	165	0.998	D_{2}, G_{2}	D_2, G_2	The root space diagram encapsulates in a very convenient way all the structure
gilmore-lie-groups_F01563	165	0.456	l(l	$l(l$	
gilmore-lie-groups_F01564	165	0.977	\mathbf{H}=\left(H_{1}, H_{2}, \ldots, H_{l}\right)	$\mathbf{H} = (H_1, H_2, \ldots, H_l)$	$[H_i, H_j] = 0$
gilmore-lie-groups_F01565	165	0.994	\alpha=\left(\alpha_{1}, \alpha_{2}, \ldots, \alpha_{l} \right)	$\alpha = (\alpha_1, \alpha_2, \ldots, \alpha_l)$	$[\mathbf{H}, E_\alpha] = \alpha E_\alpha$
gilmore-lie-groups_F01566	166	1.000	C_{2}	C_2	
gilmore-lie-groups_F01567	166	1.000	\mathbf{e}_{1}, \mathbf{e}_{2}	$\mathbf{e}_1, \mathbf{e}_2$	
gilmore-lie-groups_F01568	166	1.000	\alpha_{1}, \alpha_{2}	α_1, α_2	
gilmore-lie-groups_F01569	166	1.000	\mathbf{e}_{1}	$\mathbf{e}_1$	these roots by $\sum \alpha \cdot \alpha = 2$ so that
gilmore-lie-groups_F01570	166	1.000	\mathbf{e}_{2}	$\mathbf{e}_2$	these roots by $\sum \alpha \cdot \alpha = 2$ so that
gilmore-lie-groups_F01571	166	1.000	\pm 2 \mathbf{e}_{1}, \pm 2 \mathbf{e}_{2}, \pm \mathbf{e}_{1} \pm \mathbf{e}_{2}	$\pm 2\mathbf{e}_1, \pm 2\mathbf{e}_2, \pm\mathbf{e}_1 \pm \mathbf{e}_2$	
gilmore-lie-groups_F01572	166	0.986	H_{i}, i=1,2	$H_i, i = 1, 2$	$(\mathbf{e}_i, \mathbf{e}_j) = \frac{1}{\ldots}\delta_{ij}$ (9.48)
gilmore-lie-groups_F01573	166	1.000	\sum \alpha \cdot \alpha=2	$\sum \alpha \cdot \alpha = 2$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01574	167	0.608	`\left[H_{1}, H_{2}\right]`	$[H_1, H_2]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01575	167	0.608	`\left[\mathbf{H}, E_{ \pm 2 \mathbf{e}_{1}}\right]`	$[\mathbf{H}, E_{\pm 2\mathbf{e}_1}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01576	167	0.608	`( \pm 2 / \sqrt{12}, 0) E_{ \pm 2 \mathrm{e}_{1}}`	$(\pm 2/\sqrt{12}, 0)E_{\pm 2\mathrm{e}_1}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathrm{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathrm{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathrm{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathrm{e}_2}$ $[\mathbf{H}, E_{\pm \mathrm{e}_1 \pm \mathrm{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm \mathrm{e}_1 \pm \mathrm{e}_2}$ $[E_{+2\mathrm{e}_1}, E_{-2\mathrm{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathrm{e}_2}, E_{-2\mathrm{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm \mathrm{e}_1 \pm \mathrm{e}_2}, E_{-(\pm \mathrm{e}_1 \pm \mathrm{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathrm{e}_1}, E_{-(\mathrm{e}_1+\mathrm{e}_2)}] = *(1/\sqrt{6})E_{\mathrm{e}_1-\mathrm{e}_2}$ $[E_{-\mathrm{e}_1+\mathrm{e}_2}, E_{-\mathrm{e}_1-\mathrm{e}_2)}] = (1/\sqrt{6})E_{-2\mathrm{e}_1}$ $[E_{-\mathrm{e}_1-\mathrm{e}_2}, E_{+2\mathrm{e}_1}] = (1/\sqrt{6})E_{+\mathrm{e}_1-\mathrm{e}_2}$ $[E_{-2\mathrm{e}_1}, E_{\mathrm{e}_1-\mathrm{e}_2}] = (-1/\sqrt{6})E_{-\mathrm{e}_1-\mathrm{e}_2}$ $[E_{+\mathrm{e}_1-\mathrm{e}_2}, E_{+\mathrm{e}_1+\mathrm{e}_2}] = (-1/\sqrt{6})E_{+2\mathrm{e}_1}$ $[E_{+\mathrm{e}_1+\mathrm{e}_2}, E_{-2\mathrm{e}_2}] = (-1/\sqrt{6})E_{+\mathrm{e}_1-\mathrm{e}_2}$ $[E_{+2\mathrm{e}_2}, E_{-\mathrm{e}_1-\mathrm{e}_2}] = *(1/\sqrt{6})E_{-\mathrm{e}_1+\mathrm{e}_2}$ $[E_{-\mathrm{e}_1-\mathrm{e}_2}, E_{+\mathrm{e}_1-\mathrm{e}_2}] = (1/\sqrt{6})E_{-2\mathrm{e}_2}$ $[E_{+\mathrm{e}_1-\mathrm{e}_2}, E_{+2\mathrm{e}_2}] = (1/\sqrt{6})E_{+\mathrm{e}_1+\mathrm{e}_2}$ $[E_{-2\mathrm{e}_2}, E_{+\mathrm{e}_1+\mathrm{e}_2}] = (-1/\sqrt{6})E_{+\mathrm{e}_1-\mathrm{e}_2}$ $[E_{+\mathrm{e}_1+\mathrm{e}_2}, E_{-\mathrm{e}_1+\mathrm{e}_2}] = (-1/\sqrt{6})E_{+2\mathrm{e}_2}$ $[E_{-\mathrm{e}_1+\mathrm{e}_2}, E_{-2\mathrm{e}_2}] = (-1/\sqrt{6})E_{-\mathrm{e}_1-\mathrm{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01577	167	0.608	`\left[\mathbf{H}, E_{ \pm 2 \mathbf{e}_{2}}\right]`	$[\mathbf{H}, E_{\pm 2\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathrm{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathrm{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathrm{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathrm{e}_2}$ $[\mathbf{H}, E_{\pm \mathrm{e}_1 \pm \mathrm{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm \mathrm{e}_1 \pm \mathrm{e}_2}$ $[E_{+2\mathrm{e}_1}, E_{-2\mathrm{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathrm{e}_2}, E_{-2\mathrm{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm \mathrm{e}_1 \pm \mathrm{e}_2}, E_{-(\pm \mathrm{e}_1 \pm \mathrm{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathrm{e}_1}, E_{-(\mathrm{e}_1+\mathrm{e}_2)}] = *(1/\sqrt{6})E_{\mathrm{e}_1-\mathrm{e}_2}$ $[E_{-\mathrm{e}_1+\mathrm{e}_2}, E_{-\mathrm{e}_1-\mathrm{e}_2)}] = (1/\sqrt{6})E_{-2\mathrm{e}_1}$ $[E_{-\mathrm{e}_1-\mathrm{e}_2}, E_{+2\mathrm{e}_1}] = (1/\sqrt{6})E_{+\mathrm{e}_1-\mathrm{e}_2}$ $[E_{-2\mathrm{e}_1}, E_{\mathrm{e}_1-\mathrm{e}_2}] = (-1/\sqrt{6})E_{-\mathrm{e}_1-\mathrm{e}_2}$ $[E_{+\mathrm{e}_1-\mathrm{e}_2}, E_{+\mathrm{e}_1+\mathrm{e}_2}] = (-1/\sqrt{6})E_{+2\mathrm{e}_1}$ $[E_{+\mathrm{e}_1+\mathrm{e}_2}, E_{-2\mathrm{e}_2}] = (-1/\sqrt{6})E_{+\mathrm{e}_1-\mathrm{e}_2}$ $[E_{+2\mathrm{e}_2}, E_{-\mathrm{e}_1-\mathrm{e}_2}] = *(1/\sqrt{6})E_{-\mathrm{e}_1+\mathrm{e}_2}$ $[E_{-\mathrm{e}_1-\mathrm{e}_2}, E_{+\mathrm{e}_1-\mathrm{e}_2}] = (1/\sqrt{6})E_{-2\mathrm{e}_2}$ $[E_{+\mathrm{e}_1-\mathrm{e}_2}, E_{+2\mathrm{e}_2}] = (1/\sqrt{6})E_{+\mathrm{e}_1+\mathrm{e}_2}$ $[E_{-2\mathrm{e}_2}, E_{+\mathrm{e}_1+\mathrm{e}_2}] = (-1/\sqrt{6})E_{+\mathrm{e}_1-\mathrm{e}_2}$ $[E_{+\mathrm{e}_1+\mathrm{e}_2}, E_{-\mathrm{e}_1+\mathrm{e}_2}] = (-1/\sqrt{6})E_{+2\mathrm{e}_2}$ $[E_{-\mathrm{e}_1+\mathrm{e}_2}, E_{-2\mathrm{e}_2}] = (-1/\sqrt{6})E_{-\mathrm{e}_1-\mathrm{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01578	167	0.608	`(0, \pm 2 / \sqrt{12}) E_{ \pm 2 \mathrm{e}_{2}}`	$(0, \pm 2/\sqrt{12})E_{\pm 2\mathrm{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01579	167	0.608	`\left[\mathbf{H}, E_{ \pm \mathbf{e}_{1} \pm \mathbf{e}_{2}}\right]`	$[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01580	167	0.608	`( \pm / \sqrt{12}, \pm / \sqrt{12}) E_{ \pm \mathbf{e}_{1} \pm \mathbf{e}_{2}}`	$(\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01581	167	0.608	`\left[E_{+2 \mathrm{e}_{1}}, E_{-2 \mathrm{e}_{1}}\right]`	$[E_{+2\mathrm{e}_1}, E_{-2\mathrm{e}_1}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01582	167	0.608	`(2 / \sqrt{12}) H_{1}`	$(2/\sqrt{12})H_1$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01583	167	0.608	`\left[E_{+2 \mathrm{e}_{2}}, E_{-2 \mathrm{e}_{2}}\right]`	$[E_{+2\mathrm{e}_2}, E_{-2\mathrm{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01584	167	0.608	`(2 / \sqrt{12}) H_{2}`	$(2/\sqrt{12})H_2$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01585	167	0.608	`\left[E_{ \pm \mathbf{e}_{1} \pm \mathbf{e}_{2}}, E_{-\left( \pm \mathbf{e}_{1} \pm \mathbf{e}_{2}\right)} \right]`	$\left[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}\right]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01586	167	■ 0.608	`(1 / \sqrt{12})\left( \pm H_{1} \pm H_{2}\right)`	$(1/\sqrt{12})\,(\pm H_1 \pm H_2)$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01587	167	■ 0.608	`\left[E_{+2 \mathbf{e}_{1}}, E_{-\left(\mathbf{e}_{1}+ \mathbf{e}_{2}\right)}\right]`	$\left[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}\right]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01588	167	0.608	`*(1 / \sqrt{6}) E_{\mathbf{e}_{1}-\mathbf{e}_{2}}`	$*(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01589	167	0.608	`\left[E_{-\mathbf{e}_{1}+\mathbf{e}_{2}}, E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}\right]`	$\left[E_{-\mathbf{e}_{1}+\mathbf{e}_{2}}, E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}\right]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01590	167	0.608	`(1 / \sqrt{6}) E_{-2 \mathrm{e}_{1}}`	$(1/\sqrt{6})E_{-2\mathrm{e}_1}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01591	167	0.608	`\left[E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}, E_{+2 \mathbf{e}_{1}}\right]`	$[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01592	167	0.608	`(1 / \sqrt{6}) E_{+\mathbf{e}_{1}-\mathbf{e}_{2}}`	$(1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01593	167	0.608	`\left[E_{-2 \mathbf{e}_{1}}, E_{\mathbf{e}_{1}-\mathbf{e}_{2}}\right]`	$[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01594	167	0.608	`(-1 / \sqrt{6}) E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}`	$(-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01595	167	0.608	`\left[E_{+\mathbf{e}_{1}-\mathbf{e}_{2}}, E_{+\mathbf{e}_{1}+\mathbf{e}_{2}}\right]`	$[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01596	167	■ 0.608	`(-1 / \sqrt{6}) E_{+2 \mathrm{e}_{1}}`	$(-1/\sqrt{6})E_{+2\mathrm{e}_1}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01597	167	■ 0.608	`\left[E_{+\mathbf{e}_{1}+\mathbf{e}_{2}}, E_{-2 \mathbf{e}_{2}}\right]`	$[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01598	167	0.608	`(-1 / \sqrt{6}) E_{+\mathbf{e}_{1}-\mathbf{e}_{2}}`	$(-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01599	167	0.608	`\left[E_{+2 \mathbf{e}_{2}}, E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}\right]`	$[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01600	167	0.608	`*(1 / \sqrt{6}) E_{-\mathbf{e}_{1}+\mathbf{e}_{2}}`	$*(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01601	167	0.608	`\left[E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}, E_{+\mathbf{e}_{1}-\mathbf{e}_{2}}\right]`	$\left[E_{-\mathbf{e}_{1}-\mathbf{e}_{2}}, E_{+\mathbf{e}_{1}-\mathbf{e}_{2}}\right]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01602	167	0.608	`(1 / \sqrt{6}) E_{-2 \mathrm{e}_{2}}`	$(1/\sqrt{6})E_{-2\mathrm{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01603	167	0.608	`\left[E_{+\mathbf{e}_{1}-\mathbf{e}_{2}}, E_{+2 \mathbf{e}_{2}}\right]`	$[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01604	167	0.608	`(1 / \sqrt{6}) E_{+\mathbf{e}_{1}+\mathbf{e}_{2}}`	$(1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01605	167	0.608	`\left[E_{-2 \mathbf{e}_{2}}, E_{+\mathbf{e}_{1}+\mathbf{e}_{2}}\right]`	$[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01606	167	0.608	`\left[E_{+\mathbf{e}_{1}+\mathbf{e}_{2}}, E_{-\mathbf{e}_{1}+\mathbf{e}_{2}}\right]`	$\left[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}\right]$	$[H_1, H_2] = 0$ $\left[\mathbf{H}, E_{\pm 2\mathbf{e}_1}\right] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $\left[\mathbf{H}, E_{\pm 2\mathbf{e}_2}\right] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $\left[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}\right] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $\left[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}\right] = (2/\sqrt{12})H_1$ $\left[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}\right] = (2/\sqrt{12})H_2$ $\left[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}\right] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $\left[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}\right] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}\right] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $\left[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}\right] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $\left[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}\right] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $\left[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}\right] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $\left[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}\right] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $\left[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $\left[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01607	167	0.608	`(-1 / \sqrt{6}) E_{+2 \mathrm{e}_{2}}`	$(-1/\sqrt{6})E_{+2\mathrm{e}_2}$	$[H_1, H_2] = 0$ $\left[\mathbf{H}, E_{\pm 2\mathbf{e}_1}\right] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $\left[\mathbf{H}, E_{\pm 2\mathbf{e}_2}\right] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $\left[\mathbf{H}, E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}\right] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}$ $\left[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}\right] = (2/\sqrt{12})H_1$ $\left[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}\right] = (2/\sqrt{12})H_2$ $\left[E_{\pm\mathbf{e}_1\pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1\pm\mathbf{e}_2)}\right] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $\left[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}\right] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}\right] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $\left[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}\right] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $\left[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}\right] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $\left[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}\right] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $\left[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}\right] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $\left[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $\left[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $\left[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}\right] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01608	167	0.608	`\left[E_{-\mathbf{e}_{1}+\mathbf{e}_{2}}, E_{-2 \mathbf{e}_{2}}\right]`	$\left[E_{-\mathbf{e}_{1}+\mathbf{e}_{2}}, E_{-2 \mathbf{e}_{2}}\right]$	$[H_1, H_2] = 0$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_1}] = (\pm 2/\sqrt{12}, 0)E_{\pm 2\mathbf{e}_1}$ $[\mathbf{H}, E_{\pm 2\mathbf{e}_2}] = (0, \pm 2/\sqrt{12})E_{\pm 2\mathbf{e}_2}$ $[\mathbf{H}, E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}] = (\pm/\sqrt{12}, \pm/\sqrt{12})E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}$ $[E_{+2\mathbf{e}_1}, E_{-2\mathbf{e}_1}] = (2/\sqrt{12})H_1$ $[E_{+2\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (2/\sqrt{12})H_2$ $[E_{\pm\mathbf{e}_1 \pm\mathbf{e}_2}, E_{-(\pm\mathbf{e}_1 \pm\mathbf{e}_2)}] = (1/\sqrt{12})(\pm H_1 \pm H_2)$ $[E_{+2\mathbf{e}_1}, E_{-(\mathbf{e}_1+\mathbf{e}_2)}] = *(1/\sqrt{6})E_{\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2)}] = (1/\sqrt{6})E_{-2\mathbf{e}_1}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_1}] = (1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{-2\mathbf{e}_1}, E_{\mathbf{e}_1-\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_1}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+2\mathbf{e}_2}, E_{-\mathbf{e}_1-\mathbf{e}_2}] = *(1/\sqrt{6})E_{-\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-\mathbf{e}_1-\mathbf{e}_2}, E_{+\mathbf{e}_1-\mathbf{e}_2}] = (1/\sqrt{6})E_{-2\mathbf{e}_2}$ $[E_{+\mathbf{e}_1-\mathbf{e}_2}, E_{+2\mathbf{e}_2}] = (1/\sqrt{6})E_{+\mathbf{e}_1+\mathbf{e}_2}$ $[E_{-2\mathbf{e}_2}, E_{+\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+\mathbf{e}_1-\mathbf{e}_2}$ $[E_{+\mathbf{e}_1+\mathbf{e}_2}, E_{-\mathbf{e}_1+\mathbf{e}_2}] = (-1/\sqrt{6})E_{+2\mathbf{e}_2}$ $[E_{-\mathbf{e}_1+\mathbf{e}_2}, E_{-2\mathbf{e}_2}] = (-1/\sqrt{6})E_{-\mathbf{e}_1-\mathbf{e}_2}$ **9.8 Conclusion**
gilmore-lie-groups_F01609	168	1.000	`\mathfrak{s l}(2 ; \mathbb{C}))`	$\mathfrak{s l}(2;\mathbb{C}))$	Lie algebras. Root spaces also summarize the commutation relations for the various
gilmore-lie-groups_F01610	168	1.000	`\alpha_{i}`	α_i	will be imaginary. However, determining the real subalgebras of a complex Lie
gilmore-lie-groups_F01611	168	1.000	`\frac{1}{2}\left\{a^{\dagger}, a\right\}`	$\frac{1}{2}\left\{a^{\dagger}, a\right\}$	$a^{\dagger}, a^{\dagger}, I, a, a^{2}$. Determine the secular equation for this matrix. Determine the rank of this Lie algebra
gilmore-lie-groups_F01612	168	1.000	`a^{\dagger^{2}}, a^{\dagger}, I, a, a^{2}`	$a^{\dagger^{2}}, a^{\dagger}, I, a, a^{2}$	
gilmore-lie-groups_F01613	168	1.000	`X_{i j}=x^{i} \partial_{j}-x^{j} \partial_{i}(1 \leq i<j \leq 4)`	$X_{ij}=x^{i} \partial_{j}-x^{j} \partial_{i}(1 \leq i<j \leq 4)$	3. The Lie algebra $\mathfrak{su}(4)$ has a 4×4 defining matrix representation and a 15×15 regular
gilmore-lie-groups_F01614	168	1.000	`\mathcal{C}_{2}=\sum_{i<j} X_{i j}^{2}`	$\mathcal{C}_{2}=\sum_{i<j} X_{ij}^{2}$	3. The Lie algebra $\mathfrak{su}(4)$ has a 4×4 defining matrix representation and a 15×15 regular
gilmore-lie-groups_F01615	168	0.980	`\mathcal{C}_{2}^{\prime}=X_{12} X_{34}-X_{13} X_{24}+X_{14} X_{23}`	$\mathcal{C}_{2}^{\prime}=X_{12} X_{34}-X_{13} X_{24}+X_{14} X_{23}$	matrix representation. Show th
gilmore-lie-groups_F01616	168	0.994	`\mathfrak{s u}(4)`	$\mathfrak{s u}(4)$	between the secular equation for the regular representation and the secular equation
gilmore-lie-groups_F01617	168	1.000	`\mathfrak{s o}(2 n+1)`	$\mathfrak{s o}(2 n+1)$	Compare your results with Fig. 9.3.
gilmore-lie-groups_F01618	168	1.000	`2,4, \ldots, 2 n`	$2,4, \ldots, 2 n$	Compare your results with Fig. 9.3.
gilmore-lie-groups_F01619	168	1.000	`\mathfrak{s o}(2 n)`	$\mathfrak{s o}(2 n)$	5. In Chapter 11 we will show that $\mathfrak{su}(4) = \mathfrak{so}(6)$. Both Lie algebras have invariant
gilmore-lie-groups_F01620	168	0.600	`\mathcal{C}_{n}^{\prime}=\epsilon^{i_{1} i_{2} \cdots i_{2 n}} X_{i_{1} i_{2}} X_{i_{3} i_{4}} \cdots X_{i_{2 n-1}, i_{2 n}}`	$\mathcal{C}_{n}^{\prime}=\epsilon^{i_{1} i_{2} \cdots i_{2 n}} X_{i_{1} i_{2}} X_{i_{3} i_{4}} \cdots X_{i_{2 n-1}, i_{2 n}}$	their invariant operators.
gilmore-lie-groups_F01621	168	0.600	`\mathcal{C}_{2}^{\prime}`	$\mathcal{C}_{2}^{\prime}$	their invariant operators.
gilmore-lie-groups_F01622	168	0.600	`\mathcal{C}_{3}^{\prime}`	$\mathcal{C}_{3}^{\prime}$	their invariant operators.
gilmore-lie-groups_F01623	168	0.600	`\mathfrak{s o}(6)`	$\mathfrak{s o}(6)$	their invariant operators.
gilmore-lie-groups_F01624	168	1.000	`\mathfrak{s u}(4)=\mathfrak{s o}(6)`	$\mathfrak{s u}(4)=\mathfrak{s o}(6)$	two modes. This algebra is ten dimensional. It contains the four operators $a_i^{\dagger} a_j+\frac{1}{2} \delta_{ij}$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01625	168	1.000	a_{i}^{\dagger} a_{j}+\frac{1}{2} \delta_{i j}	$a_i^\dagger a_j + \frac{1}{2}\delta_{ij}$	
gilmore-lie-groups_F01626	169	0.999	(1 \leq i, j \leq 2)	$(1 \leq i, j \leq 2)$	$(1 \leq i, j \leq 2)$ and the two pairs of three operators $a_i^\dagger a_j^\dagger$ and $a_i a_j$ $(a_i a_j = a_j a_i)$.
gilmore-lie-groups_F01627	169	0.999	a_{i}^{\dagger} a_{j}^{\dagger}	$a_i^\dagger a_j^\dagger$	$(1 \leq i, j \leq 2)$ and the two pairs of three operators $a_i^\dagger a_j^\dagger$ and $a_i a_j$ $(a_i a_j = a_j a_i)$.
gilmore-lie-groups_F01628	169	0.999	a_{i} a_{j}\left(a_{i} a_{j}=a_{j} a_{i}\right)	$a_i a_j\,(a_i a_j = a_j a_i)$	$(1 \leq i, j \leq 2)$ and the two pairs of three operators $a_i^\dagger a_j^\dagger$ and $a_i a_j$ $(a_i a_j = a_j a_i)$.
gilmore-lie-groups_F01629	169	1.000	a_{i}^{\dagger} a_{i}+\frac{1}{2} \leftrightarrow H_{i}, a_{i}^{\dagger} a_{j}^{\dagger} \leftrightarrow E_{+\mathbf{e}_{i}+\mathbf{e}_{j}}(i \neq j), a_{i}^{\dagger} a_{j} \leftrightarrow E_{+\mathbf{e}_{i}-\mathbf{e}_{j}}(i \neq j)	$a_i^\dagger a_i + \frac{1}{2} \leftrightarrow H_i, a_i^\dagger a_j^\dagger \leftrightarrow E_{+\mathbf{e}_i+\mathbf{e}_j}(i \neq j), a_i^\dagger a_j \leftrightarrow E_{+\mathbf{e}_i-\mathbf{e}_j}(i \neq j)$	identification is: $a_i^\dagger a_i + \frac{1}{2} \leftrightarrow H_i$, $a_i^\dagger a_j^\dagger \leftrightarrow E_{+\mathbf{e}_i+\mathbf{e}_j}$ $(i \neq j)$, $a_i^\dagger a_j \leftrightarrow E_{+\mathbf{e}_i-\mathbf{e}_j}$ $(i \neq j)$,
gilmore-lie-groups_F01630	169	1.000	a_{i} a_{j} \leftrightarrow E_{-\mathbf{e}_{i}-\mathbf{e}_{j}}(i \neq j), a_{i}^{\dagger} a_{i}^{\dagger} \leftrightarrow E_{+2 \mathbf{e}_{i}}, a_{i} a_{i} \leftrightarrow E_{-2 \mathbf{e}_{i}}	$a_i a_j \leftrightarrow E_{-\mathbf{e}_i-\mathbf{e}_j}(i \neq j), a_i^\dagger a_i^\dagger \leftrightarrow E_{+2\mathbf{e}_i}, a_i a_i \leftrightarrow E_{-2\mathbf{e}_i}$	$a_i a_j \leftrightarrow E_{-\mathbf{e}_i-\mathbf{e}_j}$ $(i \neq j)$, $a_i^\dagger a_i^\dagger \leftrightarrow E_{+2\mathbf{e}_i}$, $a_i a_i \leftrightarrow E_{-2\mathbf{e}_i}$.
gilmore-lie-groups_F01631	169	1.000	D_{2}	D_2	the difference? (Hint: $f_i^\dagger f_i^\dagger = 0$.)
gilmore-lie-groups_F01632	169	0.995	f_{i}^{\dagger} f_{i}^{\dagger}=0	$f_i^\dagger f_i^\dagger = 0$	
gilmore-lie-groups_F01633	169	1.000	X, Y \in \mathfrak{s u}(2)	$X, Y \in \mathfrak{su}(2)$	tr $[\mathfrak{def}(X)\mathfrak{def}(Y)]$ by taking the trace of the 2×2 matrices in $\mathfrak{su}(2)$ that represent
gilmore-lie-groups_F01634	169	0.577	\operatorname{tr}[\mathfrak{d e f}(X) \mathfrak{d e f}(Y)]	$\operatorname{tr}[\mathfrak{def}(X)\mathfrak{def}(Y)]$	X and Y. Now compute the inner product using instead the Lie algebra $\mathfrak{so}(3)$, that is,
gilmore-lie-groups_F01635	169	0.569	\mathfrak{s u}(2):(X, Y)=\operatorname{tr}[\Re \mathfrak{e g}(X) \Re \mathfrak{e g}(Y)]	$\mathfrak{su}(2) : (X, Y) = \operatorname{tr}[\Re\mathfrak{eg}(X)\Re\mathfrak{eg}(Y)]$	the two results are proportional. What is the proportionality constant?
gilmore-lie-groups_F01636	169	0.995	\left(n^{2}-1\right) \times\left(n^{2}-1\right)	$\left(n^2-1\right) \times \left(n^2-1\right)$	constant? (Hint: set $Y = X$ and choose a special X, for example $X = H_1$.)
gilmore-lie-groups_F01637	169	1.000	Y=X	$Y = X$	form (b boson operators; f fermion operators; $1 < i, i < N$):
gilmore-lie-groups_F01638	169	1.000	X=H_{1}	$X = H_1$	form (b boson operators; f fermion operators; $1 < i, i < N$):
gilmore-lie-groups_F01639	169	0.999	1 \leq i, j \leq N	$1 \leq i, j \leq N$	
gilmore-lie-groups_F01640	169	1.000	\mathbf{R}=\frac{1}{2} \sum_{\alpha>0} \alpha	$\mathbf{R} = \frac{1}{2}\sum_{\alpha>0}\alpha$	algebras. For example, for B_n, $R_i = \frac{1}{2}(2n+1) - i$ and the spectrum is
gilmore-lie-groups_F01641	169	1.000	B_{n}, R_{i}=\frac{1}{2}(2 n+1)-i	$B_n, R_i = \frac{1}{2}(2n+1) - i$	where $\mathbf{M}$ is the highest weight in the representation. For the $(2j+1)$ dimen
gilmore-lie-groups_F01642	169	0.996	\mathbf{M}	$\mathbf{M}$	The Weyl group of reflections for a simple Lie algebra is generated by reflections in planes orthogonal to all the nonzero roots.
gilmore-lie-groups_F01643	169	1.000	\mathfrak{s o}(3), \mathbf{M}=j, \mathbf{R}=R_{1}=\frac{1}{2}	$\mathfrak{so}(3), \mathbf{M} = j, \mathbf{R} = R_1 = \frac{1}{2}$	planes orthogonal to all the nonzero roots. **a.** Show that the Weyl group for A_{n-1} is of order $n!$, the Weyl group for D_n is of
gilmore-lie-groups_F01644	169	1.000	\mathcal{C}^{2}(j)=\left(j+\frac{1}{2}\right)^{2}-\left(0+\frac{1}{2}\right)^{2}=	$\mathcal{C}^2(j) = \left(j+\frac{1}{2}\right)^2 - \left(0+\frac{1}{2}\right)^2 =$	planes orthogonal to all the nonzero roots. **a.** Show that the Weyl group for A_{n-1} is of order $n!$, the Weyl group for D_n is of
gilmore-lie-groups_F01645	169	1.000	j(j+1)	$j(j+1)$	order
gilmore-lie-groups_F01646	169	1.000	A_{n-1}	A_{n-1}	group.
gilmore-lie-groups_F01647	169	1.000	D_{n}	D_n	group.

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gilmore-lie-groups_F01648	169	0.919	`2^{n-1} n!`	$2^{n-1}n!$	
gilmore-lie-groups_F01649	169	0.919	`B_{n}`	B_n	
gilmore-lie-groups_F01650	169	0.919	`C_{n}`	C_n	
gilmore-lie-groups_F01651	169	0.919	`2^{n} n!`	$2^n n!$	
gilmore-lie-groups_F01652	170	1.000	`f_{r}(\Gamma)`	$f_r(\Gamma)$	
gilmore-lie-groups_F01653	170	1.000	`\mathcal{C}^{r}`	$\mathcal{C}^r$	
gilmore-lie-groups_F01654	170	1.000	`\mathfrak{s o}(2 n), \mathfrak{s o}(2 n+1), \mathfrak{s p}(2 n)`	$\mathfrak{so}(2n), \mathfrak{so}(2n+1), \mathfrak{sp}(2n)$	really restrictions are imposed on the coefficients a^{ij}. **a.** What are the conditions on a^{ij} for each matrix Lie algebra?
gilmore-lie-groups_F01655	170	1.000	`\sum_{i j} a^{i j} M_{i j}`	$\sum_{ij} a^{ij} M_{ij}$	really restrictions are imposed on the coefficients a^{ij}. **a.** What are the conditions on a^{ij} for each matrix Lie algebra?
gilmore-lie-groups_F01656	170	1.000	`\mathfrak{s o}(2 n), \mathfrak{s p}(2 n)`	$\mathfrak{so}(2n), \mathfrak{sp}(2n)$	these matrix Lie algebras.
gilmore-lie-groups_F01657	170	1.000	`(2 n+1) \times(2 n+1)`	$(2n+1) \times (2n+1)$	these matrix Lie algebras.
gilmore-lie-groups_F01658	170	1.000	`a^{i j}`	a^{ij}	**c.** Show that all odd coefficients $\phi_r(a^{ij})$ vanish for ea
gilmore-lie-groups_F01659	170	1.000	`\phi_{r}\left(a^{i j}\right)`	$\phi_r\left(a^{ij}\right)$	$(l = 2n, 2n+1, 2n)$.
gilmore-lie-groups_F01660	170	0.999	`\epsilon_{i_{1} i_{2} \cdots i_{l}}`	$\epsilon_{i_1 i_2 \cdots i_l}$	**g.** Show that $\phi_{2n}(a^{ij})$ is a perfect square for $\mathfrak{so}(2n)$, write down its square root, show that it is of degree n
gilmore-lie-groups_F01661	170	1.000	`(l=2 n, 2 n+1,2 n)`	$(l = 2n, 2n+1, 2n)$	
gilmore-lie-groups_F01662	170	1.000	`\phi_{2 n}\left(a^{i j}\right)`	$\phi_{2n}\left(a^{ij}\right)$	
gilmore-lie-groups_F01663	171	0.999	`\operatorname{tr} M^{2}=-2 \theta \cdot \theta`	$\operatorname{tr} M^2 = -2\theta \cdot \theta$	**b.** Show $\operatorname{tr} \mathcal{M}^2 = -2\mathbf{J} \cdot \mathbf{J}$.
gilmore-lie-groups_F01664	171	0.987	`\operatorname{tr} \mathcal{M}^{2}=-2 \mathbf{J} \cdot \mathbf{J}`	$\operatorname{tr} \mathcal{M}^2 = -2\mathbf{J} \cdot \mathbf{J}$	**c.** Show $[\mathbf{J}, \operatorname{tr} \mathcal{M}^2] = 0$.
gilmore-lie-groups_F01665	171	1.000	`\left[\mathbf{J}, \operatorname{tr} \mathcal{M}^{2} \right]=0`	$[\mathbf{J}, \operatorname{tr} \mathcal{M}^2] = 0$	**d.** Show $\operatorname{tr} \mathcal{M}^{2n+1} = 0$ and
gilmore-lie-groups_F01666	171	0.999	`\operatorname{tr} \mathcal{M}^{2 n+1}=0`	$\operatorname{tr} \mathcal{M}^{2n+1} = 0$	**Casimir covariants** A semisimple Lie algebra has ba
gilmore-lie-groups_F01667	171	0.999	`\operatorname{tr} \mathcal{M}^{2 n}=(-2)^{n}(\mathbf{J} \cdot \mathbf{J})^{n}`	$\operatorname{tr} \mathcal{M}^{2n} = (-2)^n (\mathbf{J} \cdot \mathbf{J})^n$	**Casimir covariants** A semisimple Lie algebra has ba
gilmore-lie-groups_F01668	171	1.000	`\left[X_{i}, X_{j}\right]=C_{i j}{ }^{k} X_{k}`	$[X_i, X_j] = C_{ij}{}^k X_k$	and Y_i, that carry irreducible representations of this Lie algebra: $X_i \to \Gamma^{(1)}(X_i) = Y_i$ and $X_i \to \Gamma^{(2)}(X_i) = Z_i$. Show that the Casimir covariant $g^{ij} Y_i Z_j$ commutes with
gilmore-lie-groups_F01669	171	1.000	`V^{(1)}`	$V^{(1)}$	and Y_i, that carry irreducible representations of this Lie algebra: $X_i \to \Gamma^{(1)}(X_i) = Y_i$ and $X_i \to \Gamma^{(2)}(X_i) = Z_i$. Show that the Casimir covariant $g^{ij} Y_i Z_j$ commutes with
gilmore-lie-groups_F01670	171	1.000	`V^{(2)}`	$V^{(2)}$	Y_i and $X_i \to \Gamma^{(2)}(X_i) = Z_i$. Show that the Casimir covariant $g^{ij} Y_i Z_j$ commutes with $(Y+Z)_k$ (more accurately, with $\Gamma^{(1)}(X_i) \otimes I_{\dim V^{(2)}} + I_{\dim V^{(1)}} \otimes \Gamma^{(2)}(X_i)$).
gilmore-lie-groups_F01671	171	1.000	`X_{i} \rightarrow \Gamma^{(1)}\left(X_{i}\right)=`	$X_i \to \Gamma^{(1)}\left(X_i\right) =$	Y_i and $X_i \to \Gamma^{(2)}(X_i) = Z_i$. Show that the Casimir covariant $g^{ij} Y_i Z_j$ commutes with $(Y+Z)_k$ (more accurately, with $\Gamma^{(1)}(X_i) \otimes I_{\dim V^{(2)}} + I_{\dim V^{(1)}} \otimes \Gamma^{(2)}(X_i)$).
gilmore-lie-groups_F01672	171	1.000	`Y_{i}`	Y_i	The Cayley–Hamilton theorem guarantees that a polynomial or analytic function of
gilmore-lie-groups_F01673	171	1.000	`X_{i} \rightarrow \Gamma^{(2)}\left(X_{i}\right)=Z_{i}`	$X_i \to \Gamma^{(2)}\left(X_i\right) = Z_i$	The Cayley–Hamilton theorem guarantees that a polynomial or analytic function of

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gilmore-lie-groups_F01674	171	1.000	`g^{i j} Y_{i} Z_{j}`	$g^{ij} Y_i Z_j$	The Cayley–Hamilton theorem guarantees that a polynomial or analytic function of
gilmore-lie-groups_F01675	171	0.857	`(Y+Z)_{k}`	$(Y+Z)_k$	The Cayley–Hamilton theorem guarantees that a polynomial or analytic function c a square $n \times n$ matrix X can be expressed as a finite polynomial in the first n power
gilmore-lie-groups_F01676	171	0.857	`\Gamma^{(1)}\left(X_{i}\right) \otimes I_{ \operatorname{dim} V^{(2)}}+I_{\operatorname{dim} V^{(1)}} \otimes \Gamma^{(2)}\left(X_{i}\right)`	$\Gamma^{(1)}\left(X_i\right) \otimes I_{\operatorname{dim} V^{(2)}}+I_{\operatorname{dim} V^{(1)}} \otimes \Gamma^{(2)}\left(X_i\right)$	The Cayley–Hamilton theorem guarantees that a polynomial or analytic function c a square $n \times n$ matrix X can be expressed as a finite polynomial in the first n power
gilmore-lie-groups_F01677	171	1.000	`X^{0}=I_{n}`	$X^0 = I_n$	$f(X) = f_0 I + \ldots$
gilmore-lie-groups_F01678	171	1.000	`\lambda_{i}(X)`	$\lambda_i(X)$	is chosen as generic diagonal. In fact it reduces to
gilmore-lie-groups_F01679	171	1.000	`\phi_{i}(X)`	$\phi_i(X)$	is chosen as generic diagonal. In fact it reduces to
gilmore-lie-groups_F01680	171	0.967	`e^{i \phi J_{z}}`	$e^{i\phi J_z}$	
gilmore-lie-groups_F01681	171	0.999	`j=\frac{1}{2}, 1, \frac{3}{2}, 2`	$j=\frac{1}{2}, 1, \frac{3}{2}, 2$	
gilmore-lie-groups_F01682	172	1.000	`f_{j}(\phi)`	$f_j(\phi)$	
gilmore-lie-groups_F01683	172	1.000	`e^{X}`	e^X	Representation
gilmore-lie-groups_F01684	172	1.000	`X \in \mathfrak{s u}(2)`	$X \in \mathfrak{su}(2)$	Representation
gilmore-lie-groups_F01685	172	1.000	`(i \phi)^{j} f_{j}`	$(i\phi)^j f_j$	$(i\phi)^j f_j$ | $\frac{1}{2}$ | 3 | $\frac{1}{2}$ | 5 f_0 | $\cos(\phi/2)$ | 1 | $\frac{9}{8}\cos(\frac{\phi}{2}) - \frac{1}{8}\cos(\frac{3\phi}{2})$ | 1 $(i\phi)^1 f_1$ | $2i\sin(\phi/2)$ | $i\sin(\phi)$ | $\frac{9i}{4}\sin(\frac{\phi}{2}) - \frac{i}{12}\sin(\frac{3\phi}{2})$ | $\frac{i}{3}\sin(\phi) - \frac{i}{6}\sin(2\phi)$ $(i\phi)^2 f_2$ | | $\cos(\phi)-1$ | $-\frac{1}{2}\cos(\frac{\phi}{2}) + \frac{1}{2}\cos(\frac{3\phi}{2})$ | $-\frac{5}{4}+\frac{1}{3}\cos(\phi)-\frac{1}{12}\cos(2\phi)$ $(i\phi)^3 f_3$ | | | $-i\sin(\frac{\phi}{2}) + \frac{i}{3}\sin(\frac{3\phi}{2})$ | $-\frac{i}{3}\sin(\phi) + \frac{i}{6}\sin(2\phi)$ $(i\phi)^4 f_4$ | | | | $\frac{1}{4} - \frac{1}{3}\cos(\phi) + \frac{1}{12}\cos(2\phi)$ **f.** Recover the two well-known expansions for $j = \frac{1}{2}$ and $l = 1$:
gilmore-lie-groups_F01686	172	1.000	`\frac{1}{2}`	$\frac{1}{2}$	$(i\phi)^j f_j$ | $\frac{1}{2}$ | 3 | $\frac{1}{2}$ | 5 f_0 | $\cos(\phi/2)$ | 1 | $\frac{9}{8}\cos(\frac{\phi}{2}) - \frac{1}{8}\cos(\frac{3\phi}{2})$ | 1 $(i\phi)^1 f_1$ | $2i\sin(\phi/2)$ | $i\sin(\phi)$ | $\frac{9i}{4}\sin(\frac{\phi}{2}) - \frac{i}{12}\sin(\frac{3\phi}{2})$ | $\frac{i}{3}\sin(\phi) - \frac{i}{6}\sin(2\phi)$ $(i\phi)^2 f_2$ | | $\cos(\phi)-1$ | $-\frac{1}{2}\cos(\frac{\phi}{2}) + \frac{1}{2}\cos(\frac{3\phi}{2})$ | $-\frac{5}{4}+\frac{1}{3}\cos(\phi)-\frac{1}{12}\cos(2\phi)$ $(i\phi)^3 f_3$ | | | $-i\sin(\frac{\phi}{2}) + \frac{i}{3}\sin(\frac{3\phi}{2})$ | $-\frac{i}{3}\sin(\phi) + \frac{i}{6}\sin(2\phi)$ $(i\phi)^4 f_4$ | | | | $\frac{1}{4} - \frac{1}{3}\cos(\phi) + \frac{1}{12}\cos(2\phi)$ **f.** Recover the two well-known expansions for $j = \frac{1}{2}$ and $l = 1$:
gilmore-lie-groups_F01687	172	1.000	`\frac{3}{2}`	$\frac{3}{2}$	$(i\phi)^j f_j$ | $\frac{1}{2}$ | 3 | $\frac{1}{2}$ | 5 f_0 | $\cos(\phi/2)$ | 1 | $\frac{9}{8}\cos(\frac{\phi}{2}) - \frac{1}{8}\cos(\frac{3\phi}{2})$ | 1 $(i\phi)^1 f_1$ | $2i\sin(\phi/2)$ | $i\sin(\phi)$ | $\frac{9i}{4}\sin(\frac{\phi}{2}) - \frac{i}{12}\sin(\frac{3\phi}{2})$ | $\frac{i}{3}\sin(\phi) - \frac{i}{6}\sin(2\phi)$ $(i\phi)^2 f_2$ | | $\cos(\phi)-1$ | $-\frac{1}{2}\cos(\frac{\phi}{2}) + \frac{1}{2}\cos(\frac{3\phi}{2})$ | $-\frac{5}{4}+\frac{1}{3}\cos(\phi)-\frac{1}{12}\cos(2\phi)$ $(i\phi)^3 f_3$ | | | $-i\sin(\frac{\phi}{2}) + \frac{i}{3}\sin(\frac{3\phi}{2})$ | $-\frac{i}{3}\sin(\phi) + \frac{i}{6}\sin(2\phi)$ $(i\phi)^4 f_4$ | | | | $\frac{1}{4} - \frac{1}{3}\cos(\phi) + \frac{1}{12}\cos(2\phi)$ **f.** Recover the two well-known expansions for $j = \frac{1}{2}$ and $l = 1$:

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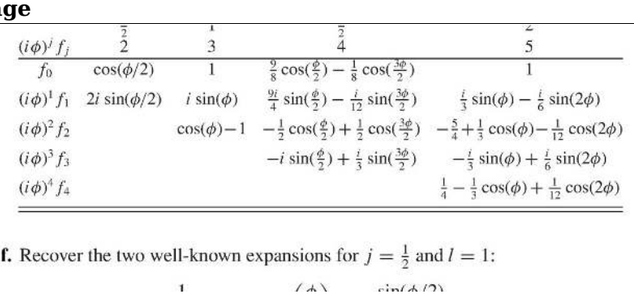
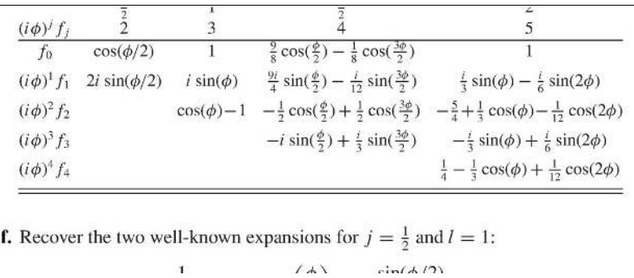
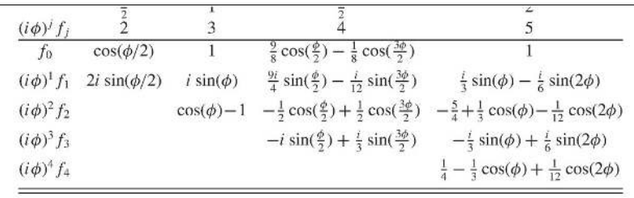
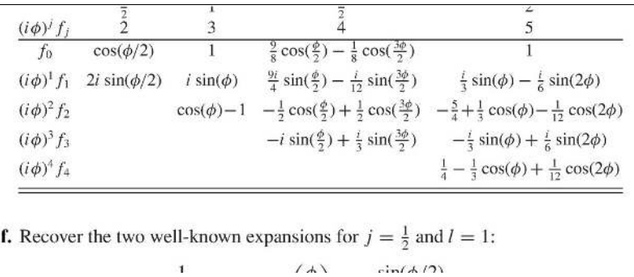
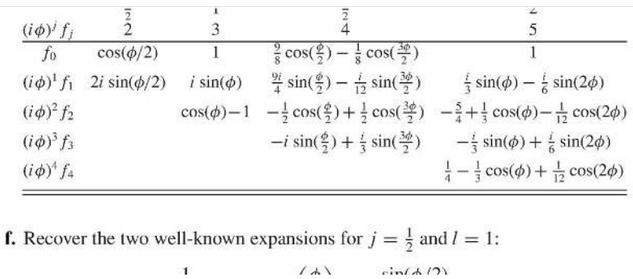
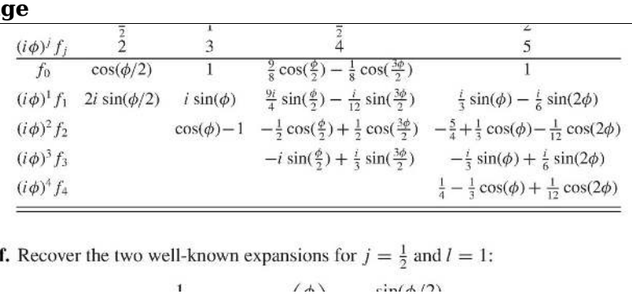
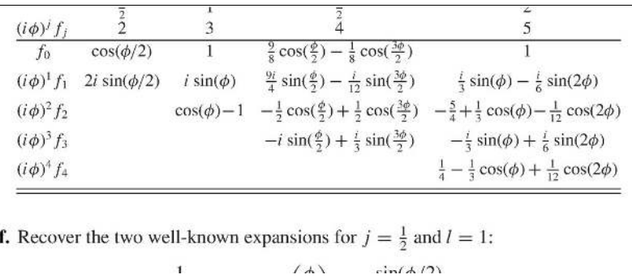
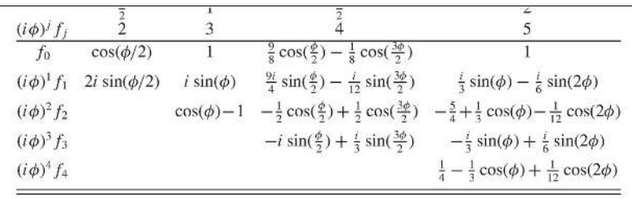
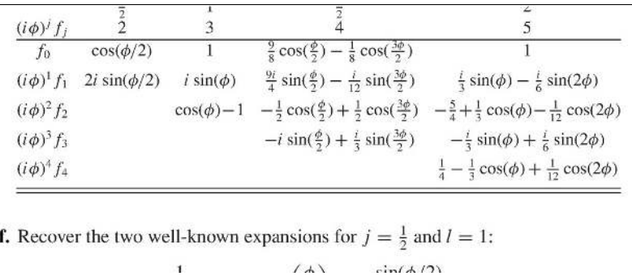
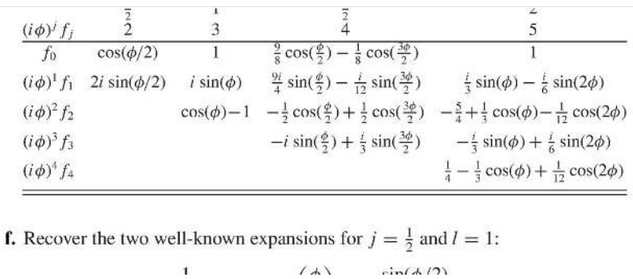
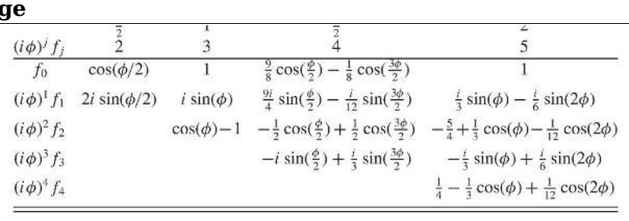
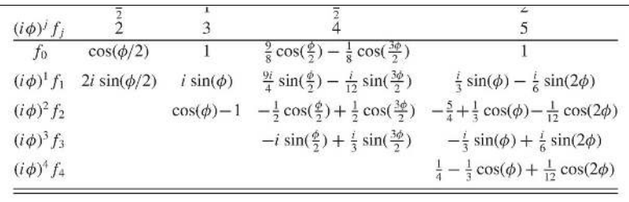
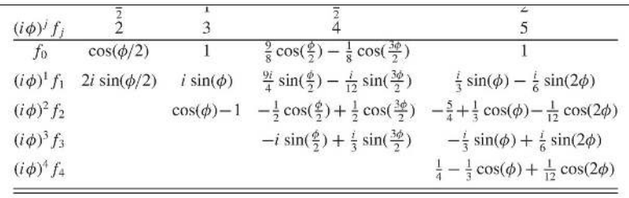
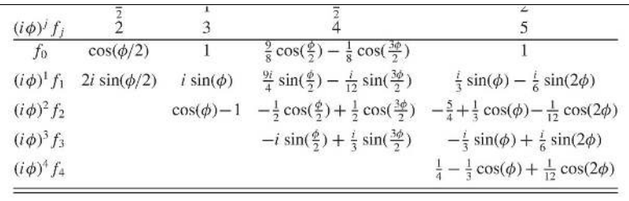
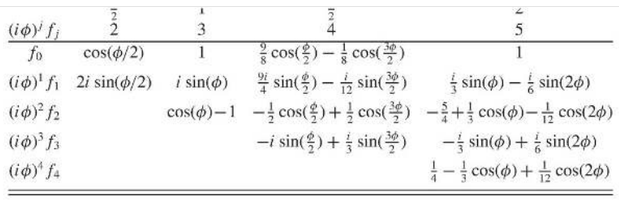
gilmore-lie-groups_F01688	172	■ 1.000	`f_{0}`	f_0	
gilmore-lie-groups_F01689	172	■ 1.000	`\cos (\phi / 2)`	$\cos(\phi/2)$	
gilmore-lie-groups_F01690	172	■ 1.000	`\frac{9}{8} \cos \left(\frac{\phi}{2}\right)-\frac{1}{8} \cos \left(\frac{3 \phi}{2}\right)`	$\frac{9}{8} \cos \left(\frac{\phi}{2}\right)-\frac{1}{8} \cos \left(\frac{3 \phi}{2}\right)$	
gilmore-lie-groups_F01691	172	■ 1.000	`(i \phi)^{1} f_{1}`	$(i\phi)^1 f_1$	
gilmore-lie-groups_F01692	172	■ 1.000	`2 i \sin (\phi / 2)`	$2i \sin(\phi/2)$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01693	172	■1.000	`i \sin (\phi)`	$i \sin(\phi)$	
gilmore-lie-groups_F01694	172	■1.000	`\frac{9 i}{4} \sin \left(\frac{\phi}{2}\right)-\frac{i}{12} \sin \left(\frac{3 \phi}{2}\right)`	$\frac{9 i}{4} \sin \left(\frac{\phi}{2}\right)-\frac{i}{12} \sin \left(\frac{3 \phi}{2}\right)$	
gilmore-lie-groups_F01695	172	■1.000	`\frac{i}{3} \sin (\phi)-\frac{i}{6} \sin (2 \phi)`	$\frac{i}{3} \sin(\phi)-\frac{i}{6} \sin(2 \phi)$	
gilmore-lie-groups_F01696	172	■1.000	`(i \phi)^{2} f_{2}`	$(i \phi)^{2} f_{2}$	
gilmore-lie-groups_F01697	172	■1.000	`\cos (\phi)-1`	$\cos(\phi)-1$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_FO1698	172	■1.000	`-\frac{1}{2} \cos \left(\frac{\phi}{2}\right)+\frac{1}{2} \cos \left(\frac{3 \phi}{2}\right)`	$-\frac{1}{2} \cos \left(\frac{\phi}{2}\right)+\frac{1}{2} \cos \left(\frac{3 \phi}{2}\right)$	
gilmore-lie-groups_FO1699	172	■1.000	`-\frac{5}{4}+\frac{1}{3} \cos (\phi)-\frac{1}{12} \cos (2 \phi)`	$-\frac{5}{4}+\frac{1}{3} \cos (\phi)-\frac{1}{12} \cos (2 \phi)$	
gilmore-lie-groups_FO1700	172	■1.000	`(i \phi)^{3} f_{3}`	$(i \phi)^{3} f_{3}$	
gilmore-lie-groups_FO1701	172	■1.000	`-i \sin \left(\frac{\phi}{2}\right)+\frac{i}{3} \sin \left(\frac{3 \phi}{2}\right)`	$-i \sin \left(\frac{\phi}{2}\right)+\frac{i}{3} \sin \left(\frac{3 \phi}{2}\right)$	
gilmore-lie-groups_FO1702	172	■1.000	`-\frac{i}{3} \sin (\phi)+\frac{i}{6} \sin (2 \phi)`	$-\frac{i}{3} \sin (\phi)+\frac{i}{6} \sin (2 \phi)$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01703	172	■1.000	`(i \phi)^{4} f_{4}`	$(i\phi)^{4} f_{4}$	$(i\phi)^j f_j$ $\frac{0}{2}$ $\frac{1}{3}$ $\frac{2}{4}$ $\frac{2}{5}$ f_0 $\cos(\phi/2)$ 1 $\frac{9}{8}\cos(\frac{\phi}{2})-\frac{1}{8}\cos(\frac{3\phi}{2})$ 1 $(i\phi)^1 f_1$ $2i\sin(\phi/2)$ $i\sin(\phi)$ $\frac{9i}{4}\sin(\frac{\phi}{2})-\frac{i}{12}\sin(\frac{3\phi}{2})$ $\frac{i}{3}\sin(\phi)-\frac{i}{6}\sin(2\phi)$ $(i\phi)^2 f_2$ $\cos(\phi)-1$ $-\frac{1}{2}\cos(\frac{\phi}{2})+\frac{1}{2}\cos(\frac{3\phi}{2})$ $-\frac{5}{4}+\frac{1}{3}\cos(\phi)-\frac{1}{12}\cos(2\phi)$ $(i\phi)^3 f_3$ $-i\sin(\frac{\phi}{2})+\frac{i}{3}\sin(\frac{3\phi}{2})$ $-\frac{i}{3}\sin(\phi)+\frac{i}{6}\sin(2\phi)$ $(i\phi)^4 f_4$ $\frac{1}{4}-\frac{1}{3}\cos(\phi)+\frac{1}{12}\cos(2\phi)$ **f.** Recover the two well-known expansions for $j=\frac{1}{2}$ and $l=1$:
gilmore-lie-groups_F01704	172	■1.000	`\frac{1}{4}-\frac{1}{3} \cos (\phi)+\frac{1}{12} \cos (2 \phi)`	$\frac{1}{4}-\frac{1}{3}\cos(\phi)+\frac{1}{12}\cos(2\phi)$	$(i\phi)^j f_j$ $\frac{0}{2}$ $\frac{1}{3}$ $\frac{2}{4}$ $\frac{2}{5}$ f_0 $\cos(\phi/2)$ 1 $\frac{9}{8}\cos(\frac{\phi}{2})-\frac{1}{8}\cos(\frac{3\phi}{2})$ 1 $(i\phi)^1 f_1$ $2i\sin(\phi/2)$ $i\sin(\phi)$ $\frac{9i}{4}\sin(\frac{\phi}{2})-\frac{i}{12}\sin(\frac{3\phi}{2})$ $\frac{i}{3}\sin(\phi)-\frac{i}{6}\sin(2\phi)$ $(i\phi)^2 f_2$ $\cos(\phi)-1$ $-\frac{1}{2}\cos(\frac{\phi}{2})+\frac{1}{2}\cos(\frac{3\phi}{2})$ $-\frac{5}{4}+\frac{1}{3}\cos(\phi)-\frac{1}{12}\cos(2\phi)$ $(i\phi)^3 f_3$ $-i\sin(\frac{\phi}{2})+\frac{i}{3}\sin(\frac{3\phi}{2})$ $-\frac{i}{3}\sin(\phi)+\frac{i}{6}\sin(2\phi)$ $(i\phi)^4 f_4$ $\frac{1}{4}-\frac{1}{3}\cos(\phi)+\frac{1}{12}\cos(2\phi)$ **f.** Recover the two well-known expansions for $j=\frac{1}{2}$ and $l=1$:
gilmore-lie-groups_F01705	172	■1.000	`j=\frac{1}{2}`	$j=\frac{1}{2}$	
gilmore-lie-groups_F01706	172	■1.000	`l=1`	$l=1$	
gilmore-lie-groups_F01707	173	■1.000	`l+1`	$l+1$	inner products among a fundamental set of basis roots in the root space
gilmore-lie-groups_F01708	174	■1.000	`m, n`	m,n	
gilmore-lie-groups_F01709	174	■1.000	`\beta+k \alpha`	$\beta+k\alpha$	$\sum \alpha\cdot\alpha = \text{rank} = l$ (10.3
gilmore-lie-groups_F01710	174	■1.000	`k=-m, \ldots,+n`	$k=-m,\ldots,+n$	$\sum \alpha\cdot\alpha = \text{rank} = l$ (10.3
gilmore-lie-groups_F01711	174	■0.999	`\beta^{\prime}`	β'	integers, then by the Schwarz inequality
gilmore-lie-groups_F01712	174	■1.000	`2(\alpha \cdot \beta) /(\alpha \cdot \alpha)=n`	$2(\alpha\cdot\beta)/(\alpha\cdot\alpha)=n$	$0 \le \cos^2(\alpha,\beta) = \left(\frac{\alpha\cdot p}{}\right)\left(\frac{\alpha\cdot p}{}\right) = \frac{n\,n}{}\ \le 1$ (10.5)
gilmore-lie-groups_F01713	174	■1.000	`2(\alpha \cdot \beta) /(\beta \cdot \beta)=n^{\prime}`	$2(\alpha\cdot\beta)/(\beta\cdot\beta)=n'$	$0 \le \cos^2(\alpha,\beta) = \left(\frac{\alpha\cdot p}{}\right)\left(\frac{\alpha\cdot p}{}\right) = \frac{n\,n}{}\ \le 1$ (10.5)
gilmore-lie-groups_F01714	174	■0.992	`\pm \mathbf{e}_{1}`	$\pm\mathbf{e}_1$	are A_2, $B_2=C_2$, D_2 and G_2, as shown in Fig. 9.6.
gilmore-lie-groups_F01715	174	■1.000	`A_{2}, B_{2}=C_{2}, D_{2}`	$A_2, B_2=C_2, D_2$	

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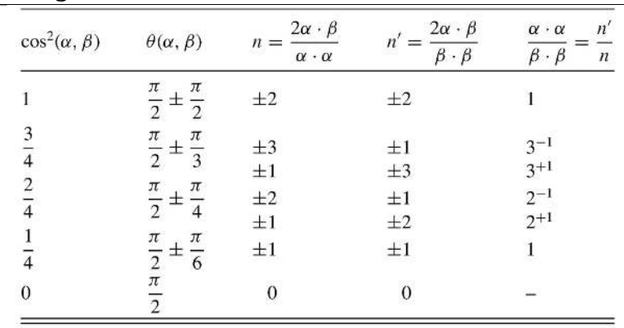
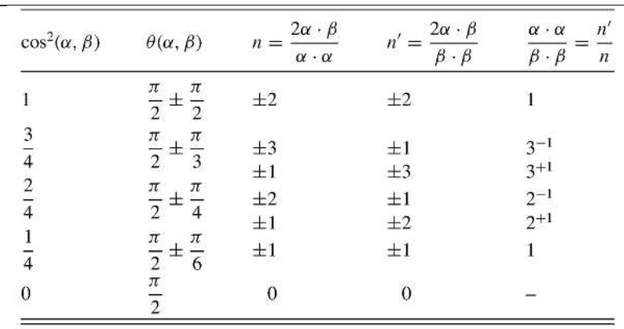
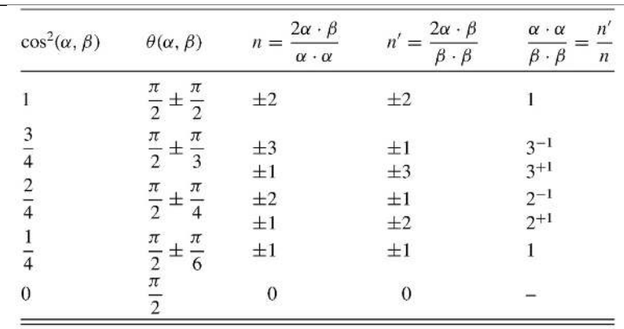
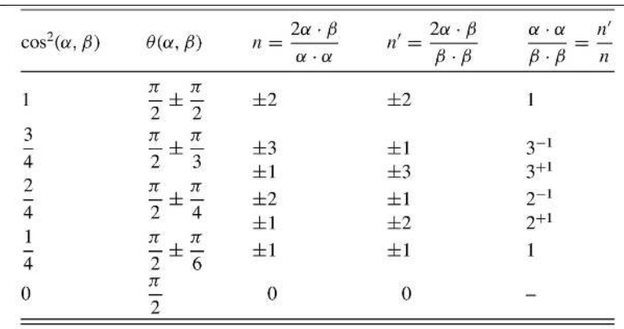
gilmore-lie-groups_F01716	175	0.995	`\cos ^{2}(\alpha, \beta)`	$\cos^{2}(\alpha, \beta)$	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ±2 ±2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ±3 ±1 3^{-1} ±1 ±3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ±2 ±1 2^{-1} ±1 ±2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ±1 ±1 1 0 $\frac{\pi}{2}$ 0 0 $-$
gilmore-lie-groups_F01717	175	0.995	`\theta(\alpha, \beta)`	$\theta(\alpha, \beta)$	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ±2 ±2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ±3 ±1 3^{-1} ±1 ±3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ±2 ±1 2^{-1} ±1 ±2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ±1 ±1 1 0 $\frac{\pi}{2}$ 0 0 $-$
gilmore-lie-groups_F01718	175	0.995	`n=\frac{2 \alpha \cdot \beta}{\alpha \cdot \alpha}`	$n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ±2 ±2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ±3 ±1 3^{-1} ±1 ±3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ±2 ±1 2^{-1} ±1 ±2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ±1 ±1 1 0 $\frac{\pi}{2}$ 0 0 $-$
gilmore-lie-groups_F01719	175	0.995	`n^{\prime}=\frac{2 \alpha \cdot \beta}{\beta \cdot \beta}`	$n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ±2 ±2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ±3 ±1 3^{-1} ±1 ±3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ±2 ±1 2^{-1} ±1 ±2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ±1 ±1 1 0 $\frac{\pi}{2}$ 0 0 $-$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01720	175	0.995	`\frac{\alpha \cdot \alpha}{\beta \cdot \beta}=\frac{n^{\prime}}{n}`	$\frac{\alpha \cdot \alpha}{\beta \cdot \beta}=\frac{n^{\prime}}{n}$	
gilmore-lie-groups_F01721	175	0.995	`\frac{\pi}{2} \pm \frac{\pi}{2}`	$\frac{\pi}{2} \pm \frac{\pi}{2}$	
gilmore-lie-groups_F01722	175	0.995	`\pm 2`	± 2	
gilmore-lie-groups_F01723	175	0.995	`\frac{\pi}{2} \pm \frac{\pi}{3}`	$\frac{\pi}{2} \pm \frac{\pi}{3}$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01724	175	0.995	`\pm 3`	± 3	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ± 2 ± 2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ± 3 ± 1 3^{-1} ± 1 ± 3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ± 2 ± 1 2^{-1} ± 1 ± 2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ± 1 ± 1 1 0 $\frac{\pi}{2}$ 0 0 $-$
gilmore-lie-groups_F01725	175	0.995	`3^{-1}`	3^{-1}	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ± 2 ± 2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ± 3 ± 1 3^{-1} ± 1 ± 3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ± 2 ± 1 2^{-1} ± 1 ± 2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ± 1 ± 1 1 0 $\frac{\pi}{2}$ 0 0 $-$
gilmore-lie-groups_F01726	175	0.995	`3^{+1}`	3^{+1}	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ± 2 ± 2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ± 3 ± 1 3^{-1} ± 1 ± 3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ± 2 ± 1 2^{-1} ± 1 ± 2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ± 1 ± 1 1 0 $\frac{\pi}{2}$ 0 0 $-$
gilmore-lie-groups_F01727	175	0.995	`\frac{2}{4}`	$\frac{2}{4}$	$\cos^2(\alpha,\beta)$ $\theta(\alpha,\beta)$ $n=\frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ $n'=\frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ $\frac{\alpha\cdot\alpha}{\beta\cdot\beta}=\frac{n'}{n}$ 1 $\frac{\pi}{2}\pm\frac{\pi}{2}$ ± 2 ± 2 1 $\frac{3}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{3}$ ± 3 ± 1 3^{-1} ± 1 ± 3 3^{+1} $\frac{2}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{4}$ ± 2 ± 1 2^{-1} ± 1 ± 2 2^{+1} $\frac{1}{4}$ $\frac{\pi}{2}\pm\frac{\pi}{6}$ ± 1 ± 1 1 0 $\frac{\pi}{2}$ 0 0 $-$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01728	175	0.995	`\frac{\pi}{2} \pm \frac{\pi}{4}`	$\frac{\pi}{2} \pm \frac{\pi}{4}$	$\cos^2(\alpha,\beta)$ / $\theta(\alpha,\beta)$ / $n = \frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ / $n' = \frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ / $\frac{\alpha\cdot\alpha}{\beta\cdot\beta} = \frac{n'}{n}$ 1 / $\frac{\pi}{2} \pm \frac{\pi}{2}$ / ± 2 / ± 2 / 1 $\frac{3}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{3}$ / ± 3 / ± 1 / 3^{-1} ± 1 / ± 3 / 3^{+1} $\frac{2}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{4}$ / ± 2 / ± 1 / 2^{-1} ± 1 / ± 2 / 2^{+1} $\frac{1}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{6}$ / ± 1 / ± 1 / 1 0 / $\frac{\pi}{2}$ / 0 / 0 / $-$
gilmore-lie-groups_F01729	175	0.995	`2^{-1}`	2^{-1}	$\cos^2(\alpha,\beta)$ / $\theta(\alpha,\beta)$ / $n = \frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ / $n' = \frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ / $\frac{\alpha\cdot\alpha}{\beta\cdot\beta} = \frac{n'}{n}$ 1 / $\frac{\pi}{2} \pm \frac{\pi}{2}$ / ± 2 / ± 2 / 1 $\frac{3}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{3}$ / ± 3 / ± 1 / 3^{-1} ± 1 / ± 3 / 3^{+1} $\frac{2}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{4}$ / ± 2 / ± 1 / 2^{-1} ± 1 / ± 2 / 2^{+1} $\frac{1}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{6}$ / ± 1 / ± 1 / 1 0 / $\frac{\pi}{2}$ / 0 / 0 / $-$
gilmore-lie-groups_F01730	175	0.995	`2^{+1}`	2^{+1}	$\cos^2(\alpha,\beta)$ / $\theta(\alpha,\beta)$ / $n = \frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ / $n' = \frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ / $\frac{\alpha\cdot\alpha}{\beta\cdot\beta} = \frac{n'}{n}$ 1 / $\frac{\pi}{2} \pm \frac{\pi}{2}$ / ± 2 / ± 2 / 1 $\frac{3}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{3}$ / ± 3 / ± 1 / 3^{-1} ± 1 / ± 3 / 3^{+1} $\frac{2}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{4}$ / ± 2 / ± 1 / 2^{-1} ± 1 / ± 2 / 2^{+1} $\frac{1}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{6}$ / ± 1 / ± 1 / 1 0 / $\frac{\pi}{2}$ / 0 / 0 / $-$
gilmore-lie-groups_F01731	175	0.995	`\frac{1}{4}`	$\frac{1}{4}$	$\cos^2(\alpha,\beta)$ / $\theta(\alpha,\beta)$ / $n = \frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ / $n' = \frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ / $\frac{\alpha\cdot\alpha}{\beta\cdot\beta} = \frac{n'}{n}$ 1 / $\frac{\pi}{2} \pm \frac{\pi}{2}$ / ± 2 / ± 2 / 1 $\frac{3}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{3}$ / ± 3 / ± 1 / 3^{-1} ± 1 / ± 3 / 3^{+1} $\frac{2}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{4}$ / ± 2 / ± 1 / 2^{-1} ± 1 / ± 2 / 2^{+1} $\frac{1}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{6}$ / ± 1 / ± 1 / 1 0 / $\frac{\pi}{2}$ / 0 / 0 / $-$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01732	175	0.995	`\frac{\pi}{2} \pm \frac{\pi}{6}`	$\frac{\pi}{2} \pm \frac{\pi}{6}$	$\cos^2(\alpha,\beta)$ / $\theta(\alpha,\beta)$ / $n = \frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ / $n' = \frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ / $\frac{\alpha\cdot\alpha}{\beta\cdot\beta} = \frac{n'}{n}$ 1 / $\frac{\pi}{2} \pm \frac{\pi}{2}$ / ± 2 / ± 2 / 1 $\frac{3}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{3}$ / ± 3, ± 1 / ± 1, ± 3 / 3^{-1}, 3^{+1} $\frac{2}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{4}$ / ± 2, ± 1 / ± 1, ± 2 / 2^{-1}, 2^{+1} $\frac{1}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{6}$ / ± 1 / ± 1 / 1 0 / $\frac{\pi}{2}$ / 0 / 0 / $-$
gilmore-lie-groups_F01733	175	0.995	`\frac{\pi}{2}`	$\frac{\pi}{2}$	$\cos^2(\alpha,\beta)$ / $\theta(\alpha,\beta)$ / $n = \frac{2\alpha\cdot\beta}{\alpha\cdot\alpha}$ / $n' = \frac{2\alpha\cdot\beta}{\beta\cdot\beta}$ / $\frac{\alpha\cdot\alpha}{\beta\cdot\beta} = \frac{n'}{n}$ 1 / $\frac{\pi}{2} \pm \frac{\pi}{2}$ / ± 2 / ± 2 / 1 $\frac{3}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{3}$ / ± 3, ± 1 / ± 1, ± 3 / 3^{-1}, 3^{+1} $\frac{2}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{4}$ / ± 2, ± 1 / ± 1, ± 2 / 2^{-1}, 2^{+1} $\frac{1}{4}$ / $\frac{\pi}{2} \pm \frac{\pi}{6}$ / ± 1 / ± 1 / 1 0 / $\frac{\pi}{2}$ / 0 / 0 / $-$
gilmore-lie-groups_F01734	175	0.998	`(l-1)`	$(l-1)$	A_{l-1} $+\mathbf{e}_i - \mathbf{e}_j$ $1 \le i \ne j \le l$ $l-1 \ge 1$
gilmore-lie-groups_F01735	175	0.998	`D_{l}`	D_l	$A_1 = B_1 = C_1$
gilmore-lie-groups_F01736	175	0.998	`\pm\left(\mathbf{e}_{i}+\mathbf{e}_{j}\right)`	$\pm\left(\mathbf{e}_i + \mathbf{e}_j\right)$	$A_1 = B_1 = C_1$
gilmore-lie-groups_F01737	175	0.998	`A_{l-1}`	A_{l-1}	$A_1 = B_1 = C_1$
gilmore-lie-groups_F01738	175	0.998	`B_{l}, C_{l}`	B_l, C_l	$A_1 = B_1 = C_1$
gilmore-lie-groups_F01739	175	1.000	`\pm \mathbf{e}_{i}, \pm 2 \mathbf{e}_{i}`	$\pm\mathbf{e}_i, \pm 2\mathbf{e}_i$	$B_2 = C_2$ (10.7)
gilmore-lie-groups_F01740	175	1.000	`A_{l-1}, D_{l}, B_{l}, C_{l}`	A_{l-1}, D_l, B_l, C_l	$B_2 = C_2$ (10.7)
gilmore-lie-groups_F01741	176	1.000	`A_{3}, D_{3}`	A_3, D_3	
gilmore-lie-groups_F01742	176	1.000	`B_{3}, C_{3}`	B_3, C_3	
gilmore-lie-groups_F01743	178	1.000	`A_{1}`	A_1	
gilmore-lie-groups_F01744	178	1.000	`S L(l ; C)`	$SL(l;C)$	**Remark 2.** The root space D_2 consists of two orthogonal sets of roots
gilmore-lie-groups_F01745	178	0.997	`\pm\left(\mathbf{e}_{1}-\mathbf{e}_{2}\right)`	$\pm\left(\mathbf{e}_1 - \mathbf{e}_2\right)$	describe semisimple Lie algebras. Root subspaces that do not have an orthogonal
gilmore-lie-groups_F01746	178	1.000	`\pm\left(\mathbf{e}_{1}+\mathbf{e}_{2}\right)`	$\pm\left(\mathbf{e}_1 + \mathbf{e}_2\right)$	decomposition describe simple Lie algebras. Complete reducibility of the regu-

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gilmore-lie-groups_F01747	178	0.964	`B_{2}`	B_2	quaternion by a complex 2×2 matrix. Therefore we should expect $SO(5)$ to
gilmore-lie-groups_F01748	178	0.513	`S O(5)`	$SO(5)$	have a four-dimensional "spinor" representation based on $U(2;\mathbb{Q})$ in the same way
gilmore-lie-groups_F01749	178	0.513	`S p(2)=U(2 ; \mathbb{Q})`	$Sp(2) = U(2;\mathbb{Q})$	have a four-dimensional "spinor" representation based on $U(2;\mathbb{Q})$ in the same way
gilmore-lie-groups_F01750	178	1.000	`U(2 ; \mathbb{Q})`	$U(2;\mathbb{Q})$	**Remark 4.** In the building-up construction the roots in each root space diagram are
gilmore-lie-groups_F01751	178	0.975	`S O(3)\left(B_{1}\right)`	$SO(3)\left(B_1\right)$	explicitly constructed. What is not immediately obvious is that there are no more
gilmore-lie-groups_F01752	178	0.975	`U(1 ; Q)`	$U(1;Q)$	explicitly constructed. What is not immediately obvious is that there are no more
gilmore-lie-groups_F01753	178	0.995	`\operatorname{SU}(2)\left(A_{1}\right)`	$\operatorname{SU}(2)\left(A_1\right)$	simpl
gilmore-lie-groups_F01754	179	1.000	`\alpha_{1}=\mathbf{e}_{1}-\mathbf{e}_{2}`	$\alpha_1 = \mathbf{e}_1 - \mathbf{e}_2$	
gilmore-lie-groups_F01755	179	1.000	`\alpha_{2}=`	$\alpha_2 =$	
gilmore-lie-groups_F01756	179	1.000	`-\mathbf{e}_{1}+2 \mathbf{e}_{2}-\mathbf{e}_{3}`	$-\mathbf{e}_1 + 2\mathbf{e}_2 - \mathbf{e}_3$	
gilmore-lie-groups_F01757	179	1.000	`\mathbf{R}=\mathbf{e}_{1}+\mathbf{e}_{2}+\mathbf{e}_{3}`	$\mathbf{R} = \mathbf{e}_1 + \mathbf{e}_2 + \mathbf{e}_3$	
gilmore-lie-groups_F01758	180	1.000	`G_{2} \oplus B_{3}`	$G_2 \oplus B_3$	
gilmore-lie-groups_F01759	180	0.508	`\alpha_{1}`	α_1	A_{l-1} $\mathbf{e}_1 - \mathbf{e}_2$ $\mathbf{e}_2 - \mathbf{e}_3$ $\mathbf{e}_3 - \mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1} - \mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1} + \mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01760	180	0.508	`\alpha_{2}`	α_2	A_{l-1} $\mathbf{e}_1 - \mathbf{e}_2$ $\mathbf{e}_2 - \mathbf{e}_3$ $\mathbf{e}_3 - \mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1} - \mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1} + \mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01761	180	0.508	`\alpha_{3}`	α_3	A_{l-1} $\mathbf{e}_1 - \mathbf{e}_2$ $\mathbf{e}_2 - \mathbf{e}_3$ $\mathbf{e}_3 - \mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1} - \mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1} + \mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01762	180	0.508	`\alpha_{l-1}`	α_{l-1}	A_{l-1} $\mathbf{e}_1 - \mathbf{e}_2$ $\mathbf{e}_2 - \mathbf{e}_3$ $\mathbf{e}_3 - \mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1} - \mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1} + \mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01763	180	0.508	`\alpha_{l}`	α_l	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01764	180	0.508	`\mathbf{e}_{1}-\mathbf{e}_{2}`	$\mathbf{e}_1-\mathbf{e}_2$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01765	180	0.508	`\mathbf{e}_{2}-\mathbf{e}_{3}`	$\mathbf{e}_2-\mathbf{e}_3$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01766	180	0.508	`\mathbf{e}_{3}-\mathbf{e}_{4}`	$\mathbf{e}_3-\mathbf{e}_4$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01767	180	0.508	`\mathbf{e}_{l-1}-\mathbf{e}_{l}`	$\mathbf{e}_{l-1}-\mathbf{e}_l$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01768	180	0.508	`\mathbf{e}_{l-1}+\mathbf{e}_{l}`	$\mathbf{e}_{l-1}+\mathbf{e}_l$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01769	180	0.508	`B_{l}`	B_l	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01770	180	0.508	`\mathbf{e}_{l}`	$\mathbf{e}_l$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv

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gilmore-lie-groups_F01771	180	0.508	`C_{l}`	C_l	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01772	180	0.508	`2 \mathbf{e}_{l}`	$2\mathbf{e}_l$	A_{l-1} $\mathbf{e}_1-\mathbf{e}_2$ $\mathbf{e}_2-\mathbf{e}_3$ $\mathbf{e}_3-\mathbf{e}_4$ $\cdots$ $\mathbf{e}_{l-1}-\mathbf{e}_l$ D_l " " " $\cdots$ " $\mathbf{e}_{l-1}+\mathbf{e}_l$ B_l " " " $\cdots$ " $\mathbf{e}_l$ C_l " " " $\cdots$ " $2\mathbf{e}_l$ Inner products among the fundamental roots are summarized conv
gilmore-lie-groups_F01773	180	1.000	`n_{i j}`	n_{ij}	is called a **Dynkin diagram**. The Dynkin diagram for the semisimple Lie algebra represented by orthogonal root spaces $G_2 + B_3$ is shown in Fig. 10.5
gilmore-lie-groups_F01774	180	1.000	`0,1,2`	$0, 1, 2$	is called a **Dynkin diagram**. The Dynkin diagram for the semisimple Lie algebra represented by orthogonal root spaces $G_2 + B_3$ is shown in Fig. 10.5
gilmore-lie-groups_F01775	180	1.000	`G_{2}+B_{3}`	$G_2 + B_3$	fundamental roots (3, 1 for G_2) are indicated over the root symbol, by
gilmore-lie-groups_F01776	180	0.665	`\mathbf{v}_{i}`	$\mathbf{v}_i$	These two observations are now used to list a set of properties that constrain the
gilmore-lie-groups_F01777	180	0.665	`\mathbf{u}`	$\mathbf{u}$	These two observations are now used to list a set of properties that constrain the
gilmore-lie-groups_F01778	180	1.000	`\mathbf{u} \cdot \mathbf{v}_{i}`	$\mathbf{u} \cdot \mathbf{v}_i$	allowed Dynkin diagrams ever more tightly.
gilmore-lie-groups_F01779	181	1.000	`\mathbf{u}_{i}=\alpha_{i} /\left|\alpha_{i}\right|`	$\mathbf{u}_i = \alpha_i / \left\|\alpha_i\right\|$	
gilmore-lie-groups_F01780	181	1.000	`2 \mathbf{u}_{i} \cdot \mathbf{u}_{j} \leq-1`	$2\mathbf{u}_i \cdot \mathbf{u}_j \leq -1$	$\sum_{i=1} (\mathbf{u} \cdot \mathbf{v}_i)^2 = \sum_{j=1} n_i/4 < 1$
gilmore-lie-groups_F01781	181	0.979	`(B, C, F)`	(B, C, F)	
gilmore-lie-groups_F01782	182	1.000	`\mathbf{u}_{i}, \mathbf{v}_{j}`	$\mathbf{u}_i, \mathbf{v}_j$	where $\mathbf{u}_i, \mathbf{v}_j$ are unit vectors $\mathbf{u}_i = \alpha_i/\|\alpha_i\|$ and $\mathbf{v}_i = \alpha_j/\|\alpha_j\|$, can be transformed to
gilmore-lie-groups_F01783	182	1.000	`\mathbf{v}_{i}=\alpha_{j} /\left|\alpha_{j}\right|`	$\mathbf{v}_i = \alpha_j / \left\|\alpha_j\right\|$	where $\mathbf{u}_i, \mathbf{v}_j$ are unit vectors $\mathbf{u}_i = \alpha_i/\|\alpha_i\|$ and $\mathbf{v}_i = \alpha_j/\|\alpha_j\|$, can be transformed to
gilmore-lie-groups_F01784	182	0.985	`p \geq q`	$p \geq q$	This has the following solutions with $p \geq$
gilmore-lie-groups_F01785	182	0.657	`(D, E)`	(D, E)	as in Eq. (10.16) leads to the inequality
gilmore-lie-groups_F01786	182	0.997	`p \geq q \geq r \geq 2`	$p \geq q \geq r \geq 2$	p q r Root space
gilmore-lie-groups_F01787	182	0.999	`D_{p+2}`	D_{p+2}	3 3 2 E_6 4 3 2 E_7 5 3 2 E_8 grams are summarized in T : root spaces. Each root spa
gilmore-lie-groups_F01788	182	0.999	`E_{6}`	E_6	3 3 2 E_6 4 3 2 E_7 5 3 2 E_8 grams are summarized in T : root spaces. Each root spa

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gilmore-lie-groups_F01789	182	0.999	`E_{7}`	E_7	3 3 2 E_6 4 3 2 E_7 5 3 2 E_8 grams are summarized in T : root spaces. Each root spa
gilmore-lie-groups_F01790	182	0.999	`E_{8}`	E_8	3 3 2 E_6 4 3 2 E_7 5 3 2 E_8 grams are summarized in T : root spaces. Each root spa
gilmore-lie-groups_F01791	182	1.000	`l-1`	$l-1$	
gilmore-lie-groups_F01792	184	1.000	`f_{1}^{\dagger} f_{1}^{\dagger}=`	$f_1^\dagger f_1^\dagger =$	
gilmore-lie-groups_F01793	184	1.000	`U(l)`	$U(l)$	
gilmore-lie-groups_F01794	184	1.000	`b_{i}^{\dagger} b_{i}`	$b_i^\dagger b_i$	H_i $b_i^\dagger b_i$ $x^i\partial_i$ $f_i^\dagger f_i$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ that the following identifications are appropriate for the eigenopera paces C_l and D_l:
gilmore-lie-groups_F01795	184	1.000	`x^{i} \partial_{i}`	$x^i\partial_i$	H_i $b_i^\dagger b_i$ $x^i\partial_i$ $f_i^\dagger f_i$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ that the following identifications are appropriate for the eigenopera paces C_l and D_l:
gilmore-lie-groups_F01796	184	1.000	`f_{i}^{\dagger} f_{i}`	$f_i^\dagger f_i$	H_i $b_i^\dagger b_i$ $x^i\partial_i$ $f_i^\dagger f_i$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ that the following identifications are appropriate for the eigenopera paces C_l and D_l:
gilmore-lie-groups_F01797	184	1.000	`E_{+\mathbf{e}_{i}-\mathbf{e}_{j}}`	$E_{+\mathbf{e}_i-\mathbf{e}_j}$	H_i $b_i^\dagger b_i$ $x^i\partial_i$ $f_i^\dagger f_i$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ that the following identifications are appropriate for the eigenopera paces C_l and D_l:
gilmore-lie-groups_F01798	184	1.000	`x^{i} \partial_{j}`	$x^i\partial_j$	H_i $b_i^\dagger b_i$ $x^i\partial_i$ $f_i^\dagger f_i$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ that the following identifications are appropriate for the eigenopera paces C_l and D_l:

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gilmore-lie-groups_F01799	184	0.960	`b_{i}^{\dagger} b_{i}+\frac{1}{2}`	$b_i^\dagger b_i + \frac{1}{2}$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$
gilmore-lie-groups_F01800	184	0.960	`f_{i}^{\dagger} f_{i}+\frac{1}{2}`	$f_i^\dagger f_i + \frac{1}{2}$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$
gilmore-lie-groups_F01801	184	0.960	`x^{i} \partial_{i}+\frac{1}{2}`	$x^i \partial_i + \frac{1}{2}$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$
gilmore-lie-groups_F01802	184	0.960	`E_{+\mathbf{e}_{i}+\mathbf{e}_{j}}`	$E_{+\mathbf{e}_i + \mathbf{e}_j}$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$

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gilmore-lie-groups_FO1803	184	0.960	`b_{i}^{\dagger} b_{j}^{\dagger}`	$b_i^\dagger b_j^\dagger$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$
gilmore-lie-groups_FO1804	184	0.960	`x^{i} x^{j}`	$x^i x^j$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$
gilmore-lie-groups_FO1805	184	0.960	`E_{-\mathbf{e}_{i}-\mathbf{e}_{j}}`	$E_{-\mathbf{e}_i - \mathbf{e}_j}$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$
gilmore-lie-groups_FO1806	184	0.960	`b_{i} b_{j}`	$b_i b_j$	$\begin{array}{lll lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i & f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j & f_i^\dagger f_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j & f_i^\dagger f_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j & f_i f_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i & & \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i & & \end{array}$

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gilmore-lie-groups_F01807	184	■ 0.960	`\partial_{i} \partial_{j}`	$\partial_i \partial_j$	$\begin{array}{lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i \end{array} \quad \begin{array}{ll} f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ f_i^\dagger f_j & x^i \partial_j \\ f_i^\dagger f_j^\dagger & x^i x^j \\ f_i f_j & \partial_i \partial_j \end{array}$
gilmore-lie-groups_F01808	184	■ 0.960	`E_{+2 \mathrm{e}_{i}}`	$E_{+2\mathrm{e}_i}$	$\begin{array}{lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i \end{array} \quad \begin{array}{ll} f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ f_i^\dagger f_j & x^i \partial_j \\ f_i^\dagger f_j^\dagger & x^i x^j \\ f_i f_j & \partial_i \partial_j \end{array}$
gilmore-lie-groups_F01809	184	■ 0.960	`b_{i}^{\dagger} b_{i}^{\dagger}`	$b_i^\dagger b_i^\dagger$	$\begin{array}{lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i \end{array} \quad \begin{array}{ll} f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ f_i^\dagger f_j & x^i \partial_j \\ f_i^\dagger f_j^\dagger & x^i x^j \\ f_i f_j & \partial_i \partial_j \end{array}$
gilmore-lie-groups_F01810	184	■ 0.960	`x^{i} x^{i}`	$x^i x^i$	$\begin{array}{lll} H_i & b_i^\dagger b_i + \frac{1}{2} & x^i \partial_i \\ E_{+\mathbf{e}_i - \mathbf{e}_j} & b_i^\dagger b_j & x^i \partial_j \\ E_{+\mathbf{e}_i + \mathbf{e}_j} & b_i^\dagger b_j^\dagger & x^i x^j \\ E_{-\mathbf{e}_i - \mathbf{e}_j} & b_i b_j & \partial_i \partial_j \\ E_{+2\mathbf{e}_i} & b_i^\dagger b_i^\dagger & x^i x^i \\ E_{-2\mathbf{e}_i} & b_i b_i & \partial_i \partial_i \end{array} \quad \begin{array}{ll} f_i^\dagger f_i + \frac{1}{2} & x^i \partial_i + \frac{1}{2} \\ f_i^\dagger f_j & x^i \partial_j \\ f_i^\dagger f_j^\dagger & x^i x^j \\ f_i f_j & \partial_i \partial_j \end{array}$

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gilmore-lie-groups_F01811	184	0.960	`E_{-2 \mathbf{e}_{i}}`	$E_{-2\mathbf{e}_i}$	H_i $b_i^\dagger b_i + \frac{1}{2}$ $x^i\partial_i$ $f_i^\dagger f_i + \frac{1}{2}$ $x^i\partial_i + \frac{1}{2}$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ $x^i\partial_j$ $E_{+\mathbf{e}_i+\mathbf{e}_j}$ $b_i^\dagger b_j^\dagger$ $x^i x^j$ $f_i^\dagger f_j^\dagger$ $x^i x^j$ $E_{-\mathbf{e}_i-\mathbf{e}_j}$ $b_i b_j$ $\partial_i\partial_j$ $f_i f_j$ $\partial_i\partial_j$ $E_{+2\mathbf{e}_i}$ $b_i^\dagger b_i^\dagger$ $x^i x^i$ $E_{-2\mathbf{e}_i}$ $b_i b_i$ $\partial_i\partial_i$
gilmore-lie-groups_F01812	184	0.960	`b_{i} b_{i}`	$b_i b_i$	H_i $b_i^\dagger b_i + \frac{1}{2}$ $x^i\partial_i$ $f_i^\dagger f_i + \frac{1}{2}$ $x^i\partial_i + \frac{1}{2}$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ $x^i\partial_j$ $E_{+\mathbf{e}_i+\mathbf{e}_j}$ $b_i^\dagger b_j^\dagger$ $x^i x^j$ $f_i^\dagger f_j^\dagger$ $x^i x^j$ $E_{-\mathbf{e}_i-\mathbf{e}_j}$ $b_i b_j$ $\partial_i\partial_j$ $f_i f_j$ $\partial_i\partial_j$ $E_{+2\mathbf{e}_i}$ $b_i^\dagger b_i^\dagger$ $x^i x^i$ $E_{-2\mathbf{e}_i}$ $b_i b_i$ $\partial_i\partial_i$
gilmore-lie-groups_F01813	184	0.960	`\partial_{i} \partial_{i}`	$\partial_i\partial_i$	H_i $b_i^\dagger b_i + \frac{1}{2}$ $x^i\partial_i$ $f_i^\dagger f_i + \frac{1}{2}$ $x^i\partial_i + \frac{1}{2}$ $E_{+\mathbf{e}_i-\mathbf{e}_j}$ $b_i^\dagger b_j$ $x^i\partial_j$ $f_i^\dagger f_j$ $x^i\partial_j$ $E_{+\mathbf{e}_i+\mathbf{e}_j}$ $b_i^\dagger b_j^\dagger$ $x^i x^j$ $f_i^\dagger f_j^\dagger$ $x^i x^j$ $E_{-\mathbf{e}_i-\mathbf{e}_j}$ $b_i b_j$ $\partial_i\partial_j$ $f_i f_j$ $\partial_i\partial_j$ $E_{+2\mathbf{e}_i}$ $b_i^\dagger b_i^\dagger$ $x^i x^i$ $E_{-2\mathbf{e}_i}$ $b_i b_i$ $\partial_i\partial_i$
gilmore-lie-groups_F01814	185	0.852	`D, E`	D, E	Dynkin diagrams of type (D, E) to obtain the inequality of Eq. (10.19).
gilmore-lie-groups_F01815	185	1.000	`1 \leq i, j \leq n`	$1 \leq i, j \leq n$	8. A Lie algebra is spanned by n^2 operators of the form $a_i^\dagger a_j$, with $1 \leq i, j \leq n$. Show that the linear vector space for this algebra can be written as the direct sum of two
gilmore-lie-groups_F01816	185	1.000	`n=3`	$n = 3$	tensor. Show that the commutation relations are
gilmore-lie-groups_F01817	185	1.000	`\hat{\mathbf{Q}}`	$\hat{\mathbf{Q}}$	$\hat{N} = \sum a_i^\dagger a_i$
gilmore-lie-groups_F01818	185	1.000	`\hat{N}`	$\hat{N}$	mathematical terms (commutative invariant subalgebra $\hat{N}$, Cartan decomposition of a simple Lie algebra $\mathbf{L} + \hat{\mathbf{O}}$).
gilmore-lie-groups_F01819	185	0.998	`\mathbf{L}+\hat{\mathbf{Q}}`	$\mathbf{L} + \hat{\mathbf{Q}}$	the discussion of Problem 8 a $(6 \to n(n+1)/2)$, and the di
gilmore-lie-groups_F01820	185	0.623	`\mathbf{L}(3 \rightarrow n(n-1) / 2)`	$\mathbf{L}(3 \to n(n-1)/2)$	
gilmore-lie-groups_F01821	185	0.623	`\mathbf{Q}`	$\mathbf{Q}$	
gilmore-lie-groups_F01822	185	1.000	`(6 \rightarrow n(n+1) / 2)`	$(6 \to n(n+1)/2)$	

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gilmore-lie-groups_F01823	185	1.000	`\hat{N}(3 \rightarrow n)`	$\hat{N}(3 \rightarrow n)$	
gilmore-lie-groups_F01824	186	1.000	`Z=r^{i} X_{i}`	$Z = r^{i} X_{i}$	general unless the field is extended from the real to the complex numbers. Allowing
gilmore-lie-groups_F01825	186	1.000	`r^{i}`	r^{i}	general unless the field is extended from the real to the complex numbers. Allowing
gilmore-lie-groups_F01826	186	1.000	`\sum \sum r^{i}\left[R_{i}{ }^{j}(Z)-\lambda \delta_{i}{ }^{j}\right] X_{j}=0`	$\sum \sum r^{i}\left[R_{i}{}^{j}(Z)-\lambda \delta_{i}{}^{j}\right] X_{j}=0$	Lie algebras. The general operator in such algebras has the form
gilmore-lie-groups_F01827	186	1.000	`h^{i}`	h^{i}	
gilmore-lie-groups_F01828	186	1.000	`e^{\alpha}`	e^{α}	
gilmore-lie-groups_F01829	187	1.000	`A_{n-1}, D_{n}, B_{n}, C_{n}`	$A_{n-1}, D_{n}, B_{n}, C_{n}$	submatrix decomposition: subfield restriction: and field embeddings.
gilmore-lie-groups_F01830	187	1.000	`a_{1}, a_{2}, a_{3}`	a_{1}, a_{2}, a_{3}	matrices – the Lie algebra for $SL(2;\mathbb{C})$. This relation is shown in Fig. 11.1.
gilmore-lie-groups_F01831	187	1.000	`\left(a_{1}, a_{2}, a_{3}\right)`	$\left(a_{1}, a_{2}, a_{3}\right)$	The complex extension Lie algebra has root space A_1 describing canonical com-
gilmore-lie-groups_F01832	187	1.000	`\left(b_{1}, b_{2}, b_{3}\right)`	$\left(b_{1}, b_{2}, b_{3}\right)$	The complex extension Lie algebra has root space A_1 describing canonical com-
gilmore-lie-groups_F01833	188	0.998	`H_{i}, E_{\alpha}`	H_{i}, E_{α}	$\begin{bmatrix} 1 & \\ & \end{bmatrix}$ H_1
gilmore-lie-groups_F01834	188	1.000	`\frac{1}{\sqrt{2}}\left(E_{\alpha} \pm E_{-\alpha}\right)`	$\frac{1}{\sqrt{2}}\left(E_{\alpha} \pm E_{-\alpha}\right)$	$\begin{vmatrix} 1 & \\ & 1 \end{vmatrix}$
gilmore-lie-groups_F01835	189	0.826	`H_{i}, \frac{1}{\sqrt{2}}\left(E_{\alpha}+E_{-\alpha}\right)`	$H_{i}, \frac{1}{\sqrt{2}}\left(E_{\alpha}+E_{-\alpha}\right)$	If we restrict the coefficients of H_i, $\frac{1}{\sqrt{2}}(E_\alpha + E_{-\alpha})$, and $\frac{1}{\sqrt{2}}(E_\alpha - E_{-\alpha})$ (all $\alpha \neq 0$)
gilmore-lie-groups_F01836	189	0.826	`\frac{1}{\sqrt{2}}\left(E_{\alpha}-E_{-\alpha}\right)`	$\frac{1}{\sqrt{2}}\left(E_{\alpha}-E_{-\alpha}\right)$	If we restrict the coefficients of H_i, $\frac{1}{\sqrt{2}}(E_\alpha + E_{-\alpha})$, and $\frac{1}{\sqrt{2}}(E_\alpha - E_{-\alpha})$ (all $\alpha \neq 0$)
gilmore-lie-groups_F01837	189	0.826	`\alpha \neq 0`	$\alpha \neq 0$	If we restrict the coefficients of H_i, $\frac{1}{\sqrt{2}}(E_\alpha + E_{-\alpha})$, and $\frac{1}{\sqrt{2}}(E_\alpha - E_{-\alpha})$ (all $\alpha \neq 0$)
gilmore-lie-groups_F01838	189	1.000	`\frac{1}{\sqrt{2}}\left(E_{\alpha}+E_{-\alpha}\right)`	$\frac{1}{\sqrt{2}}\left(E_{\alpha}+E_{-\alpha}\right)$	generators H_i and $\frac{1}{\sqrt{2}}(E_\alpha + E_{-\alpha})$ span a noncompact subspace. On the other hand, if we restrict the coefficients of H_i and $\frac{1}{\sqrt{2}}(E_\alpha +$
gilmore-lie-groups_F01839	189	0.999	`A_{1}, \mathfrak{s l}(2 ; \mathbb{R})`	$A_{1}, \mathfrak{sl}(2;\mathbb{R})$	$\begin{bmatrix} 1 & 0 \end{bmatrix}$ $\begin{bmatrix} 0 & 1 \end{bmatrix}$ $\begin{bmatrix} 0 & 1 \end{bmatrix}$ (
gilmore-lie-groups_F01840	189	1.000	`h_{r}, h_{i} ; a_{r}, a_{i} ; b_{r}, b_{i}`	$h_{r}, h_{i} ; a_{r}, a_{i} ; b_{r}, b_{i}$	
gilmore-lie-groups_F01841	190	0.850	`n_{+}, n_{-}`	n_{+}, n_{-}	It is useful to specify how compact a real form is by specifying its **index** (n_+, n_-),
gilmore-lie-groups_F01842	190	1.000	`n_{+}`	n_{+}	where n_+ is the dimension of the subspace on which the nonsingular Cartan–
gilmore-lie-groups_F01843	190	1.000	`n_{-}`	n_{-}	Killing inner product is positive-definite and n_- is the dimension of the subspace
gilmore-lie-groups_F01844	190	1.000	`\chi=n_{+}-n_{-}`	$\chi=n_{+}-n_{-}$	be abbreviated to a single integer, the **character** $\chi = n_+ - n_-$, to describe a real form. This is the trace of the normalized Cartan–Killing form. Inspection of (11.3)
gilmore-lie-groups_F01845	190	1.000	`i H_{i}, i \frac{1}{\sqrt{2}}\left(E_{\alpha}+E_{-\alpha}\right)`	$iH_{i}, i\frac{1}{\sqrt{2}}\left(E_{\alpha}+E_{-\alpha}\right)$	and $\frac{1}{\sqrt{2}}(E_\alpha - E_{-\alpha})$. In general, for all real forms the character satisfies the bounds
gilmore-lie-groups_F01846	190	0.917	`g_{\mu, \nu}=\operatorname{diag}(1,1,1,-1)`	$g_{\mu,\nu}=\operatorname{diag}(1,1,1,-1)$	diag(1, 1, 1, 1).
gilmore-lie-groups_F01847	190	0.870	`x, y, z, i c t`	x, y, z, ict	Since the compact real form can always be constructed easily for a simple Lie algebra (see Eq. (11.6)) it is useful to begin with that form. The compact Lie

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gilmore-lie-groups_F01848	190	0.870	`g_{\mu, \nu}=`	$g_{\mu,\nu} =$	Since the compact real form can always be constructed easily for a simple Lie algebra (see Eq. (11.6)) it is useful to begin with that form. The compact Lie
gilmore-lie-groups_F01849	190	0.672	`\operatorname{diag}(1,1,1,1)`	$\operatorname{diag}(1,1,1,1)$	algebra (algebra $\mathfrak{g}$
gilmore-lie-groups_F01850	190	1.000	`\mathfrak{p} \rightarrow \mathfrak{p}^{\prime}=i \mathfrak{p}`	$\mathfrak{p} \rightarrow \mathfrak{p}^{\prime}=i \mathfrak{p}$	
gilmore-lie-groups_F01851	191	1.000	`\mathfrak{g}^{\prime}, \mathfrak{h}`	$\mathfrak{g}^{\prime}, \mathfrak{h}$	generators. The character of this algebra is
gilmore-lie-groups_F01852	191	1.000	`\mathfrak{p}^{\prime}`	$\mathfrak{p}^{\prime}$	generators. The character of this algebra is
gilmore-lie-groups_F01853	191	1.000	`T^{2}=I`	$T^{2}=I$	All of the real forms of all of the simple classical (matrix) Lie alge
gilmore-lie-groups_F01854	192	1.000	`\mathfrak{u}(n, \mathbb{F})`	$\mathfrak{u}(n, \mathbb{F})$	$\begin{bmatrix} A & 0 \end{bmatrix}$ $\begin{bmatrix} 0 & B \end{bmatrix}$
gilmore-lie-groups_F01855	192	0.949	`A_{p}=-A_{p}^{\dagger}, A_{q}=-A_{q}^{\dagger}`	$A_{p}=-A_{p}^{\dagger}, A_{q}=-A_{q}^{\dagger}$	procedure described in the previous section the off-diagonal block is multiplied by i. This is equivalent to changing the matrix $I_{p,q}$ that is preserved by $\mathfrak{u}(p,q;\mathbb{F})$ to the
gilmore-lie-groups_F01856	192	0.999	`I_{p+q}`	I_{p+q}	matrix $I_{p,q}$ that is preserved by $\mathfrak{u}(p,q;\mathbb{F})$, where $p+q=n$. The factor i can be absorbed into the $n \times a$ off-diagonal blocks, so that the noncompact algebra has
gilmore-lie-groups_F01857	192	0.999	`\mathfrak{u}(n ; \mathbb{F})`	$\mathfrak{u}(n ; \mathbb{F})$	matrix $I_{p,q}$ that is preserved by $\mathfrak{u}(p,q;\mathbb{F})$, where $p+q=n$. The factor i can be absorbed into the $n \times a$ off-diagonal blocks, so that the noncompact algebra has
gilmore-lie-groups_F01858	192	1.000	`I_{p, q}`	$I_{p, q}$	matrix form
gilmore-lie-groups_F01859	192	1.000	`\mathfrak{u}(p, q ; \mathbb{F})`	$\mathfrak{u}(p, q ; \mathbb{F})$	matrix form
gilmore-lie-groups_F01860	192	0.995	`\mathbb{F}=\mathbb{R}, \mathbb{C}, \mathbb{Q}`	$\mathbb{F}=\mathbb{R}, \mathbb{C}, \mathbb{Q}$	$\mathbb{R}$ $\mathfrak{so}(p,q)$ D, B
gilmore-lie-groups_F01861	192	0.995	`(D, B), A, C`	$(D, B), A, C$	$\mathbb{R}$ $\mathfrak{so}(p,q)$ D, B
gilmore-lie-groups_F01862	192	0.998	`\mathfrak{s p}(2 n ; \mathbb{R})`	$\mathfrak{sp}(2n ; \mathbb{R})$	
gilmore-lie-groups_F01863	193	1.000	`\mathfrak{s p}(n)=\mathfrak{u}(n ; \mathbb{Q})`	$\mathfrak{sp}(n)=\mathfrak{u}(n ; \mathbb{Q})$	To make the mapping more comprehensible, it is useful to recall the mappings of
gilmore-lie-groups_F01864	193	1.000	`\alpha, \beta, \gamma`	α, β, γ	these matrices $\mathfrak{ou}(2n)$, since they form an orthogonal representation of the unitary
gilmore-lie-groups_F01865	193	0.999	`\mathfrak{o u}(2 n)`	$\mathfrak{ou}(2n)$	matrices for $\mathfrak{sp}(n)$ is replaced by a set of $2n \times 2n$ complex matrices $\mathfrak{usp}(2n)$, the unitary representation of the symplectic algebra of $2n \times 2n$ matrices:
gilmore-lie-groups_F01866	193	1.000	`\underline{2 n} \times 2 n`	$\underline{2n} \times 2n$	unitary representation of the symplectic algebra of $\underline{2n} \times 2n$ matrices:
gilmore-lie-groups_F01867	194	1.000	`R^{2 n}`	R^{2n}	metric metric in R^{2n}. It is possible to choose coordinates $p_1, q_1, p_2, q_2, \ldots, p_n, q_n$ in this space so that the inner product between two vectors $v'Gv$ is
gilmore-lie-groups_F01868	194	1.000	`p_{1}, q_{1}, p_{2}, q_{2}, \ldots, p_{n}, q_{n}`	$p_{1}, q_{1}, p_{2}, q_{2}, \ldots, p_{n}, q_{n}$	metric metric in R^{2n}. It is possible to choose coordinates $p_1, q_1, p_2, q_2, \ldots, p_n, q_n$ in this space so that the inner product between two vectors $v'Gv$ is
gilmore-lie-groups_F01869	194	1.000	`v_{i}^{\prime} G_{i j} v_{j}`	$v_{i}^{\prime} G_{i j} v_{j}$	in this space so that the inner product between two vectors $v_i' G_{ij} v_j$ is
gilmore-lie-groups_F01870	194	0.967	`M \in \operatorname{Sp}(2 n ; \mathbb{R})`	$M \in \operatorname{Sp}(2n ; \mathbb{R})$	of the hamiltonian equations of motion in classical mechanics.
gilmore-lie-groups_F01871	194	1.000	`M^{t} G M=G`	$M^{t} G M=G$	
gilmore-lie-groups_F01872	194	1.000	`\mathfrak{p} \rightarrow i \mathfrak{p}`	$\mathfrak{p} \rightarrow i \mathfrak{p}$	
gilmore-lie-groups_F01873	194	1.000	`\mathfrak{s} \mathfrak{o}^{*}(2 n)`	$\mathfrak{so}^{*}(2n)$	

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gilmore-lie-groups_F01874	194	1.000	`\mathfrak{s} \mathfrak{u}^{*}(2 n)`	$\mathfrak{su}^{*}(2n)$	
gilmore-lie-groups_F01875	194	0.991	`A_{2 n-1}`	A_{2n-1}	
gilmore-lie-groups_F01876	195	1.000	`\mathfrak{s u}(2)), B_{1}(\mathfrak{s o}(3))`	$\mathfrak{su}(2)), B_1(\mathfrak{so}(3))$	the compact real form is $\mathfrak{su}(2)$), B_1 ($\mathfrak{so}(3)$), and C_1 ($\mathfrak{sp}(1)$) are equivalent, as are B_2 ($\mathfrak{so}(5)$) and C_2 ($\mathfrak{sp}(2)$). So also are A_3 ($\mathfrak{su}(4)$) and D_3 ($\mathfrak{so}(6)$). As a result, there are
gilmore-lie-groups_F01877	195	1.000	`C_{1}(\mathfrak{s p}(1))`	$C_1(\mathfrak{sp}(1))$	the compact real form is $\mathfrak{su}(2)$), B_1 ($\mathfrak{so}(3)$), and C_1 ($\mathfrak{sp}(1)$) are equivalent, as are B_2 ($\mathfrak{so}(5)$) and C_2 ($\mathfrak{sp}(2)$). So also are A_3 ($\mathfrak{su}(4)$) and D_3 ($\mathfrak{so}(6)$). As a result, there are
gilmore-lie-groups_F01878	195	1.000	`(\mathfrak{s o}(5))`	$(\mathfrak{so}(5))$	equivalences between the real forms of these Lie algebras. These equivalences are
gilmore-lie-groups_F01879	195	1.000	`C_{2}(\mathfrak{s p}(2))`	$C_2(\mathfrak{sp}(2))$	equivalences between the real forms of these Lie algebras. These equivalences are
gilmore-lie-groups_F01880	195	1.000	`A_{3}(\mathfrak{s u}(4))`	$A_3(\mathfrak{su}(4))$	equivalences between the real forms of these Lie algebras. These equivalences are
gilmore-lie-groups_F01881	195	1.000	`D_{3}(\mathfrak{s o}(6))`	$D_3(\mathfrak{so}(6))$	equivalences between the real forms of these Lie algebras. These equivalences are
gilmore-lie-groups_F01882	195	0.899	`\mathfrak{s} \mathfrak{o}(p, q)`	$\mathfrak{so}(p, q)$	Block submatrix: $\mathfrak{so}(p,q)$ D_n $p+q=2n$; $\mathfrak{so}(p,q)$ B_n $p+q=2n+1$; $\mathfrak{su}(p,q)$ A_{n-1} $p+q=n$; $\mathfrak{sp}(p,q)$ C_n $p+q=n$; Subfield restriction: $\mathfrak{sl}(n;\mathbb{R})$ A_{n-1}; $\mathfrak{sp}(2n;\mathbb{R})$ C_n; Field embedding: $\mathfrak{so}^*(2n)$ D_n; $\mathfrak{su}^*(2n)$ A_{2n-1}
gilmore-lie-groups_F01883	195	0.899	`p+q=2 n`	$p+q=2n$	Block submatrix: $\mathfrak{so}(p,q)$ D_n $p+q=2n$; $\mathfrak{so}(p,q)$ B_n $p+q=2n+1$; $\mathfrak{su}(p,q)$ A_{n-1} $p+q=n$; $\mathfrak{sp}(p,q)$ C_n $p+q=n$; Subfield restriction: $\mathfrak{sl}(n;\mathbb{R})$ A_{n-1}; $\mathfrak{sp}(2n;\mathbb{R})$ C_n; Field embedding: $\mathfrak{so}^*(2n)$ D_n; $\mathfrak{su}^*(2n)$ A_{2n-1}
gilmore-lie-groups_F01884	195	0.899	`p+q=2 n+1`	$p+q=2n+1$	Block submatrix: $\mathfrak{so}(p,q)$ D_n $p+q=2n$; $\mathfrak{so}(p,q)$ B_n $p+q=2n+1$; $\mathfrak{su}(p,q)$ A_{n-1} $p+q=n$; $\mathfrak{sp}(p,q)$ C_n $p+q=n$; Subfield restriction: $\mathfrak{sl}(n;\mathbb{R})$ A_{n-1}; $\mathfrak{sp}(2n;\mathbb{R})$ C_n; Field embedding: $\mathfrak{so}^*(2n)$ D_n; $\mathfrak{su}^*(2n)$ A_{2n-1}

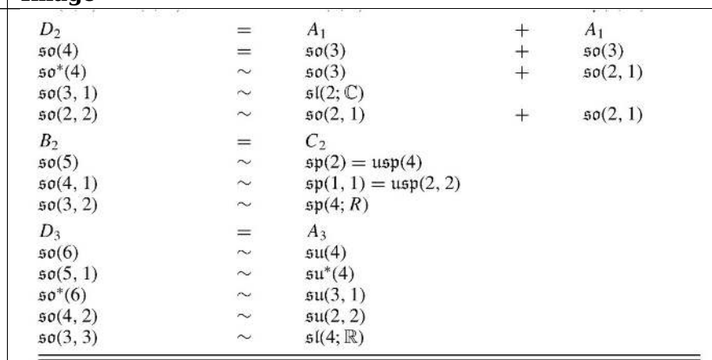
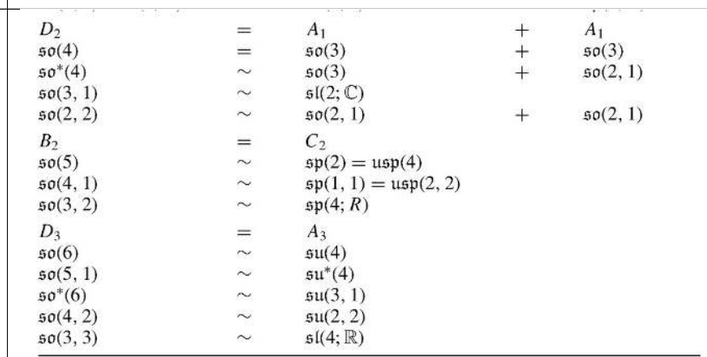
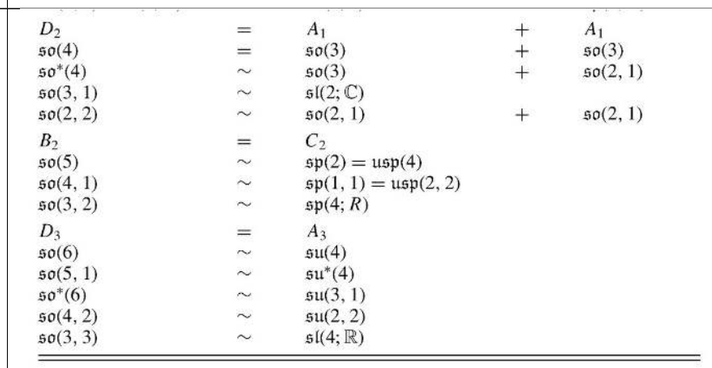
Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01885	195	0.899	`\mathfrak{s} \mathfrak{u}(p, q)`	$\mathfrak{su}(p, q)$	Block submatrix $\mathfrak{so}(p,q)$ D_n $p+q=2n$ $\mathfrak{so}(p,q)$ B_n $p+q=2n+1$ $\mathfrak{su}(p,q)$ A_{n-1} $p+q=n$ $\mathfrak{sp}(p,q)$ C_n $p+q=n$ Subfield restriction $\mathfrak{sl}(n;\mathbb{R})$ A_{n-1} $\mathfrak{sp}(2n;\mathbb{R})$ C_n Field embedding $\mathfrak{so}^*(2n)$ D_n $\mathfrak{su}^*(2n)$ A_{2n-1}
gilmore-lie-groups_F01886	195	0.899	`\mathfrak{s} \mathfrak{p}(p, q)`	$\mathfrak{sp}(p, q)$	Block submatrix $\mathfrak{so}(p,q)$ D_n $p+q=2n$ $\mathfrak{so}(p,q)$ B_n $p+q=2n+1$ $\mathfrak{su}(p,q)$ A_{n-1} $p+q=n$ $\mathfrak{sp}(p,q)$ C_n $p+q=n$ Subfield restriction $\mathfrak{sl}(n;\mathbb{R})$ A_{n-1} $\mathfrak{sp}(2n;\mathbb{R})$ C_n Field embedding $\mathfrak{so}^*(2n)$ D_n $\mathfrak{su}^*(2n)$ A_{2n-1}
gilmore-lie-groups_F01887	195	0.899	`\mathfrak{s} \mathfrak{p}(2 n ; \mathbb{R})`	$\mathfrak{sp}(2n;\mathbb{R})$	Block submatrix $\mathfrak{so}(p,q)$ D_n $p+q=2n$ $\mathfrak{so}(p,q)$ B_n $p+q=2n+1$ $\mathfrak{su}(p,q)$ A_{n-1} $p+q=n$ $\mathfrak{sp}(p,q)$ C_n $p+q=n$ Subfield restriction $\mathfrak{sl}(n;\mathbb{R})$ A_{n-1} $\mathfrak{sp}(2n;\mathbb{R})$ C_n Field embedding $\mathfrak{so}^*(2n)$ D_n $\mathfrak{su}^*(2n)$ A_{2n-1}
gilmore-lie-groups_F01888	195	0.500	`B_{1}`	B_1	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01889	195	0.500	`C_{1}`	C_1	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01890	195	0.500	`\mathfrak{s} \mathfrak{o}(3)`	$\mathfrak{so}(3)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01891	195	0.500	`\mathfrak{s} \mathfrak{p}(1)=\mathfrak{u} \mathfrak{s} \mathfrak{p}(2)`	$\mathfrak{sp}(1) = \mathfrak{usp}(2)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01892	195	0.500	`\mathfrak{s u}(1,1)=\mathfrak{s l}(2 ; \mathbb{R})`	$\mathfrak{su}(1,1) = \mathfrak{sl}(2;\mathbb{R})$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01893	195	0.500	`\mathfrak{s} \mathfrak{o}(2,1)`	$\mathfrak{so}(2,1)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01894	195	0.500	`\mathfrak{s} \mathfrak{p}(2 ; \mathbb{R})`	$\mathfrak{sp}(2;\mathbb{R})$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01895	195	0.500	`\mathfrak{s} \mathfrak{o}(4)`	$\mathfrak{so}(4)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01896	195	0.500	`\mathfrak{s} \mathfrak{o}^{*}(4)`	$\mathfrak{so}^*(4)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01897	195	0.500	`\mathfrak{s} \mathfrak{o}(3,1)`	$\mathfrak{so}(3,1)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01898	195	0.500	`\mathfrak{s} \mathfrak{l}(2 ; \mathbb{C})`	$\mathfrak{sl}(2;\mathbb{C})$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01899	195	0.500	`\mathfrak{s} \mathfrak{o}(2,2)`	$\mathfrak{so}(2,2)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01900	195	0.500	`\mathfrak{s} \mathfrak{p}(2)=\mathfrak{u} \mathfrak{s} \mathfrak{p}(4)`	$\mathfrak{sp}(2) = \mathfrak{usp}(4)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01901	195	■0.500	`\mathfrak{s} \mathfrak{p}(1,1)=\mathfrak{u} \mathfrak{s} \mathfrak{p}(2,2)`	$\mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$	
gilmore-lie-groups_F01902	195	■0.500	`\mathfrak{s} \mathfrak{p}(4 ; R)`	$\mathfrak{sp}(4; R)$	
gilmore-lie-groups_F01903	195	■0.500	`D_{3}`	D_3	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01904	195	0.500	`\mathfrak{s} \mathfrak{o}(6)`	$\mathfrak{so}(6)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2, 1)$ $\mathfrak{so}(3, 1) \sim \mathfrak{sl}(2; \mathbb{C})$ $\mathfrak{so}(2, 2) \sim \mathfrak{so}(2, 1) + \mathfrak{so}(2, 1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4, 1) \sim \mathfrak{sp}(1, 1) = \mathfrak{usp}(2, 2)$ $\mathfrak{so}(3, 2) \sim \mathfrak{sp}(4; R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5, 1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3, 1)$ $\mathfrak{so}(4, 2) \sim \mathfrak{su}(2, 2)$ $\mathfrak{so}(3, 3) \sim \mathfrak{sl}(4; \mathbb{R})$
gilmore-lie-groups_F01905	195	0.500	`\mathfrak{s} \mathfrak{u}(4)`	$\mathfrak{su}(4)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2, 1)$ $\mathfrak{so}(3, 1) \sim \mathfrak{sl}(2; \mathbb{C})$ $\mathfrak{so}(2, 2) \sim \mathfrak{so}(2, 1) + \mathfrak{so}(2, 1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4, 1) \sim \mathfrak{sp}(1, 1) = \mathfrak{usp}(2, 2)$ $\mathfrak{so}(3, 2) \sim \mathfrak{sp}(4; R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5, 1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3, 1)$ $\mathfrak{so}(4, 2) \sim \mathfrak{su}(2, 2)$ $\mathfrak{so}(3, 3) \sim \mathfrak{sl}(4; \mathbb{R})$
gilmore-lie-groups_F01906	195	0.500	`\mathfrak{s} \mathfrak{o}(5,1)`	$\mathfrak{so}(5, 1)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2, 1)$ $\mathfrak{so}(3, 1) \sim \mathfrak{sl}(2; \mathbb{C})$ $\mathfrak{so}(2, 2) \sim \mathfrak{so}(2, 1) + \mathfrak{so}(2, 1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4, 1) \sim \mathfrak{sp}(1, 1) = \mathfrak{usp}(2, 2)$ $\mathfrak{so}(3, 2) \sim \mathfrak{sp}(4; R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5, 1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3, 1)$ $\mathfrak{so}(4, 2) \sim \mathfrak{su}(2, 2)$ $\mathfrak{so}(3, 3) \sim \mathfrak{sl}(4; \mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01907	195	0.500	`\mathfrak{s} \mathfrak{u}^{*}(4)`	$\mathfrak{su}^{*}(4)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01908	195	0.500	`\mathfrak{s} \mathfrak{o}^{*}(6)`	$\mathfrak{so}^{*}(6)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01909	195	0.500	`\mathfrak{s} \mathfrak{u}(3,1)`	$\mathfrak{su}(3,1)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01910	195	0.500	`\mathfrak{s} \mathfrak{o}(4,2)`	$\mathfrak{so}(4,2)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01911	195	0.500	`\mathfrak{s} \mathfrak{u}(2,2)`	$\mathfrak{su}(2,2)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01912	195	0.500	`\mathfrak{s} \mathfrak{o}(3,3)`	$\mathfrak{so}(3,3)$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$

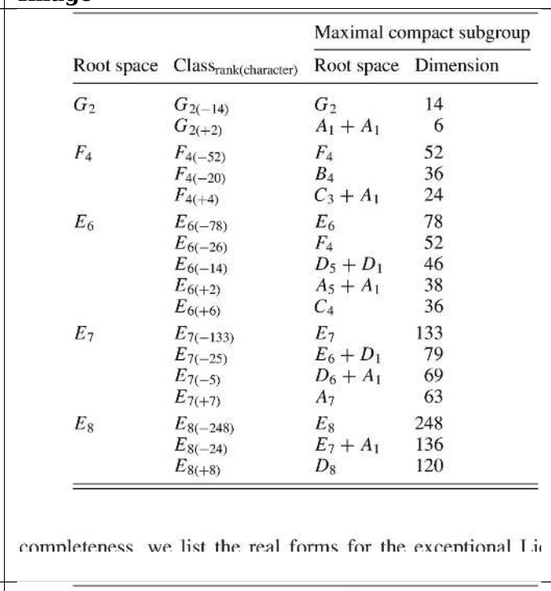
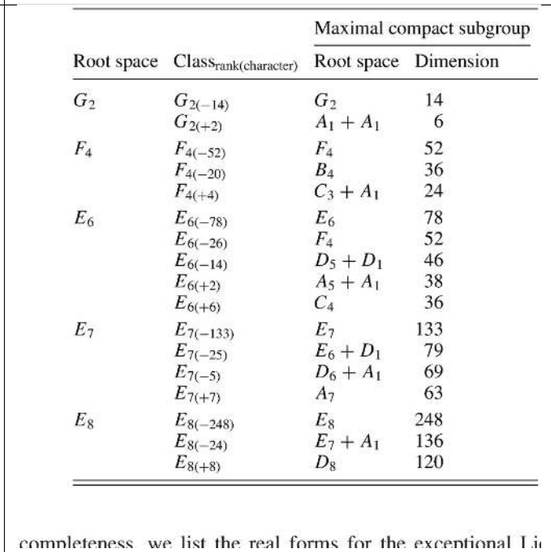
Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01913	195	0.500	`\mathfrak{s} \mathfrak{l}(4 ; \mathbb{R})`	$\mathfrak{sl}(4;\mathbb{R})$	$D_2 = A_1 + A_1$ $\mathfrak{so}(4) = \mathfrak{so}(3) + \mathfrak{so}(3)$ $\mathfrak{so}^*(4) \sim \mathfrak{so}(3) + \mathfrak{so}(2,1)$ $\mathfrak{so}(3,1) \sim \mathfrak{sl}(2;\mathbb{C})$ $\mathfrak{so}(2,2) \sim \mathfrak{so}(2,1) + \mathfrak{so}(2,1)$ $B_2 = C_2$ $\mathfrak{so}(5) \sim \mathfrak{sp}(2) = \mathfrak{usp}(4)$ $\mathfrak{so}(4,1) \sim \mathfrak{sp}(1,1) = \mathfrak{usp}(2,2)$ $\mathfrak{so}(3,2) \sim \mathfrak{sp}(4;R)$ $D_3 = A_3$ $\mathfrak{so}(6) \sim \mathfrak{su}(4)$ $\mathfrak{so}(5,1) \sim \mathfrak{su}^*(4)$ $\mathfrak{so}^*(6) \sim \mathfrak{su}(3,1)$ $\mathfrak{so}(4,2) \sim \mathfrak{su}(2,2)$ $\mathfrak{so}(3,3) \sim \mathfrak{sl}(4;\mathbb{R})$
gilmore-lie-groups_F01914	196	1.000	`{ }_{\text {rank(character) }}`	rank(character)	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, G_2, 14; $G_{2(+2)}$, $A_1 + A_1$, 6 F_4: $F_{4(-52)}$, F_4, 52; $F_{4(-20)}$, B_4, 36; $F_{4(+4)}$, $C_3 + A_1$, 24 E_6: $E_{6(-78)}$, E_6, 78; $E_{6(-26)}$, F_4, 52; $E_{6(-14)}$, $D_5 + D_1$, 46; $E_{6(+2)}$, $A_5 + A_1$, 38; $E_{6(+6)}$, C_4, 36 E_7: $E_{7(-133)}$, E_7, 133; $E_{7(-25)}$, $E_6 + D_1$, 79; $E_{7(-5)}$, $D_6 + A_1$, 69; $E_{7(+7)}$, A_7, 63 E_8: $E_{8(-248)}$, E_8, 248; $E_{8(-24)}$, $E_7 + A_1$, 136; $E_{8(+8)}$, D_8, 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01915	196	1.000	G_{2(-14)}	$G_{2(-14)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$ — G_2 14; $G_{2(+2)}$ — A_1+A_1 6 F_4: $F_{4(-52)}$ — F_4 52; $F_{4(-20)}$ — B_4 36; $F_{4(+4)}$ — C_3+A_1 24 E_6: $E_{6(-78)}$ — E_6 78; $E_{6(-26)}$ — F_4 52; $E_{6(-14)}$ — D_5+D_1 46; $E_{6(+2)}$ — A_5+A_1 38; $E_{6(+6)}$ — C_4 36 E_7: $E_{7(-133)}$ — E_7 133; $E_{7(-25)}$ — E_6+D_1 79; $E_{7(-5)}$ — D_6+A_1 69; $E_{7(+7)}$ — A_7 63 E_8: $E_{8(-248)}$ — E_8 248; $E_{8(-24)}$ — E_7+A_1 136; $E_{8(+8)}$ — D_8 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01916	196	1.000	G_{2(+2)}	$G_{2(+2)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$ — G_2 14; $G_{2(+2)}$ — A_1+A_1 6 F_4: $F_{4(-52)}$ — F_4 52; $F_{4(-20)}$ — B_4 36; $F_{4(+4)}$ — C_3+A_1 24 E_6: $E_{6(-78)}$ — E_6 78; $E_{6(-26)}$ — F_4 52; $E_{6(-14)}$ — D_5+D_1 46; $E_{6(+2)}$ — A_5+A_1 38; $E_{6(+6)}$ — C_4 36 E_7: $E_{7(-133)}$ — E_7 133; $E_{7(-25)}$ — E_6+D_1 79; $E_{7(-5)}$ — D_6+A_1 69; $E_{7(+7)}$ — A_7 63 E_8: $E_{8(-248)}$ — E_8 248; $E_{8(-24)}$ — E_7+A_1 136; $E_{8(+8)}$ — D_8 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01917	196	1.000	A_{1}+A_{1}	$A_1 + A_1$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, $A_1 + A_1$ / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, $C_3 + A_1$ / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, $E_6 + D_1$, $D_6 + A_1$, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, $E_7 + A_1$, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01918	196	1.000	F_{4}	F_4	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, $A_1 + A_1$ / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, $C_3 + A_1$ / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, $E_6 + D_1$, $D_6 + A_1$, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, $E_7 + A_1$, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01919	196	1.000	F_{4(-52)}	$F_{4(-52)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, A_1+A_1 / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, C_3+A_1 / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, D_5+D_1, A_5+A_1, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, E_6+D_1, D_6+A_1, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, E_7+A_1, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01920	196	1.000	F_{4(-20)}	$F_{4(-20)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, A_1+A_1 / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, C_3+A_1 / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, D_5+D_1, A_5+A_1, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, E_6+D_1, D_6+A_1, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, E_7+A_1, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01921	196	1.000	`B_{4}`	B_4	Maximal compact subgroup Root space | $\text{Class}_{\text{rank(character)}}$ | Root space | Dimension G_2 | $G_{2(-14)}$ | G_2 | 14 | $G_{2(+2)}$ | $A_1 + A_1$ | 6 F_4 | $F_{4(-52)}$ | F_4 | 52 | $F_{4(-20)}$ | B_4 | 36 | $F_{4(+4)}$ | $C_3 + A_1$ | 24 E_6 | $E_{6(-78)}$ | E_6 | 78 | $E_{6(-26)}$ | F_4 | 52 | $E_{6(-14)}$ | $D_5 + D_1$ | 46 | $E_{6(+2)}$ | $A_5 + A_1$ | 38 | $E_{6(+6)}$ | C_4 | 36 E_7 | $E_{7(-133)}$ | E_7 | 133 | $E_{7(-25)}$ | $E_6 + D_1$ | 79 | $E_{7(-5)}$ | $D_6 + A_1$ | 69 | $E_{7(+7)}$ | A_7 | 63 E_8 | $E_{8(-248)}$ | E_8 | 248 | $E_{8(-24)}$ | $E_7 + A_1$ | 136 | $E_{8(+8)}$ | D_8 | 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01922	196	1.000	`F_{4(+4)}`	$F_{4(+4)}$	Maximal compact subgroup Root space | $\text{Class}_{\text{rank(character)}}$ | Root space | Dimension G_2 | $G_{2(-14)}$ | G_2 | 14 | $G_{2(+2)}$ | $A_1 + A_1$ | 6 F_4 | $F_{4(-52)}$ | F_4 | 52 | $F_{4(-20)}$ | B_4 | 36 | $F_{4(+4)}$ | $C_3 + A_1$ | 24 E_6 | $E_{6(-78)}$ | E_6 | 78 | $E_{6(-26)}$ | F_4 | 52 | $E_{6(-14)}$ | $D_5 + D_1$ | 46 | $E_{6(+2)}$ | $A_5 + A_1$ | 38 | $E_{6(+6)}$ | C_4 | 36 E_7 | $E_{7(-133)}$ | E_7 | 133 | $E_{7(-25)}$ | $E_6 + D_1$ | 79 | $E_{7(-5)}$ | $D_6 + A_1$ | 69 | $E_{7(+7)}$ | A_7 | 63 E_8 | $E_{8(-248)}$ | E_8 | 248 | $E_{8(-24)}$ | $E_7 + A_1$ | 136 | $E_{8(+8)}$ | D_8 | 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01923	196	1.000	`C_{3}+A_{1}`	$C_3 + A_1$	
gilmore-lie-groups_F01924	196	1.000	`E_{6(-78)}`	$E_{6(-78)}$	

		Maximal compact subgroup	
Root space	$\text{Class}_{\text{rank(character)}}$	Root space	Dimension
G_2	$G_{2(-14)}$	G_2	14
	$G_{2(+2)}$	$A_1 + A_1$	6
F_4	$F_{4(-52)}$	F_4	52
	$F_{4(-20)}$	B_4	36
	$F_{4(+4)}$	$C_3 + A_1$	24
E_6	$E_{6(-78)}$	E_6	78
	$E_{6(-26)}$	F_4	52
	$E_{6(-14)}$	$D_5 + D_1$	46
	$E_{6(+2)}$	$A_5 + A_1$	38
	$E_{6(+6)}$	C_4	36
E_7	$E_{7(-133)}$	E_7	133
	$E_{7(-25)}$	$E_6 + D_1$	79
	$E_{7(-5)}$	$D_6 + A_1$	69
	$E_{7(+7)}$	A_7	63
E_8	$E_{8(-248)}$	E_8	248
	$E_{8(-24)}$	$E_7 + A_1$	136
	$E_{8(+8)}$	D_8	120

completeness, we list the real forms for the exceptional Li

		Maximal compact subgroup	
Root space	$\text{Class}_{\text{rank(character)}}$	Root space	Dimension
G_2	$G_{2(-14)}$	G_2	14
	$G_{2(+2)}$	$A_1 + A_1$	6
F_4	$F_{4(-52)}$	F_4	52
	$F_{4(-20)}$	B_4	36
	$F_{4(+4)}$	$C_3 + A_1$	24
E_6	$E_{6(-78)}$	E_6	78
	$E_{6(-26)}$	F_4	52
	$E_{6(-14)}$	$D_5 + D_1$	46
	$E_{6(+2)}$	$A_5 + A_1$	38
	$E_{6(+6)}$	C_4	36
E_7	$E_{7(-133)}$	E_7	133
	$E_{7(-25)}$	$E_6 + D_1$	79
	$E_{7(-5)}$	$D_6 + A_1$	69
	$E_{7(+7)}$	A_7	63
E_8	$E_{8(-248)}$	E_8	248
	$E_{8(-24)}$	$E_7 + A_1$	136
	$E_{8(+8)}$	D_8	120

completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01925	196	1.000	`E_{6(-26)}`	$E_{6(-26)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, A_1+A_1 / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, C_3+A_1 / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, D_5+D_1, A_5+A_1, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, E_6+D_1, D_6+A_1, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, E_7+A_1, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01926	196	1.000	`E_{6(-14)}`	$E_{6(-14)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, A_1+A_1 / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, C_3+A_1 / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, D_5+D_1, A_5+A_1, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, E_6+D_1, D_6+A_1, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, E_7+A_1, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01927	196	■ 1.000	D_{5}+D_{1}	$D_5 + D_1$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, $A_1 + A_1$ / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, $C_3 + A_1$ / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, $E_6 + D_1$, $D_6 + A_1$, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, $E_7 + A_1$, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01928	196	■ 1.000	E_{6(+2)}	$E_{6(+2)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, $A_1 + A_1$ / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, $C_3 + A_1$ / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, $E_6 + D_1$, $D_6 + A_1$, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, $E_7 + A_1$, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F01929	196	1.000	A_{5}+A_{1}	$A_5 + A_1$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; $A_1 + A_1$: 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; B_4, $C_3 + A_1$: 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4: 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7, $E_6 + D_1$, $D_6 + A_1$, A_7: 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8, $E_7 + A_1$, D_8: 248, 136, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01930	196	1.000	E_{6(+6)}	$E_{6(+6)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; $A_1 + A_1$: 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; B_4, $C_3 + A_1$: 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4: 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7, $E_6 + D_1$, $D_6 + A_1$, A_7: 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8, $E_7 + A_1$, D_8: 248, 136, 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01931	196	1.000	`C_{4}`	C_4	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; $A_1 + A_1$, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; B_4, 36; $C_3 + A_1$, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6, 78; F_4, 52; $D_5 + D_1$, 46; $A_5 + A_1$, 38; C_4, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7, 133; $E_6 + D_1$, 79; $D_6 + A_1$, 69; A_7, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8, 248; $E_7 + A_1$, 136; D_8, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01932	196	1.000	`E_{7(-133)}`	$E_{7(-133)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; $A_1 + A_1$, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; B_4, 36; $C_3 + A_1$, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6, 78; F_4, 52; $D_5 + D_1$, 46; $A_5 + A_1$, 38; C_4, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7, 133; $E_6 + D_1$, 79; $D_6 + A_1$, 69; A_7, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8, 248; $E_7 + A_1$, 136; D_8, 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01933	196	1.000	E_{7(-25)}	$E_{7(-25)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01934	196	1.000	E_{6}+D_{1}	E_6+D_1	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01935	196	1.000	`E_{7(-5)}`	$E_{7(-5)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01936	196	1.000	`D_{6}+A_{1}`	D_6+A_1	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01937	196	1.000	E_{7(+7)}	$E_{7(+7)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01938	196	1.000	A_{7}	A_7	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01939	196	1.000	E_{8(-248)}	$E_{8(-248)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01940	196	1.000	E_{8(-24)}	$E_{8(-24)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$; G_2 14, A_1+A_1 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$; F_4 52, B_4 36, C_3+A_1 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$; E_6 78, F_4 52, D_5+D_1 46, A_5+A_1 38, C_4 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$; E_7 133, E_6+D_1 79, D_6+A_1 69, A_7 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$; E_8 248, E_7+A_1 136, D_8 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01941	196	1.000	`E_{7}+A_{1}`	$E_7 + A_1$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, $A_1 + A_1$ / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, $C_3 + A_1$ / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, $E_6 + D_1$, $D_6 + A_1$, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, $E_7 + A_1$, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01942	196	1.000	`E_{8(+8)}`	$E_{8(+8)}$	Maximal compact subgroup Root space / $\text{Class}_{\text{rank(character)}}$ / Root space / Dimension G_2: $G_{2(-14)}$, $G_{2(+2)}$ / G_2, $A_1 + A_1$ / 14, 6 F_4: $F_{4(-52)}$, $F_{4(-20)}$, $F_{4(+4)}$ / F_4, B_4, $C_3 + A_1$ / 52, 36, 24 E_6: $E_{6(-78)}$, $E_{6(-26)}$, $E_{6(-14)}$, $E_{6(+2)}$, $E_{6(+6)}$ / E_6, F_4, $D_5 + D_1$, $A_5 + A_1$, C_4 / 78, 52, 46, 38, 36 E_7: $E_{7(-133)}$, $E_{7(-25)}$, $E_{7(-5)}$, $E_{7(+7)}$ / E_7, $E_6 + D_1$, $D_6 + A_1$, A_7 / 133, 79, 69, 63 E_8: $E_{8(-248)}$, $E_{8(-24)}$, $E_{8(+8)}$ / E_8, $E_7 + A_1$, D_8 / 248, 136, 120 completeness, we list the real forms for the exceptional Li

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gilmore-lie-groups_F01943	196	■1.000	`D_{8}`	D_8	Root space / Class$_{\text{rank(character)}}$ / Maximal compact subgroup: Root space / Dimension G_2: $G_{2(-14)}$ — G_2, 14; $G_{2(+2)}$ — A_1+A_1, 6 F_4: $F_{4(-52)}$ — F_4, 52; $F_{4(-20)}$ — B_4, 36; $F_{4(+4)}$ — C_3+A_1, 24 E_6: $E_{6(-78)}$ — E_6, 78; $E_{6(-26)}$ — F_4, 52; $E_{6(-14)}$ — D_5+D_1, 46; $E_{6(+2)}$ — A_5+A_1, 38; $E_{6(+6)}$ — C_4, 36 E_7: $E_{7(-133)}$ — E_7, 133; $E_{7(-25)}$ — E_6+D_1, 79; $E_{7(-5)}$ — D_6+A_1, 69; $E_{7(+7)}$ — A_7, 63 E_8: $E_{8(-248)}$ — E_8, 248; $E_{8(-24)}$ — E_7+A_1, 136; $E_{8(+8)}$ — D_8, 120 completeness, we list the real forms for the exceptional Li
gilmore-lie-groups_F01944	196	■1.000	`T(\mathfrak{p})=-\mathfrak{p}`	$T(\mathfrak{p}) = -\mathfrak{p}$	decomposition; subfield restriction; and field embedding.
gilmore-lie-groups_F01945	196	■1.000	`T(\mathfrak{h})=+\mathfrak{h}`	$T(\mathfrak{h}) = +\mathfrak{h}$	
gilmore-lie-groups_F01946	196	■1.000	`\mathfrak{g}^{\prime}: \mathfrak{g}=\mathfrak{h}+ \mathfrak{p} \rightarrow \mathfrak{g}^{\prime}= \mathfrak{h}+i \mathfrak{p}^{\prime}`	$\mathfrak{g}^{\prime}: \mathfrak{g}=\mathfrak{h}+\mathfrak{p} \rightarrow \mathfrak{g}^{\prime}=\mathfrak{h}+i\mathfrak{p}^{\prime}$	
gilmore-lie-groups_F01947	197	■1.000	`1 \leq i`	$1 \leq i$	1. Four operators $a_i^\dagger a_j$ can be constructed from boson operators for two modes $1 \leq i$,
gilmore-lie-groups_F01948	197	■1.000	`j \leq 2`	$j \leq 2$	$j \leq 2$. These operators close under commutation.
gilmore-lie-groups_F01949	197	■1.000	`a_{1}^{\dagger} a_{1}+a_{2}^{\dagger} a_{2}`	$a_1^\dagger a_1 + a_2^\dagger a_2$	and $a_1a_2 + a_2a_1$ are noncompact. Identify the simple three-dimensional subalgebra as $sl(2;\mathbb{R})$ or $su(1,1)$. Show that
gilmore-lie-groups_F01950	197	■1.000	`a_{1}^{\dagger} a_{2}-`	$a_1^\dagger a_2-$	and $a_1a_2 + a_2a_1$ are noncompact. Identify the simple three-dimensional subalgebra as $sl(2;\mathbb{R})$ or $su(1,1)$. Show that
gilmore-lie-groups_F01951	197	■1.000	`a_{1}^{\dagger} a_{1}-a_{2}^{\dagger} a_{2}`	$a_1^\dagger a_1 - a_2^\dagger a_2$	the compact real form is obtained by multiplying the two noncompact generators
gilmore-lie-groups_F01952	197	■1.000	`a_{1}^{\dagger} a_{2}+a_{2}^{\dagger} a_{1}`	$a_1^\dagger a_2 + a_2^\dagger a_1$	by i.
gilmore-lie-groups_F01953	197	■1.000	`i \sigma_{j}`	$i\sigma_j$	nages of their universal covering groups $\overline{SO(n)} = Spin(n)$, for some integer k.
gilmore-lie-groups_F01954	197	■1.000	`\sigma_{j}`	σ_j	nages of their universal covering groups $\overline{SO(n)} = Spin(n)$, for some integer k.
gilmore-lie-groups_F01955	197	■0.982	`k \rightarrow 1`	$k \rightarrow 1$	$Spin(3) = SU(2)$
gilmore-lie-groups_F01956	197	■0.844	`\overline{S O(n)}=S p i n(n)`	$\overline{SO(n)} = Spin(n)$	$Spin(3) = SU(2)$ $Spin(4) = SU(2) \otimes SU(2)$
gilmore-lie-groups_F01957	197	■1.000	`\operatorname{Spin}(n)`	$\operatorname{Spin}(n)$	$Spin(4) = SU(2) \otimes SU(2)$ $Spin(5) = USp(4)$
gilmore-lie-groups_F01958	197	■1.000	`n=3,4,5,6`	$n = 3, 4, 5, 6$	$Spin(4) = SU(2) \otimes SU(2)$ $Spin(5) = USp(4)$
gilmore-lie-groups_F01959	197	■1.000	`n>6`	$n > 6$	

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gilmore-lie-groups_F01960	198	0.968	`H_{i}:\left|n_{1}, n_{2}, \ldots, n_{r}\right\rangle`	$H_i : \left\|n_1, n_2, \ldots, n_r\right\rangle$	
gilmore-lie-groups_F01961	198	1.000	`H_{j} \rightarrow`	$H_j \rightarrow$	iH_j, etc.), choose a Hilbert space containing the state $\|l, 0, \ldots, 0\rangle$ and show that
gilmore-lie-groups_F01962	198	1.000	`i H_{j}`	iH_j	the value of C^- on every vector (i.e., apply shift operators E_α until no new states
gilmore-lie-groups_F01963	198	1.000	`|l, 0, \ldots, 0\rangle`	$\|l, 0, \ldots, 0\rangle$	the value of C^- on every vector (i.e., apply shift operators E_α until no new states
gilmore-lie-groups_F01964	198	0.989	`-m^{2}`	$-m^2$	4. **Master analytic representation for A_1** The complex Lie algebra with root space
gilmore-lie-groups_F01965	198	0.989	`e^{i m \phi}`	$e^{im\phi}$	4. **Master analytic representation for A_1** The complex Lie algebra with root space
gilmore-lie-groups_F01966	198	0.989	`-l(l+1)`	$-l(l+1)$	4. **Master analytic representation for A_1** The complex Lie algebra with root space
gilmore-lie-groups_F01967	198	0.989	`Y_{m}^{l}(\theta, \phi)`	$Y_m^l(\theta, \phi)$	4. **Master analytic representation for A_1** The complex Lie algebra with root space
gilmore-lie-groups_F01968	198	1.000	`J_{i}, i=1,2,3`	$J_i, i = 1, 2, 3$	$(2J + 1)$ and are obtained in this way. In this problem we will review the construction
gilmore-lie-groups_F01969	198	0.926	`\operatorname{EXP}\left(i r^{k} J_{k}\right)`	$\operatorname{EXP}\left(ir^k J_k\right)$	of the UIR (unitary irreducible representations) of the compact group $SU(2)$ and will
gilmore-lie-groups_F01970	198	0.926	`r^{k}`	r^k	of the UIR (unitary irreducible representations) of the compact group $SU(2)$ and will
gilmore-lie-groups_F01971	198	1.000	`\mathfrak{s} \mathfrak{u}(1,1)`	$\mathfrak{su}(1,1)$	
gilmore-lie-groups_F01972	199	0.826	`K_{3}`	K_3	$SU(2)$ with J_3 diagonal, or in any matrix representation of $SU(1,1)$ with K_3
gilmore-lie-groups_F01973	199	1.000	`e^{i m \phi} \delta_{m^{\prime} m}`	$e^{im\phi}\delta_{m'm}$	diagonal, the matrix is diagonal with matrix elements $e^{im\varphi}\delta_{m'm}$. Show that the
gilmore-lie-groups_F01974	199	1.000	`\phi \rightarrow \phi+4 \pi`	$\phi \rightarrow \phi + 4\pi$	single-valuedness condition under $\varphi \to \varphi + 4\pi$ requires that $m = \frac{1}{2}(n_1 - n_2)$ is integer or half-integer. Show that the shift operators $J_\pm$ and $K_\pm$ require that all m
gilmore-lie-groups_F01975	199	1.000	`m=\frac{1}{2}\left(n_{1}-n_{2}\right)`	$m = \frac{1}{2}\left(n_1 - n_2\right)$	single-valuedness condition under $\varphi \to \varphi + 4\pi$ requires that $m = \frac{1}{2}(n_1 - n_2)$ is integer or half-integer. Show that the shift operators $J_\pm$ and $K_\pm$ require that all m
gilmore-lie-groups_F01976	199	1.000	`J_{ \pm}`	$J_\pm$	values in a UIR with J_3 or K_3 diagonal are either integer or half-integer.
gilmore-lie-groups_F01977	199	1.000	`K_{ \pm}`	$K_\pm$	values in a UIR with J_3 or K_3 diagonal are either integer or half-integer.
gilmore-lie-groups_F01978	199	1.000	`n_{1}, n_{2}`	n_1, n_2	$\|n_2\rangle$ must be nonnegative integers. Construct the matrix elements of the operators
gilmore-lie-groups_F01979	199	1.000	`\left|n_{1}, n_{2}\right\rangle=\left|n_{1}\right\rangle \otimes`	$\|n_1, n_2\rangle = \|n_1\rangle \otimes$	$\|n_2\rangle$ must be nonnegative integers. Construct the matrix elements of the operators
gilmore-lie-groups_F01980	199	1.000	`\left|n_{2}\right\rangle`	$\|n_2\rangle$	$J_3, J_\pm, K_3, K_\pm$ under this relaxed assumption. Show that all commutation relations
gilmore-lie-groups_F01981	199	0.999	`J_{3}, J_{ \pm}, K_{3}, K_{ \pm}`	$J_3, J_\pm, K_3, K_\pm$	are satisfied in the representation afforded by this set of basis states.
gilmore-lie-groups_F01982	199	1.000	`J_{x}`	J_x	$\langle n_1 + 1, n_2 - 1\|J_+\|n_1, n_2\rangle = \sqrt{(n_1 + 1)n_2}$
gilmore-lie-groups_F01983	199	1.000	`J_{y}`	J_y	$\langle n_1 + 1, n_2 - 1\|J_+\|n_1, n_2\rangle = \sqrt{(n_1 + 1)n_2}$
gilmore-lie-groups_F01984	199	0.749	`(0,0)`	$(0,0)$	. With the identification $\|{}^{J}_{\ldots}\rangle = \|n_1, n_2\rangle$, $j = \frac{1}{2}(n_1 + n_2)$, $m = \frac{1}{2}(n_1 - n_2)$, show
gilmore-lie-groups_F01985	199	0.975	`\left|{ }_{m}^{j}\right\rangle=\left|n_{1}, n_{2}\right\rangle, j=\frac{1}{2}\left(n_{1}+n_{2}\right), m=\frac{1}{2}\left(n_{1}-n_{2}\right)`	$\left\|{}^{j}_{m}\right\rangle = \left\|n_1, n_2\right\rangle, j = \frac{1}{2}\left(n_1 + n_2\right), m = \frac{1}{2}\left(n_1 - n_2\right)$	$\left\langle \ldots j \ldots \right\|J_+\left\|j \ldots\right\rangle = \sqrt{(j \mp m)(j \pm m + 1)} = \sqrt{\left(j \pm \frac{1}{2}\right)^2 - \left(m \pm \frac{1}{2}\right)^2}$ (11.20)

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gilmore-lie-groups_F01986	199	1.000	`n_{1}`	n_1	Quadrant Operator Edge
gilmore-lie-groups_F01987	199	1.000	`n_{2}`	n_2	Quadrant Operator Edge
gilmore-lie-groups_F01988	199	1.000	`n_{2}=0`	$n_2 = 0$	III J_- $n_2 = -1$ elements for the shift operators $K_\pm$ in su(1 $i\sqrt{(j \mp m)(j \pm m + 1)} = \sqrt{\left(m \pm \frac{1}{2}\right)^2 -}$
gilmore-lie-groups_F01989	199	1.000	`n_{1}=0`	$n_1 = 0$	III J_- $n_2 = -1$ elements for the shift operators $K_\pm$ in su(1 $i\sqrt{(j \mp m)(j \pm m + 1)} = \sqrt{\left(m \pm \frac{1}{2}\right)^2 -}$
gilmore-lie-groups_F01990	199	1.000	`n_{1}=-1`	$n_1 = -1$	III J_- $n_2 = -1$ elements for the shift operators $K_\pm$ in su(1 $i\sqrt{(j \mp m)(j \pm m + 1)} = \sqrt{\left(m \pm \frac{1}{2}\right)^2 -}$
gilmore-lie-groups_F01991	199	1.000	`n_{2}=-1`	$n_2 = -1$	III J_- $n_2 = -1$ elements for the shift operators $K_\pm$ in su(1 $i\sqrt{(j \mp m)(j \pm m + 1)} = \sqrt{\left(m \pm \frac{1}{2}\right)^2 -}$
gilmore-lie-groups_F01992	200	0.982	`n_{1}+n_{2}=`	$n_1 + n_2 =$	and $-1 < n_2 < 0$ (wavy lines). All points labeled x belong to the principal
gilmore-lie-groups_F01993	200	0.872	`-1<n_{1}<0`	$-1 < n_1 < 0$	
gilmore-lie-groups_F01994	200	1.000	`-1<n_{2}<0`	$-1 < n_2 < 0$	**h.** For su(1, 1) show the hermiticity condition is satisfied for all real numbers exc
gilmore-lie-groups_F01995	200	0.997	`n_{1}+n_{2}=-\frac{1}{2}+i \beta`	$n_1 + n_2 = -\frac{1}{2} + i\beta$	those in QI and QIII.
gilmore-lie-groups_F01996	200	0.998	`\left|n_{1}+k, n_{2}-k\right\rangle`	$\|n_1 + k, n_2 - k\rangle$	$0, \frac{1}{2}, 1, \frac{3}{2}, \ldots$ or $2j + 1 = 0, 1, 2, 3, \ldots$ and $m = j + 1, j + 2, \ldots$. This is the
gilmore-lie-groups_F01997	200	1.000	`\left|n_{1}, n_{2}=-1\right\rangle`	$\|n_1, n_2 = -1\rangle$	**j.** In order to ensure that a set of states $\|n_1 + k, n_2 - k\rangle$ (k integer) mapped into
gilmore-lie-groups_F01998	200	1.000	`n_{1}=0,1,2, \ldots`	$n_1 = 0, 1, 2, \ldots$	**j.** In order to ensure that a set of states $\|n_1 + k, n_2 - k\rangle$ (k integer) mapped into
gilmore-lie-groups_F01999	200	0.995	`\left|{ }_{m}^{j}\right\rangle=\left|n_{1}, n_{2}\right\rangle`	$\left\|{}^{j}_{m}\right\rangle = \|n_1, n_2\rangle$	each other by the shift operators $K_\pm$ do not enter QI from QII, show that the edge
gilmore-lie-groups_F02000	200	0.995	`j+\frac{1}{2}=`	$j + \frac{1}{2} =$	each other by the shift operators $K_\pm$ do not enter QI from QII, show that the edge
gilmore-lie-groups_F02001	200	0.993	`0, \frac{1}{2}, 1, \frac{3}{2}, \ldots`	$0, \frac{1}{2}, 1, \frac{3}{2}, \ldots$	(highest m) state must be $\|n_1 = -1, n_2\rangle$ for $n_2 = 0, 1, 2, \ldots$. The basis states for
gilmore-lie-groups_F02002	200	0.993	`2 j+1=0,1,2,3, \ldots`	$2j + 1 = 0, 1, 2, 3, \ldots$	(highest m) state must be $\|n_1 = -1, n_2\rangle$ for $n_2 = 0, 1, 2, \ldots$. The basis states for

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gilmore-lie-groups_FO2003	200	0.993	m=j+1, j+2, \ldots	$m = j+1, j+2, \ldots$	(highest m) state must be $\lvert n_1 = -1, n_2\rangle$ for $n_2 = 0, 1, 2, \ldots$. The basis states for
gilmore-lie-groups_FO2004	200	1.000	\mathcal{D}_{+}^{j}	$\mathcal{D}_{+}^{j}$	this bounded discrete series of representations are $\lvert {}^{j}_{m}\rangle = \lvert$
gilmore-lie-groups_FO2005	200	0.831	\mathbf{j}	$\mathbf{j}$	$0, \frac{1}{2}, 1, \frac{3}{2}, \ldots$ or $2j+1 = 0, 1, 2, 3, \ldots$ and $m = -j-1, -j-2, \ldots$. This is the discrete series of representations that is bounded above: $\mathcal{D}^{j}$
gilmore-lie-groups_FO2006	200	1.000	\left|n_{1}=-1, n_{2}\right\rangle	$\lvert n_1 = -1, n_2\rangle$	
gilmore-lie-groups_FO2007	200	1.000	n_{2}=0,1,2, \ldots	$n_2 = 0, 1, 2, \ldots$	
gilmore-lie-groups_FO2008	200	1.000	m=-j-1,-j-2, \ldots	$m = -j-1, -j-2, \ldots$	
gilmore-lie-groups_FO2009	200	0.999	\mathcal{D}_{-}^{j}	$\mathcal{D}_{-}^{j}$	
gilmore-lie-groups_FO2010	201	0.998	\left(\mathcal{D}_{+}^{j}\right)	$\left(\mathcal{D}_{+}^{j}\right)$	$(\mathcal{D}_{+}^{j})$ or from QII $(\mathcal{D}_{-}^{j})$.
gilmore-lie-groups_FO2011	201	0.998	\left(\mathcal{D}_{-}^{j}\right)	$\left(\mathcal{D}_{-}^{j}\right)$	$(\mathcal{D}_{+}^{j})$ or from QII $(\mathcal{D}_{-}^{j})$.
gilmore-lie-groups_FO2012	201	0.999	\mid n_{1}+k, n_{2}-	$\mid n_1 + k, n_2-$	**I.** Now relax the condition that n_1 and n_2 are integers. The set of states $\lvert n_1 + k, n_2 -$
gilmore-lie-groups_FO2013	201	1.000	k\rangle(k=\ldots,-2,-1,0,+1,+2, \ldots)	$k\rangle(k = \ldots, -2, -1, 0, +1, +2, \ldots)$	$k\rangle$ $(k = \ldots, -2, -1, 0, +1, +2, \ldots)$ connected by $K_{\pm}$ carries a hermitian repre-
gilmore-lie-groups_FO2014	201	1.000	|p, q\rangle	$\lvert p, q\rangle$	vertices of the four quadrants. If this state is $\lvert p, q\rangle$, with $-1 \leq p, q \leq 0$ then the single-valuedness condition requires $\frac{1}{2}(p-q) =$ integer or half-integer. In the lat-
gilmore-lie-groups_FO2015	201	1.000	-1 \leq p, q \leq 0	$-1 \leq p, q \leq 0$	vertices of the four quadrants. If this state is $\lvert p, q\rangle$, with $-1 \leq p, q \leq 0$ then the single-valuedness condition requires $\frac{1}{2}(p-q) =$ integer or half-integer. In the lat-
gilmore-lie-groups_FO2016	201	1.000	\frac{1}{2}(p-q)=	$\frac{1}{2}(p-q) =$	single-valuedness condition requires $\frac{1}{2}(p-q) =$ integer or half-integer. In the lat- ter case, it is not possible for the matrix element in Eq. (11.30) to be real for all
gilmore-lie-groups_FO2017	201	0.891	p-q=0	$p - q = 0$	$\lvert {}^{j}_{m}\rangle$ with m integer, j real and $-\frac{1}{2} \leq j + \frac{1}{2} \leq +\frac{1}{2}$ carry representations $\mathcal{D}^{p}$ of the
gilmore-lie-groups_FO2018	201	0.891	-1 \leq p=q \leq 0	$-1 \leq p = q \leq 0$	$\lvert {}^{j}_{m}\rangle$ with m integer, j real and $-\frac{1}{2} \leq j + \frac{1}{2} \leq +\frac{1}{2}$ carry representations $\mathcal{D}^{p}$ of the
gilmore-lie-groups_FO2019	201	0.679	\left.\left.\right|_{m} ^{j}\right\rangle	$\left\lvert {}^{j}_{m}\right\rangle$	complementary series of UIR for $SU(1, 1)$.
gilmore-lie-groups_FO2020	201	0.679	-\frac{1}{2} \leq j+\frac{1}{2} \leq+\frac{1}{2}	$-\frac{1}{2} \leq j + \frac{1}{2} \leq +\frac{1}{2}$	complementary series of UIR for $SU(1, 1)$.
gilmore-lie-groups_FO2021	201	0.679	\mathcal{D}^{p}	$\mathcal{D}^{p}$	complementary series of UIR for $SU(1, 1)$.
gilmore-lie-groups_FO2022	201	1.000	j+\frac{1}{2}=i \beta	$j + \frac{1}{2} = i\beta$	
gilmore-lie-groups_FO2023	201	1.000	j^{\prime}<-\frac{1}{2}	$j' < -\frac{1}{2}$	indices is $j + \frac{1}{2} = -(j' + \frac{1}{2})$ and the relation among states is $\lvert {}^{j'}_{m'}\rangle \simeq \lvert {}^{j}_{m=m'}\rangle$.
gilmore-lie-groups_FO2024	201	0.693	\left(n_{1}, n_{2}\right)=\left(-\frac{1}{2},-\frac{1}{2} \right)	$(n_1, n_2) = \left(-\frac{1}{2}, -\frac{1}{2}\right)$	. Show that the following equivalences occur among representations of these four series:
gilmore-lie-groups_FO2025	201	1.000	j>-\frac{1}{2}	$j > -\frac{1}{2}$	series:
gilmore-lie-groups_FO2026	201	0.311	j+\frac{1}{2}=-\left(j^{\prime}+\frac{1}{2}\right)	$j + \frac{1}{2} = -\left(j' + \frac{1}{2}\right)$	principal series $j' = -\frac{1}{2} - i\lvert\beta\rvert \leftrightarrow j = j'^{*} = -\frac{1}{2} + i\lvert\beta\rvert$
gilmore-lie-groups_FO2027	201	0.311	\left|k_{m^{\prime}}^{j^{\prime}}\right\rangle \simeq \left|\underset{m=m^{\prime}}{j}\right\rangle	$\left\lvert k_{m'}^{j'}\right\rangle \simeq \left\lvert {}^{j}_{m=m'}\right\rangle$	principal series $j' = -\frac{1}{2} - i\lvert\beta\rvert \leftrightarrow j = j'^{*} = -\frac{1}{2} + i\lvert\beta\rvert$

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gilmore-lie-groups_F02028	201	0.996	`X=h^{i} H_{i}+e^{\alpha} E_{\alpha}`	$X = h^i H_i + e^\alpha E_\alpha$	
gilmore-lie-groups_F02029	201	0.996	`h^{i}, e^{\alpha}`	h^i, e^α	
gilmore-lie-groups_F02030	201	1.000	`\frac{1}{2}(n-l)`	$\frac{1}{2}(n-l)$	
gilmore-lie-groups_F02031	201	1.000	`\left(E_{\alpha}-E_{-\alpha}\right) / \sqrt{2}`	$\left(E_\alpha - E_{-\alpha}\right) / \sqrt{2}$	
gilmore-lie-groups_F02032	202	1.000	`\mathfrak{s p}(p, q)`	$\mathfrak{sp}(p, q)$	6. The noncompact real form $\mathfrak{sp}(p, q)$ of the symplectic algebra was constructed from
gilmore-lie-groups_F02033	202	1.000	`\mathfrak{s p}(p+q)`	$\mathfrak{sp}(p+q)$	the compact real form $\mathfrak{sp}(p+q)$ by "Minkowski's trick," or analytic continuation.
gilmore-lie-groups_F02034	203	0.999	`\mathfrak{p}, i \mathfrak{p}`	$\mathfrak{p}, i\mathfrak{p}$	subspaces exponentiate onto algebraic manifolds on which the invariant
gilmore-lie-groups_F02035	203	1.000	`i \mathfrak{p}`	$i\mathfrak{p}$	metric g_{ij} is definite, either negative or positive. Manifolds with a definite
gilmore-lie-groups_F02036	203	1.000	`g_{i j}`	g_{ij}	ric in the sense that every point looks like every other point – because
gilmore-lie-groups_F02037	203	1.000	`\operatorname{EXP}(\mathfrak{p})`	$\mathrm{EXP}(\mathfrak{p})$	Riemannian globally symmetric spaces in this chapter.
gilmore-lie-groups_F02038	203	1.000	`\operatorname{EXP}(i \mathfrak{p})`	$\mathrm{EXP}(i\mathfrak{p})$	Riemannian globally symmetric spaces in this chapter.
gilmore-lie-groups_F02039	203	0.997	`S^{2} \sim S U(2) / U(1)`	$S^2 \sim SU(2)/U(1)$	sheeted hyperboloid. These spaces are shown in Fig. 12.1.
gilmore-lie-groups_F02040	203	0.997	`H_{2+}^{2}=S L(2 ; \mathbb{R}) /`	$H_{2+}^2 = SL(2;\mathbb{R})/$	sheeted hyperboloid. These spaces are shown in Fig. 12.1.
gilmore-lie-groups_F02041	203	1.000	`S O(2)=S U(1,1) / U(1)`	$SO(2) = SU(1,1)/U(1)$	The Cartan–Killing inner product in the linear vector subspace $\mathfrak{su}(2) - \mathfrak{u}(1)$ is
gilmore-lie-groups_F02042	203	1.000	`H_{1}^{2}=S L(2 ; \mathbb{R}) / S O(1,1)`	$H_1^2 = SL(2;\mathbb{R})/SO(1,1)$	negative definite. This is mapped, under the EXPonential function, to the Cartan–
gilmore-lie-groups_F02043	203	0.943	`\mathfrak{s u}(2)-\mathfrak{u}(1)`	$\mathfrak{su}(2) - \mathfrak{u}(1)$	metric is negative-definite. We may just as well take it as positive-definite. Under his metric the sphere becomes a Riemannian manifold since there is a metric on it
gilmore-lie-groups_F02044	203	0.999	`S U(2) / U(1) \sim S^{2}`	$SU(2)/U(1) \sim S^2$	The Cartan–Killing inner product on $\mathfrak{su}(1,1) - \mathfrak{u}(1) \simeq \mathfrak{sl}(2;\mathbb{R}) - \mathfrak{so}(2)$ is
gilmore-lie-groups_F02045	203	0.991	`\mathfrak{s u}(1,1)-\mathfrak{u}(1) \simeq \mathfrak{s l}(2 ; \mathbb{R})-\mathfrak{s o}(2)`	$\mathfrak{su}(1,1) - \mathfrak{u}(1) \simeq \mathfrak{sl}(2;\mathbb{R}) - \mathfrak{so}(2)$	via its Cartan–Killing metric and the curvature tensor derived from it.
gilmore-lie-groups_F02046	203	1.000	`H_{2+}^{2}=S U(1,1) / S O(2)`	$H_{2+}^2 = SU(1,1)/SO(2)$	180
gilmore-lie-groups_F02047	204	1.000	`S^{2}=S O(3) / S O(2)=S U(2) / U(1), \quad H_{2+}^{2}=S O(2,1) / S O(2)=`	$S^2 = SO(3)/SO(2) = SU(2)/U(1), \quad H_{2+}^2 = SO(2,1)/SO(2) =$	space.
gilmore-lie-groups_F02048	204	1.000	`S U(1,1) / U(1), H_{1}^{2}=S O(2,1) / S O(1,1)=S L(2 ; \mathbb{R}) / S O(1,1)`	$SU(1,1)/U(1), H_1^2 = SO(2,1)/SO(1,1) = SL(2;\mathbb{R})/SO(1,1)$	
gilmore-lie-groups_F02049	204	0.998	`\mathfrak{s u}(1,1)-\mathfrak{s o}(1,1)`	$\mathfrak{su}(1,1) - \mathfrak{so}(1,1)$	The space is a pseudo-Riemannian manifold. In addition it is multiply connected.
gilmore-lie-groups_F02050	204	0.966	`\operatorname{EXP}[\mathfrak{s u}(1,1)-\mathfrak{s o}(1,1)]=S U(1,1) / S O(1,1)`	$\mathrm{EXP}[\mathfrak{su}(1,1) - \mathfrak{so}(1,1)] = SU(1,1)/SO(1,1)$	**12.2 Globally symmetric spaces**
gilmore-lie-groups_F02051	204	0.952	`\mathfrak{s o}(n), \mathfrak{s u}(n), \mathfrak{s p}(n)`	$\mathfrak{so}(n), \mathfrak{su}(n), \mathfrak{sp}(n)$	
gilmore-lie-groups_F02052	205	1.000	`\mathfrak{p}(i \mathfrak{p})`	$\mathfrak{p}(i\mathfrak{p})$	On the linear vector space $\mathfrak{p}$ $(i\mathfrak{p})$ the Cartan–Killing inner product is negative
gilmore-lie-groups_F02053	205	1.000	`P=G / H=\operatorname{EXP}(\mathfrak{p})`	$P = G/H = \mathrm{EXP}(\mathfrak{p})$	straight line through the origin in $\mathfrak{p}$ returns periodically to the neighborhood of the

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gilmore-lie-groups_F02054	205	1.000	`P`	P	which a straight line (geodesic) through the origin never returns to the origin. The space P may be simply connected or multiply connected
gilmore-lie-groups_F02055	205	0.999	`P^{\prime}=G^{\prime} / H=\operatorname{EXP}(i \mathfrak{p})`	$P' = G'/H = \mathrm{EXP}(i\mathfrak{p})$	simply goes away from this point without ever returning. The space $P' = \mathrm{EXP}(i\mathfrak{p})$ is
gilmore-lie-groups_F02056	205	1.000	`P^{\prime}=\operatorname{EXP}(i \mathfrak{p})`	$P' = \mathrm{EXP}(i\mathfrak{p})$	it is not Euclidean since it has nonzero curvature. This space is simply connected.
gilmore-lie-groups_F02057	205	1.000	`n=\operatorname{dim} i \mathfrak{p}`	$n = \dim i\mathfrak{p}$	The Riemannian spaces $P = \mathrm{EXP}(\mathfrak{p})$ and $P' = \mathrm{EXP}(i\mathfrak{p})$ are symmetric but not
gilmore-lie-groups_F02058	205	1.000	`P=\operatorname{EXP}(\mathfrak{p})`	$P = \mathrm{EXP}(\mathfrak{p})$	If $\mathfrak{g}$ is simple with a Cartan decomposition of the form $\mathfrak{g} = \mathfrak{k} + \mathfrak{p}$, with standard commutation relations $[\mathfrak{k}, \mathfrak{k}] \subset \mathfrak{k}$, $[\mathfrak{k}, \mathfrak{p}] \subset \mathfrak{p}$, and $[\mathfrak{p}, \mathfrak{p}] \subset \mathfrak{k}$, the quotient coset $P =$
gilmore-lie-groups_F02059	205	1.000	`\mathfrak{g}=\mathfrak{k}+\mathfrak{p}`	$\mathfrak{g} = \mathfrak{k} + \mathfrak{p}$	
gilmore-lie-groups_F02060	205	1.000	`[\mathfrak{k}, \mathfrak{k}] \subseteq \mathfrak{k},[ \mathfrak{k}, \mathfrak{p}] \subseteq \mathfrak{p}`	$[\mathfrak{k}, \mathfrak{k}] \subseteq \mathfrak{k}, [\mathfrak{k}, \mathfrak{p}] \subseteq \mathfrak{p}$	
gilmore-lie-groups_F02061	205	1.000	`[\mathfrak{p}, \mathfrak{p}] \subseteq \mathfrak{k}`	$[\mathfrak{p}, \mathfrak{p}] \subseteq \mathfrak{k}$	
gilmore-lie-groups_F02062	205	1.000	`P=`	$P =$	
gilmore-lie-groups_F02063	205	1.000	`G / K`	G/K	**12.3 Rank**
gilmore-lie-groups_F02064	205	1.000	`P=G / H`	$P = G/H$	$\| \mathfrak{Reg}(\mathfrak{h} + \mathfrak{p}) - \lambda I_n \| = \sum^{\cdot\cdot} (-\lambda)^{n-j} \phi_i(\mathfrak{h}, \mathfrak{p})$ (12.3)
gilmore-lie-groups_F02065	205	1.000	`P^{\prime}=G^{\prime} / H`	$P' = G'/H$	$\| \mathfrak{Reg}(\mathfrak{h} + \mathfrak{p}) - \lambda I_n \| = \sum^{\cdot\cdot} (-\lambda)^{n-j} \phi_i(\mathfrak{h}, \mathfrak{p})$ (12.3)
gilmore-lie-groups_F02066	205	0.993	`S O(p, q) / S O(p) \times S O(q)`	$SO(p, q)/SO(p) \times SO(q)$	
gilmore-lie-groups_F02067	206	1.000	`B^{\dagger} B`	$B^{\dagger} B$	It is easy to check that the function ψ_j depends on the $q \times q$ matrix $B^{\dagger} B$ of the $p \times p$ matrix $BB^{\dagger}$, whichever is smaller. The rank of these spaces is $\min(p, q)$.
gilmore-lie-groups_F02068	206	1.000	`B B^{\dagger}`	$BB^{\dagger}$	For Riemannian globally symmetric spaces the rank is (cf. Section 10.1):
gilmore-lie-groups_F02069	206	1.000	`\min (p, q)`	$\min(p, q)$	For Riemannian globally symmetric spaces the rank is (cf. Section 10.1):
gilmore-lie-groups_F02070	206	1.000	`P\left(P^{\prime}\right)`	$P\left(P'\right)$	(v) the dimension of a positive-definite root space that can be used to define diagrammatically the properties of these spaces (Araki–Satake root diagrams);
gilmore-lie-groups_F02071	206	0.999	`G^{\prime} / H`	G'/H	Root space / Quotient G'/H / Dimension P / Rank P
gilmore-lie-groups_F02072	206	0.999	`G^{\prime}`	G'	Root space / Quotient G'/H / Dimension P / Rank P
gilmore-lie-groups_F02073	206	0.877	`A_{p+q-1}`	A_{p+q-1}	A_{2n-1} / $SU^*(2n)/USp(2n)$ / $(2n+1)(n-1)$ / $n-1$ B_{p+q} / $SO(p,q)/SO(p) \otimes SO(q)$ / pq / $\min(p,q)$ D_{p+q} / $SO(p,q)/SO(p) \otimes SO(q)$ / pq / $\min(p,q)$ D_n / $SO^*(2n)/U(n)$ / $n(n-1)$ / $[n/2]$ C_{p+q} / $USp(2p,2q)/USp(2p) \otimes USp(2q)$ / $4pq$ / $\min(p,q)$ C_n / $Sp(2n;\mathbb{R})/U(n)$ / $n(n+1)$ / n

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gilmore-lie-groups_FO2074	206	0.877	`S U(p, q) / S[U(p) \otimes U(q)]`	$SU(p,q)/S[U(p)\otimes U(q)]$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2075	206	0.877	`2 p q`	$2pq$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2076	206	0.877	`S L(n ; \mathbb{R}) / S O(n)`	$SL(n;\mathbb{R})/SO(n)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2077	206	0.877	`\frac{1}{2}(n+2)(n-1)`	$\frac{1}{2}(n+2)(n-1)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2078	206	0.877	`n-1`	$n-1$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n

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gilmore-lie-groups_FO2079	206	0.877	`S U^{*}(2 n) / U \operatorname{Sp}(2 n)`	$SU^{*}(2n)/U\operatorname{Sp}(2n)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2080	206	0.877	`(2 n+1)(n-1)`	$(2n+1)(n-1)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2081	206	0.877	`B_{p+q}`	B_{p+q}	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2082	206	0.877	`S O(p, q) / S O(p) \otimes S O(q)`	$SO(p,q)/SO(p)\otimes SO(q)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2083	206	0.877	`D_{p+q}`	D_{p+q}	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n

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gilmore-lie-groups_FO2084	206	0.877	`S O^{*}(2 n) / U(n)`	$SO^*(2n)/U(n)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2085	206	0.877	`n(n-1)`	$n(n-1)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2086	206	0.877	`C_{p+q}`	C_{p+q}	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2087	206	0.877	`U S p(2 p, 2 q) / U S p(2 p) \otimes U S p(2 q)`	$USp(2p,2q)/USp(2p)\otimes USp(2q)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2088	206	0.877	`4 p q`	$4pq$	A_{2n-1} $SU^*(2n)/USp(2n)$ $(2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n

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gilmore-lie-groups_FO2089	206	0.877	`S p(2 n ; \mathbb{R}) / U(n)`	$Sp(2n;\mathbb{R})/U(n)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $\tilde{(}2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2090	206	0.877	`n(n+1)`	$n(n+1)$	A_{2n-1} $SU^*(2n)/USp(2n)$ $\tilde{(}2n+1)(n-1)$ $n-1$ B_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_{p+q} $SO(p,q)/SO(p)\otimes SO(q)$ pq $\min(p,q)$ D_n $SO^*(2n)/U(n)$ $n(n-1)$ $[n/2]$ C_{p+q} $USp(2p,2q)/USp(2p)\otimes USp(2q)$ $4pq$ $\min(p,q)$ C_n $Sp(2n;\mathbb{R})/U(n)$ $n(n+1)$ n
gilmore-lie-groups_FO2091	207	0.979	`\operatorname{Dim} G^{\prime}`	$\operatorname{Dim} G^{\prime}$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 $G_{2(+2)}/(A_1\oplus A_1)$ 14 6 8 2 F_4 $F_{4(-20)}/B_4$ 52 36 16 1 $F_{4(+4)}/(C_3\oplus A_1)$ 52 24 28 4 E_6 $E_{6(-26)}/F_4$ 78 52 26 2 $E_{6(-14)}/(D_5\oplus D_1)$ 78 46 32 2 $E_{6(+2)}/(A_5\oplus A_1)$ 78 38 40 4 $E_{6(+6)}/C_4$ 78 36 42 6 E_7 $E_{7(-25)}/(E_6\oplus D_1)$ 133 79 54 3 $E_{7(-5)}/(D_6\oplus A_1)$ 133 69 64 4 $E_{7(+7)}/A_7$ 133 63 70 7 E_8 $E_{8(-24)}/(E_7\oplus A_1)$ 248 136 112 4 $E_{8(+8)}/D_8$ 248 120 128 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2092	207	0.979	`\operatorname{Dim} H`	$\operatorname{Dim} H$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 $G_{2(+2)}/(A_1\oplus A_1)$ 14 6 8 2 F_4 $F_{4(-20)}/B_4$ 52 36 16 1 $F_{4(+4)}/(C_3\oplus A_1)$ 52 24 28 4 E_6 $E_{6(-26)}/F_4$ 78 52 26 2 $E_{6(-14)}/(D_5\oplus D_1)$ 78 46 32 2 $E_{6(+2)}/(A_5\oplus A_1)$ 78 38 40 4 $E_{6(+6)}/C_4$ 78 36 42 6 E_7 $E_{7(-25)}/(E_6\oplus D_1)$ 133 79 54 3 $E_{7(-5)}/(D_6\oplus A_1)$ 133 69 64 4 $E_{7(+7)}/A_7$ 133 63 70 7 E_8 $E_{8(-24)}/(E_7\oplus A_1)$ 248 136 112 4 $E_{8(+8)}/D_8$ 248 120 128 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For

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gilmore-lie-groups_FO2093	207	■ 0.979	`\operatorname{Dim} P`	$\operatorname{Dim} P$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2094	207	■ 0.979	`G_{2(+2)} /\left(A_{1} \oplus A_{1}\right)`	$G_{2(+2)}/\left(A_1 \oplus A_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2095	207	■ 0.979	`F_{4(-20)} / B_{4}`	$F_{4(-20)}/B_4$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2096	207	■ 0.979	`F_{4(+4)} /\left(C_{3} \oplus A_{1}\right)`	$F_{4(+4)}/\left(C_3 \oplus A_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For

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gilmore-lie-groups_FO2097	207	■0.979	`E_{6(-26)} / F_{4}`	$E_{6(-26)}/F_4$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2098	207	■0.979	`E_{6(-14)} /\left(D_{5} \oplus D_{1}\right)`	$E_{6(-14)}/\left(D_5 \oplus D_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2099	207	■0.979	`E_{6(+2)} /\left(A_{5} \oplus A_{1}\right)`	$E_{6(+2)}/\left(A_5 \oplus A_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_FO2100	207	■0.979	`E_{6(+6)} / C_{4}`	$E_{6(+6)}/C_4$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For

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gilmore-lie-groups_F02101	207	■0.979	`E_{7(-25)} /\left(E_{6} \oplus D_{1}\right)`	$E_{7(-25)}/\left(E_6 \oplus D_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_F02102	207	■0.979	`E_{7(-5)} /\left(D_{6} \oplus A_{1}\right)`	$E_{7(-5)}/\left(D_6 \oplus A_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_F02103	207	■0.979	`E_{7(+7)} / A_{7}`	$E_{7(+7)}/A_7$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_F02104	207	■0.979	`E_{8(-24)} /\left(E_{7} \oplus A_{1}\right)`	$E_{8(-24)}/\left(E_7 \oplus A_1\right)$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For

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gilmore-lie-groups_F02105	207	0.979	`E_{8(+8)} / D_{8}`	$E_{8(+8)}/D_8$	Root space / G'/H / Dim G' / Dim H / Dim P / Rank P G_2 / $G_{2(+2)}/(A_1 \oplus A_1)$ / 14 / 6 / 8 / 2 F_4 / $F_{4(-20)}/B_4$ / 52 / 36 / 16 / 1 $F_{4(+4)}/(C_3 \oplus A_1)$ / 52 / 24 / 28 / 4 E_6 / $E_{6(-26)}/F_4$ / 78 / 52 / 26 / 2 $E_{6(-14)}/(D_5 \oplus D_1)$ / 78 / 46 / 32 / 2 $E_{6(+2)}/(A_5 \oplus A_1)$ / 78 / 38 / 40 / 4 $E_{6(+6)}/C_4$ / 78 / 36 / 42 / 6 E_7 / $E_{7(-25)}/(E_6 \oplus D_1)$ / 133 / 79 / 54 / 3 $E_{7(-5)}/(D_6 \oplus A_1)$ / 133 / 69 / 64 / 4 $E_{7(+7)}/A_7$ / 133 / 63 / 70 / 7 E_8 / $E_{8(-24)}/(E_7 \oplus A_1)$ / 248 / 136 / 112 / 4 $E_{8(+8)}/D_8$ / 248 / 120 / 128 / 8 subgroup in G'. To each there is a compact real form under $G'/H \to G/H$. For
gilmore-lie-groups_F02106	207	1.000	`G^{\prime} / H \rightarrow G / H`	$G'/H \to G/H$	These spaces are classical because they involve the classical series of Lie groups:
gilmore-lie-groups_F02107	207	1.000	`S O(p+q) / S O(p) \otimes S O(q)`	$SO(p+q)/SO(p) \otimes SO(q)$	the orthogonal, the unitary, and the symplectic.
gilmore-lie-groups_F02108	207	1.000	`P, P^{\prime}`	P, P'	If $dx(\mathrm{Id})$ are infinitesimal displacements at the identity that are translated to
gilmore-lie-groups_F02109	207	0.987	`d x(\mathrm{Id})`	$dx(\mathrm{Id})$	$dx^i(\mathrm{Id}) = M^i{}_\mu\, dx^\mu(p)$ (12.5)
gilmore-lie-groups_F02110	207	1.000	`d x(p)`	$dx(p)$	
gilmore-lie-groups_F02111	208	1.000	`M^{i}{ }_{\mu}(p)`	$M^i{}_\mu(p)$	The matrix $M^i{}_\mu(p)$ is not easy to compute in general. For the rank-one spaces
gilmore-lie-groups_F02112	208	0.998	`S O(n, 1) / S O(n), S U(n, 1) / U(n), S p(n, 1) / S p(n) \times S p(1)`	$SO(n,1)/SO(n), SU(n,1)/U(n), Sp(n,1)/Sp(n) \times Sp(1)$	$SO(n,1)/SO(n)$, $SU(n,1)/U(n)$, $Sp(n,1)/Sp(n) \times Sp(1)$ defined by
gilmore-lie-groups_F02113	208	1.000	`M^{i}{ }_{\mu}(X)`	$M^i{}_\mu(X)$	
gilmore-lie-groups_F02114	208	1.000	`W^{-1}`	W^{-1}	at the identity, we find
gilmore-lie-groups_F02115	208	1.000	`H_{2}^{2}=S O(2,1) / S O(2)`	$H_2^2 = SO(2,1)/SO(2)$	
gilmore-lie-groups_F02116	209	0.999	`S^{2}=S O(3) / S O(2)`	$S^2 = SO(3)/SO(2)$	$S^2 = SO(3)/SO(2)$. The metric tensors in the two cases are the 2×2 matrices
gilmore-lie-groups_F02117	209	1.000	`S O(2+1) / S O(2)`	$SO(2+1)/SO(2)$	$Y^2 = 1 - (x^2 + y^2) \geq 0$. Since the (intrinsic) properties of the Riemannian symmetric space are entirely
gilmore-lie-groups_F02118	209	0.999	`Y^{2}=1-\left(x^{2}+y^{2}\right) \geq 0`	$Y^2 = 1 - \left(x^2 + y^2\right) \geq 0$	Since the (intrinsic) pro encoded in its metric tensc
gilmore-lie-groups_F02119	209	1.000	`x, y`	x, y	the neighborhood of the origin (identity in the coset) only up to quadratic terms,
gilmore-lie-groups_F02120	209	1.000	`x^{i}, i=1,2, \ldots, N`	$x^i, i = 1, 2, \ldots, N$	
gilmore-lie-groups_F02121	209	1.000	`N=2`	$N = 2$	
gilmore-lie-groups_F02122	210	1.000	`g^{i j} \simeq \delta^{i j}-x^{i} x^{j}`	$g^{ij} \simeq \delta^{ij} - x^i x^j$	The inverse (contravariant metric) is $g^{ij} \simeq \delta^{ij} - x^i x^j$, but we will not need this
gilmore-lie-groups_F02123	210	0.900	`g^{i j} \rightarrow \delta^{i j}`	$g^{ij} \to \delta^{ij}$	result. In the neighborhood of the identity ($g^{ij} \to \delta^{ij}$
gilmore-lie-groups_F02124	210	1.000	`R_{\mu \sigma, \alpha \beta}=`	$R_{\mu\sigma,\alpha\beta} =$	The Ricci tensor is obtained by contraction

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gilmore-lie-groups_F02125	210	1.000	`\delta_{\alpha \mu} \delta_{\beta \sigma}-\delta_{\alpha \sigma} \delta_{\beta \mu}`	$\delta_{\alpha\mu}\delta_{\beta\sigma} - \delta_{\alpha\sigma}\delta_{\beta\mu}$	$R_{\sigma\beta} = R^{\mu}{}_{\sigma,\mu\beta} = \delta_{\sigma\beta}\delta_{\mu\mu} - \delta_{\sigma\mu}\delta_{\beta\mu} = N\delta_{\sigma\beta} - \delta_{\sigma\beta}$
gilmore-lie-groups_F02126	210	0.874	`R=2`	$R = 2$	the origin undergoes the el
gilmore-lie-groups_F02127	210	1.000	`H_{2}^{2}`	H_2^2	$SO(2+1)/SO(2) \qquad SO(2,1)/SO(2)$ (12.18)
gilmore-lie-groups_F02128	210	0.848	`\Gamma_{\mu \nu}^{\sigma} \rightarrow-\delta_{\mu \nu} x^{\sigma}`	$\Gamma^{\sigma}_{\mu\nu} \rightarrow -\delta_{\mu\nu} x^{\sigma}$	
gilmore-lie-groups_F02129	210	0.848	`R=-2`	$R = -2$	
gilmore-lie-groups_F02130	211	0.998	`d s^{2}=g_{\mu \nu} d x^{\mu} d x^{\nu}>0`	$ds^2 = g_{\mu\nu} dx^{\mu} dx^{\nu} > 0$	positive-definite ($ds^2 = g_{\mu\nu}\ dx^{\mu}dx^{\nu} > 0$, equality $\Rightarrow dx = 0$) nor negative-
gilmore-lie-groups_F02131	211	0.998	`\Rightarrow d x=0`	$\Rightarrow dx = 0$	positive-definite ($ds^2 = g_{\mu\nu}\ dx^{\mu}dx^{\nu} > 0$, equality $\Rightarrow dx = 0$) nor negative-
gilmore-lie-groups_F02132	211	0.958	`\left(d s^{2}<0\right)`	$\left(ds^2 < 0\right)$	definite ($ds^2 < 0$), but which is nonsingular ($\| g \| \neq 0$) are called **pseudo-**
gilmore-lie-groups_F02133	211	0.958	`\\|g\\| \neq 0`	$\|g\| \neq 0$	definite ($ds^2 < 0$), but which is nonsingular ($\| g \| \neq 0$) are called **pseudo-**
gilmore-lie-groups_F02134	211	1.000	`\mathfrak{g}^{\prime \prime}`	$\mathfrak{g}''$	has a decomposition
gilmore-lie-groups_F02135	211	1.000	`\mathfrak{h}^{\prime \prime}`	$\mathfrak{h}''$	$P'' = \mathrm{EXP}(\mathfrak{h}'') = G''/H''$ (12.21)
gilmore-lie-groups_F02136	211	1.000	`\mathfrak{p}^{\prime \prime}`	$\mathfrak{p}''$	$P'' = \mathrm{EXP}(\mathfrak{p}'') = G''/H''$ (12.21)
gilmore-lie-groups_F02137	211	1.000	`H^{\prime \prime}=`	$H'' =$	hold also for pseudo-Riemannian symmetric spaces. That is, rank can be defined,
gilmore-lie-groups_F02138	211	1.000	`\operatorname{EXP}\left(\mathfrak{h}^{\prime \prime} \right)`	$\mathrm{EXP}\left(\mathfrak{h}''\right)$	and carries most of the implications listed in Section 12.3.
gilmore-lie-groups_F02139	211	1.000	`T_{1}, T_{2}`	T_1, T_2	$T_1\ \mathfrak{g}_{\pm,*} = \pm\mathfrak{g}_{\pm,*}$ (12.22)
gilmore-lie-groups_F02140	211	0.819	`T_{1}^{2}=I`	$T_1^2 = I$	$T_2\ \mathfrak{g}_{*,\pm} = \pm\mathfrak{g}_{*,\pm}$ (12.22)
gilmore-lie-groups_F02141	211	0.819	`T_{2}^{2}=I`	$T_2^2 = I$	$T_2\ \mathfrak{g}_{*,\pm} = \pm\mathfrak{g}_{*,\pm}$ (12.22)
gilmore-lie-groups_F02142	211	1.000	`T_{1} \neq T_{2}`	$T_1 \neq T_2$	
gilmore-lie-groups_F02143	211	1.000	`\mathfrak{g}_{ \pm, \pm}`	$\mathfrak{g}_{\pm,\pm}$	
gilmore-lie-groups_F02144	212	1.000	`\mathfrak{h}^{\prime \prime}, \mathfrak{p}^{\prime \prime}`	$\mathfrak{h}'', \mathfrak{p}''$	product is indefinite on both $\mathfrak{h}''$ and $\mathfrak{p}''$ as long as $T_1 \neq T_2$.
gilmore-lie-groups_F02145	212	0.996	`\mathrm{p}^{\prime \prime}`	p''	For $\mathfrak{su}(2)$ the only two mappings are T_1 = block diag
gilmore-lie-groups_F02146	212	0.999	`T_{1}=`	$T_1 =$	T_2 = complex conjugation. The eigenspace decomposition is
gilmore-lie-groups_F02147	212	1.000	`T_{2}=`	$T_2 =$	
gilmore-lie-groups_F02148	212	1.000	`i \sigma_{1}`	$i\sigma_1$	T_1 = block matrix decomposition $-1 \quad -1 \quad +1$ T_2 = complex conjugation $-1 \quad +1 \quad -1$ $T_3 = T_1\ T_2$ $+1 \quad -1 \quad -1$ es $\mathfrak{g}_{+,+} = 0, \mathfrak{g}_{+,-} = i\sigma_3, \mathfrak{g}_{-,+} = i\sigma_2, \mathfrak{g}_{-,-} = i\sigma_1$. Note tha

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gilmore-lie-groups_F02149	212	1.000	`i \sigma_{2}`	$i\sigma_2$	T_1 = block matrix decomposition -1 -1 $+1$ T_2 = complex conjugation -1 $+1$ -1 $T_3 = T_1\, T_2$ $+1$ -1 -1 es $\mathfrak{g}_{+,+} = 0, \mathfrak{g}_{+,-} = i\sigma_3, \mathfrak{g}_{-,+} = i\sigma_2, \mathfrak{g}_{-,-} = i\sigma_1$. Note tha
gilmore-lie-groups_F02150	212	1.000	`i \sigma_{3}`	$i\sigma_3$	T_1 = block matrix decomposition -1 -1 $+1$ T_2 = complex conjugation -1 $+1$ -1 $T_3 = T_1\, T_2$ $+1$ -1 -1 es $\mathfrak{g}_{+,+} = 0, \mathfrak{g}_{+,-} = i\sigma_3, \mathfrak{g}_{-,+} = i\sigma_2, \mathfrak{g}_{-,-} = i\sigma_1$. Note tha
gilmore-lie-groups_F02151	212	1.000	`T_{3}=T_{1} T_{2}`	$T_3 = T_1 T_2$	T_1 = block matrix decomposition -1 -1 $+1$ T_2 = complex conjugation -1 $+1$ -1 $T_3 = T_1\, T_2$ $+1$ -1 -1 es $\mathfrak{g}_{+,+} = 0, \mathfrak{g}_{+,-} = i\sigma_3, \mathfrak{g}_{-,+} = i\sigma_2, \mathfrak{g}_{-,-} = i\sigma_1$. Note tha
gilmore-lie-groups_F02152	212	1.000	`\mathfrak{g}_{+,+}=0, \mathfrak{g}_{+,-}=i \sigma_{3}, \mathfrak{g}_{-,+}=i \sigma_{2}, \mathfrak{g}_{-,-}=i \sigma_{1}`	$\mathfrak{g}_{+,+} = 0, \mathfrak{g}_{+,-} = i\sigma_3, \mathfrak{g}_{-,+} = i\sigma_2, \mathfrak{g}_{-,-} = i\sigma_1$	for the maximal compact subalgebra $\mathfrak{h}'$ of the noncompact real form $\mathfrak{g}'$.
gilmore-lie-groups_F02153	212	1.000	`T_{i}`	T_i	
gilmore-lie-groups_F02154	212	0.999	`\mathfrak{h}^{\prime}`	$\mathfrak{h}'$	
gilmore-lie-groups_F02155	212	0.984	`P=G / K`	$P = G/K$	Riemannian globally symmetric spaces are constructed as quotients of a simple Lie group G by a maximal compact subgroup K. More specifically, they are expo-
gilmore-lie-groups_F02156	212	1.000	`\phi_{j}\left(B, B^{\dagger}\right)`	$\phi_j\left(B, B^{\dagger}\right)$	matrix are zero (singular value decomposition theorem).
gilmore-lie-groups_F02157	212	0.585	`(p-q)`	$(p-q)$	
gilmore-lie-groups_F02158	212	0.585	`(q-p)`	$(q-p)$	
gilmore-lie-groups_F02159	213	1.000	`\Delta^{2}`	Δ^2	2. The second order Laplace–Beltrami operator Δ^2 is constructed from the second order
gilmore-lie-groups_F02160	213	1.000	`G / H=P`	$G/H = P$	$G/H = P$.
gilmore-lie-groups_F02161	213	1.000	`\Delta^{2}=g^{i j}\left(\partial_{i} \partial_{j}-\Gamma_{i j}{ }^{k} \partial_{k}\right)`	$\Delta^2 = g^{ij}\left(\partial_i\partial_j - \Gamma_{ij}{}^k\partial_k\right)$	tensor on P as $\Delta^2 = g^{ij}(\partial_i\partial_j - \Gamma_{ij}{}^k\partial_k)$. Show that there is one Laplace–Beltrami op
gilmore-lie-groups_F02162	213	1.000	`x^{2}+y^{2} \leq 1`	$x^2 + y^2 \leq 1$	. Show that there is one L
gilmore-lie-groups_F02163	213	1.000	`S^{n}`	S^n	Show that the two metric-preserving mappings T_1 and T_2 that satisfy
gilmore-lie-groups_F02164	213	1.000	`H^{n}, n>2`	$H^n, n > 2$	Show that the two metric-preserving mappings T_1 and T_2 that satisfy
gilmore-lie-groups_F02165	213	1.000	`T_{1}^{2}=T_{2}^{2}=I`	$T_1^2 = T_2^2 = I$	that these three operators, together with the identity, form a group isomorphic with
gilmore-lie-groups_F02166	213	1.000	`T_{1} T_{2}=T_{2} T_{1}`	$T_1 T_2 = T_2 T_1$	the "four-group" ("vierergruppe") V_4. Describe the variety of decompositions of a
gilmore-lie-groups_F02167	213	1.000	`T_{3} \neq I`	$T_3 \neq I$	the "four-group" ("vierergruppe") V_4. Describe the variety of decompositions of a
gilmore-lie-groups_F02168	213	1.000	`\mathfrak{g}=\mathfrak{g}_{+,+}+\mathfrak{g}_{+,-}+\mathfrak{g}_{-,+}+\mathfrak{g}_{-,-}`	$\mathfrak{g} = \mathfrak{g}_{+,+} + \mathfrak{g}_{+,-} + \mathfrak{g}_{-,+} + \mathfrak{g}_{-,-}$	Discuss dualities.
gilmore-lie-groups_F02169	213	1.000	`3!/ 1!=6`	$3!/1! = 6$	Show that the secular equation for the symmetric space $SO(3)/SO(2)$ can be obtained

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gilmore-lie-groups_F02170	213	1.000	`b_{3}=0`	$b_3 = 0$	There is one independent functic
gilmore-lie-groups_F02171	213	1.000	`\phi_{j}(\mathfrak{p})`	$\phi_j(\mathfrak{p})$	6. The hyperbolic plane H_2^2 is the Riemannian symmetric space $SO(2,1)/SO(2)$ ob-
gilmore-lie-groups_F02172	213	0.992	`\phi_{j}(\mathfrak{h}, \mathfrak{p})`	$\phi_j(\mathfrak{h}, \mathfrak{p})$	tained by exponentiating a real symmetric matrix in the three-dimensional Lie algebra
gilmore-lie-groups_F02173	213	0.998	`\mathfrak{h}=0`	$\mathfrak{h} = 0$	⌈ 0 |t_1 t_2 ⌉ ⌈ x_0 |
gilmore-lie-groups_F02174	213	0.891	`x_{0}^{2}-x_{1}^{2}-x_{2}^{2}=1`	$x_0^2 - x_1^2 - x_2^2 = 1$	
gilmore-lie-groups_F02175	213	1.000	`-d s^{2}=d x_{0}^{2}-d x_{1}^{2}-`	$-ds^2 = dx_0^2 - dx_1^2 -$	
gilmore-lie-groups_F02176	213	0.973	`d x_{2}^{2}`	dx_2^2	
gilmore-lie-groups_F02177	214	1.000	`x_{1}, x_{2}`	x_1, x_2	**c.** Use coordinates x_1, x_2 to parameterize the points in H_2^2, and show
gilmore-lie-groups_F02178	214	1.000	`(r, \theta), x_{1}=r \cos (\theta), x_{2}=r \sin (\theta)`	$(r, \theta), x_1 = r\cos(\theta), x_2 = r\sin(\theta)$	⌈ 1 0 ⌉ ⌈ dr ⌉
gilmore-lie-groups_F02179	214	1.000	`S O(1,2)`	$SO(1,2)$	7. The metric on a pseudo Riemannian symmetric space is $g_{ij}(x)$. **a.** Show that the generators of infinitesimal rotations at a point are $X_{rs} = g_{rt}x^t\partial_s -$
gilmore-lie-groups_F02180	214	1.000	`\left(x_{1}, x_{2}\right) \in H_{2}^{2}`	$(x_1, x_2) \in H_2^2$	7. The metric on a pseudo Riemannian symmetric space is $g_{ij}(x)$. **a.** Show that the generators of infinitesimal rotations at a point are $X_{rs} = g_{rt}x^t\partial_s -$
gilmore-lie-groups_F02181	214	1.000	`g_{i j}(x)`	$g_{ij}(x)$	$g_{st}x^t\partial_r$. **b.** Show $[X_{ab}, \Delta] = 0$, where $\Delta = G^{ab;rs}X_{ab}X_{rs}$ is the Laplace–Beltrami operator on this space, $G^{ab;rs} = \mathrm{tr}\,[\partial\mathfrak{e}f(X_{ab})\partial\mathfrak{e}f(X_{rs})]$, and $G^{ab;rs}$ is the inverse of $G_{ab;rs}$.
gilmore-lie-groups_F02182	214	1.000	`X_{r s}=g_{r t} x^{t} \partial_{s}-`	$X_{rs} = g_{rt}x^t\partial_s -$	
gilmore-lie-groups_F02183	214	1.000	`g_{s t} x^{t} \partial_{r}`	$g_{st}x^t\partial_r$	**c.** S
gilmore-lie-groups_F02184	214	1.000	`\left[X_{a b}, \Delta\right]=0`	$[X_{ab}, \Delta] = 0$	**d.** Show that Δ consists of terms that are both quadratic and linear in the operators ∂_r, and that
gilmore-lie-groups_F02185	214	1.000	`\Delta=G^{a b ; r s} X_{a b} X_{r s}`	$\Delta = G^{ab;rs}X_{ab}X_{rs}$	**d.** Show that Δ consists of terms that are both quadratic and linear in the operators ∂_r, and that
gilmore-lie-groups_F02186	214	0.546	`G_{a b ; r s}=\operatorname{tr}\left\{\mathfrak{d e f} \left(X_{a b}\right) \mathfrak{d e f}\left(X_{r s}\right) \right\}`	$G_{ab;rs} = \mathrm{tr}\left\{\mathfrak{def}\left(X_{ab}\right)\mathfrak{def}\left(X_{rs}\right)\right\}$	
gilmore-lie-groups_F02187	214	0.546	`G^{a b ; r s}`	$G^{ab;rs}$	
gilmore-lie-groups_F02188	214	0.546	`G_{a b ; r s}`	$G_{ab;rs}$	
gilmore-lie-groups_F02189	214	0.989	`\Delta`	Δ	$\Delta = g^{rs}\partial_r\partial_s - g^{rs}\Gamma_{rs}{}^t\partial_t$
gilmore-lie-groups_F02190	214	1.000	`\partial_{r}`	∂_r	The f
gilmore-lie-groups_F02191	214	0.765	`\Gamma_{r}{ }_{s}{ }^{t}`	$\Gamma_{rs}{}^t$	$\Gamma_{rs}{}^t = \frac{1}{2}g^{tu}(\partial_s g_{ru} + \partial_r g_{su} - \partial_u g_{rs})$
gilmore-lie-groups_F02192	214	1.000	`\left(r, \phi_{2}, \phi_{3}, \ldots, \phi_{n}\right)`	$(r, \phi_2, \phi_3, \ldots, \phi_n)$	$dr \wedge d\phi_2 \wedge d\phi_3 \wedge \cdots \wedge d\phi_n$
gilmore-lie-groups_F02193	214	1.000	`S^{n} \subset R^{n+1}`	$S^n \subset R^{n+1}$	$dr \wedge d\phi_2 \wedge d\phi_3 \wedge \cdots \wedge d\phi_n$
gilmore-lie-groups_F02194	215	0.995	`S O(n+1)`	$SO(n+1)$	**c.** Compare this with the second order Casimir operator for $SO(n+1)$:
gilmore-lie-groups_F02195	215	1.000	`f_{1}(\phi)`	$f_1(\phi)$	quantum system with n dea

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gilmore-lie-groups_F02196	215	1.000	f_{2}(\phi)	$f_2(\phi)$	
gilmore-lie-groups_F02197	215	0.994	a_{i}^{\dagger} a_{j}\left(\mathcal{H}=h_{i j}(t) a_{i}^{\dagger} a_{j}, 1 \leq i, j \leq\right.	$a_i^\dagger a_j \left(\mathcal{H}=h_{ij}(t) a_i^\dagger a_j, 1 \leq i, j \leq\right.$	n), so that $i\mathcal{H}$ is a time-dependent element in the Lie algebra u(n). Assume the
gilmore-lie-groups_F02198	215	0.985	i \mathcal{H}	$i\mathcal{H}$	system is initially in its ground state. Show that it evolves into a coherent state whose
gilmore-lie-groups_F02199	215	1.000	S U(n) / U(n-1)	$SU(n)/U(n-1)$	state parameters to the forcing terms in the hamiltonian
gilmore-lie-groups_F02200	215	1.000	V^{(n)}	$V^{(n)}$	vector space $W^{(n+2)}$ as follows
gilmore-lie-groups_F02201	215	0.999	(x, x)_{m}=m_{i j} x^{i} x^{j}	$(x,x)_m = m_{ij}x^i x^j$	$v^i = sx^i \quad (1 < i < n)$
gilmore-lie-groups_F02202	215	0.999	n+2	$n+2$	$v^i = sx^i \quad (1 < i < n)$
gilmore-lie-groups_F02203	215	1.000	W^{(n+2)}	$W^{(n+2)}$	y^{n+}
gilmore-lie-groups_F02204	215	1.000	(y, y)_{M}=M_{\mu \nu} y^{\mu} y^{\nu}=(s x, s x)_{m}-\frac{2}{2} s\left[s(x, x)_{m}\right]=0	$(y,y)_M = M_{\mu\nu}y^\mu y^\nu = (sx,sx)_m - \frac{2}{2}s\left[s(x,x)_m\right] = 0$	**c.** Show that the Lie group H that preserves inner products in W **d.** If the metric m has signature n_1, n_2 $(n_1+n_2=n)$, show that $G =$
gilmore-lie-groups_F02205	215	1.000	G=O(n)	$G = O(n)$	. H is called
gilmore-lie-groups_F02206	215	1.000	O(n+1,1)	$O(n+1,1)$	**f.** Construct the quotient space $SO(n_1+1, n_2+1)/SO(n_1, n_2)$.
gilmore-lie-groups_F02207	215	1.000	n_{1}, n_{2}\left(n_{1}+n_{2}=n\right)	$n_1, n_2\left(n_1+n_2=n\right)$	**g.** Under a conformal transformation $y \to y'$ and $x \to x'$. Show $x'' = y''/y'^{n+1}$.
gilmore-lie-groups_F02208	215	1.000	G=O\left(n_{1}, n_{2}\right)	$G = O\left(n_1, n_2\right)$	**g.** Under a conformal transformation $y \to y'$ and $x \to x'$. Show $x'' = y''/y'^{n+1}$.
gilmore-lie-groups_F02209	215	1.000	H=O\left(n_{1}+1, n_{2}+1\right)	$H = O\left(n_1+1, n_2+1\right)$	. The Lorentz metric $(+1, -$
gilmore-lie-groups_F02210	215	1.000	S O\left(n_{1}+1, n_{2}+1\right) / S O\left(n_{1}, n_{2}\right)	$SO\left(n_1+1, n_2+1\right)/SO\left(n_1, n_2\right)$	
gilmore-lie-groups_F02211	215	0.996	y \rightarrow y^{\prime}	$y \to y'$	Show that the conformal group on space-time is $SO(4,2)$.
gilmore-lie-groups_F02212	215	0.996	x \rightarrow x^{\prime}	$x \to x'$	Show that the conformal group on space-time is $SO(4,2)$.
gilmore-lie-groups_F02213	215	0.996	x^{\prime i}=y^{\prime i} / y^{\prime n+1}	$x'^i = y'^i/y'^{n+1}$	Show that the conformal group on space-time is $SO(4,2)$.
gilmore-lie-groups_F02214	215	0.997	(+1,-1,-1,-1)	$(+1,-1,-1,-1)$	
gilmore-lie-groups_F02215	216	0.988	L_{\mu \nu}	$L_{\mu\nu}$	and P_μ generate translations. Taken together $L_{\mu\nu}$ and P_μ generate the Poincaré
gilmore-lie-groups_F02216	216	1.000	P_{\mu}	P_μ	group. The operator S generates dilations and the four operators K_μ generate
gilmore-lie-groups_F02217	216	1.000	K_{\mu}	K_μ	conformal transformations. Above $x_\mu = g_{\mu\nu}x^\nu$.
gilmore-lie-groups_F02218	216	1.000	x_{\mu}=g_{\mu \nu} x^{\nu}	$x_\mu = g_{\mu\nu}x^\nu$	**j.** Show that the additional operators satisfy the
gilmore-lie-groups_F02219	216	0.989	e^{c^{\mu} K_{\mu}}\left(x^{\nu}\right)=x^{\prime \nu}=\frac{x^{\nu}+c^{\nu}(x, x)}{1+2(c, x)+(c, c)(x, x)}	$e^{c^\mu K_\mu}\left(x^\nu\right) = x'^\nu = \frac{x^\nu + c^\nu(x,x)}{1+2(c,x)+(c,c)(x,x)}$	• the largest group that leaves the free space (
gilmore-lie-groups_F02220	216	0.999	P_{\mu} \rightarrow P_{\mu}^{\prime}=x_{\mu}	$P_\mu \to P'_\mu = x_\mu$	11. The upper half of the complex plane has coordinates $z = x + iy$. This upper half-plane provides a well studied model for the hyperbolic plane when a suitable metric is
gilmore-lie-groups_F02221	216	0.999	K_{\mu} \rightarrow K_{\mu}^{\prime}=2(x, \partial) \partial_{\mu}-	$K_\mu \to K'_\mu = 2(x,\partial)\partial_\mu -$	11. The upper half of the complex plane has coordinates $z = x + iy$. This upper half-plane provides a well studied model for the hyperbolic plane when a suitable metric is

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gilmore-lie-groups_F02222	216	0.719	(\partial, \partial) x_{\mu}	$(\partial, \partial)x_\mu$	plane place
gilmore-lie-groups_F02223	216	1.000	z=x+i y	$z = x + iy$	$az + b$ $\begin{bmatrix} a & b \end{bmatrix}$
gilmore-lie-groups_F02224	216	1.000	P S L(2, \mathbb{R})	$PSL(2, \mathbb{R})$	
gilmore-lie-groups_F02225	216	1.000	M,-M \in S L(2 ; \mathbb{R})	$M, -M \in SL(2; \mathbb{R})$	$z' = \frac{\quad}{\lvert cz + d \rvert^2}$
gilmore-lie-groups_F02226	216	1.000	y^{\prime}>0	$y' > 0$	
gilmore-lie-groups_F02227	216	1.000	y>0	$y > 0$	
gilmore-lie-groups_F02228	216	1.000	y^{\prime}=0	$y' = 0$	
gilmore-lie-groups_F02229	216	0.997	(y=0)	$(y = 0)$	
gilmore-lie-groups_F02230	217	1.000	d z^{\prime}=d z /|c z+d|^{2}	$dz' = dz/\lvert cz + d \rvert^2$	**d.** Show $dz' = dz/\lvert cz + d \rvert$ **e.** Show that the invariant mea
gilmore-lie-groups_F02231	217	1.000	d \mu=d x d y / y^{2}	$d\mu = dxdy/y^2$	**f.** Show that the distance between two points z_1 and z_2 is
gilmore-lie-groups_F02232	217	1.000	z_{2}	z_2	
gilmore-lie-groups_F02233	217	1.000	w=x+i y	$w = x + iy$	$ww = x^2 + y^2 \leq 1$. The unit disk, with a suitable metric, provides a second represen-
gilmore-lie-groups_F02234	217	1.000	\bar{w} w=x^{2}+y^{2} \leq 1	$\bar{w}w = x^2 + y^2 \leq 1$	tation of the hyperbolic plane. The unit disk is mapped onto itself by linear fractional transformations
gilmore-lie-groups_F02235	217	1.000	M,-M \in S U(1,1)	$M, -M \in SU(1, 1)$	**b.** Show that $w = e^{i\phi} \to w' = e^{i\psi}$. Compute $\psi(\phi)$.
gilmore-lie-groups_F02236	217	1.000	w=e^{i \phi} \rightarrow w^{\prime}=e^{i \psi}	$w = e^{i\phi} \to w' = e^{i\psi}$	$\begin{bmatrix} \frac{1}{\quad} & 0 \end{bmatrix}$,
gilmore-lie-groups_F02237	217	1.000	\psi(\phi)	$\psi(\phi)$	$\begin{bmatrix} \frac{1}{\quad} & 0 \end{bmatrix}$,
gilmore-lie-groups_F02238	217	1.000	w_{1}	w_1	Show that the mapping from z in the upper half-plane to w in the unit disk given by
gilmore-lie-groups_F02239	217	1.000	w_{2}	w_2	Show that the mapping from z in the upper half-plane to w in the unit disk given by
gilmore-lie-groups_F02240	217	1.000	w	w	**a.** Compute the inverse of this mapping, and show that it maps the interior of the unit
gilmore-lie-groups_F02241	217	1.000	z_{0}	z_0	
gilmore-lie-groups_F02242	218	1.000	z_{0}=i	$z_0 = i$	**b.** Choose $z_0 = i$ and $e^{i\phi} = i$ to give the canonical ma
gilmore-lie-groups_F02243	218	1.000	e^{i \phi}=i	$e^{i\phi} = i$	**b.** Choose $z_0 = i$ and $e^{i\phi} = i$ to give the canonical ma
gilmore-lie-groups_F02244	219	1.000	Y_{r}	Y_r	$C_{rs}(\epsilon) = M_r(\epsilon)M_s(\epsilon)C_{ij}(M(\epsilon)^{-1})_k$ (cf. Eq. (4.22)). As long as the change of
gilmore-lie-groups_F02245	219	1.000	Y_{r}=	$Y_r =$	basis transformation is nonsingular the Lie algebra is unchanged. If the transformation becomes singular, the structure constants $C_{rs}(\epsilon)$ may
gilmore-lie-groups_F02246	219	1.000	M_{r}{ }^{i}(\epsilon) X_{i}	$M_r{}^i(\epsilon)X_i$	If the transformation becomes singular, the structure constants $C_{rs}(\epsilon)$ may still converge to a well-defined limit. It is often the case that the structure con-
gilmore-lie-groups_F02247	219	0.986	C_{r s}{ }^{t}(\epsilon)=M_{r}{ }^{i}(\epsilon) M_{s}{ }^{j}(\epsilon) C_{i j}{ }^{k}\left(M(\epsilon)^{-1} \right)_{k}{ }^{t}	$C_{rs}{}^t(\epsilon) = M_r{}^i(\epsilon)M_s{}^j(\epsilon)C_{ij}{}^k \left(M(\epsilon)^{-1}\right)_k{}^t$	still converge to a well-defined limit. It is often the case that the structure constants

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gilmore-lie-groups_F02248	219	1.000	`C_{r s}{ }^{t}(\epsilon)`	$C_{rs}{}^{t}(\epsilon)$	$C_{rs}{}^{t}(0) = \lim C_{rs}{}^{t}(\epsilon)$ (13.1)
gilmore-lie-groups_F02249	220	0.998	`\mathfrak{g} \rightarrow \mathfrak{g}^{\prime}`	$\mathfrak{g} \rightarrow \mathfrak{g}^{\prime}$	basis transformation
gilmore-lie-groups_F02250	220	1.000	`\operatorname{dim}(\mathfrak{h})`	$\operatorname{dim}(\mathfrak{h})$	
gilmore-lie-groups_F02251	220	1.000	`\epsilon \rightarrow 0`	$\epsilon \rightarrow 0$	$[\mathfrak{h}', \mathfrak{h}'] = [\mathfrak{h}, \mathfrak{h}] \subseteq \mathfrak{h}$
gilmore-lie-groups_F02252	220	1.000	`\left[\mathfrak{h}, \mathfrak{p}^{\prime}\right] \subseteq \mathfrak{p}^{\prime}`	$[\mathfrak{h}, \mathfrak{p}^{\prime}] \subseteq \mathfrak{p}^{\prime}$	$[\mathfrak{h}, \mathfrak{h}] \subseteq \mathfrak{h} \longrightarrow [\mathfrak{h}, \mathfrak{h}] \subseteq \mathfrak{h}$
gilmore-lie-groups_F02253	220	0.905	`\mathrm{SO}(3) \rightarrow \operatorname{ISO}(2)`	$\mathrm{SO}(3) \rightarrow \operatorname{ISO}(2)$	
gilmore-lie-groups_F02254	220	0.998	`L_{1}=X_{23}=`	$L_1 = X_{23} =$	$[L_1, L_2] = -L_3$
gilmore-lie-groups_F02255	220	1.000	`x_{2} \partial_{3}-x_{3} \partial_{2}=\epsilon_{1 j k} x_{j} \partial_{k}`	$x_2 \partial_3 - x_3 \partial_2 = \epsilon_{1jk} x_j \partial_k$	$[L_2, L_3] = -L_1$ (13.6)
gilmore-lie-groups_F02256	220	1.000	`L_{2}`	L_2	$[L_2, L_3] = -L_1$ (13.6)
gilmore-lie-groups_F02257	220	1.000	`L_{3}`	L_3	$[L_2, L_3] = -L_1$ (13.6)
gilmore-lie-groups_F02258	221	1.000	`L_{1}`	L_1	finitesimal generator L_3) the operators L_1 and L_2 go to
gilmore-lie-groups_F02259	221	1.000	`I S O(2)=E(2)`	$ISO(2) = E(2)$	
gilmore-lie-groups_F02260	221	1.000	`L_{3}, P_{1}, P_{2}`	L_3, P_1, P_2	$E(2)$, or innomogeneous orthogonal transformations in the plane R^2, $ISO(2)$. This
gilmore-lie-groups_F02261	221	0.983	`R^{2}, I S O(2)`	$R^2, ISO(2)$	group consists of rotations about the z-axis, generated by L_3, and displacements of the origin in the x- and y-directions, generated by $P_1 = \partial_1$ and $P_2 = \partial_2$
gilmore-lie-groups_F02262	221	1.000	`P_{1}=\partial_{1}`	$P_1 = \partial_1$	$x^2 + y^2 + z^2 = R^2$ in the neighborhood of the north pole $(0, 0, R)$, as shown
gilmore-lie-groups_F02263	221	1.000	`P_{2}=\partial_{2}`	$P_2 = \partial_2$	$x^2 + y^2 + z^2 = R^2$ in the neighborhood of the north pole $(0, 0, R)$, as shown
gilmore-lie-groups_F02264	221	0.698	`x^{2}+y^{2}+z^{2}=R^{2}`	$x^2 + y^2 + z^2 = R^2$	
gilmore-lie-groups_F02265	221	0.698	`0,0, R`	$0, 0, R$	
gilmore-lie-groups_F02266	221	1.000	`R \rightarrow \infty`	$R \rightarrow \infty$	
gilmore-lie-groups_F02267	221	0.992	`-P_{2},+P_{1}`	$-P_2, +P_1$	$d_2 = -R\theta_1$ (13.11)
gilmore-lie-groups_F02268	221	0.992	`-y`	$-y$	$d_2 = -R\theta_1$ (13.11)
gilmore-lie-groups_F02269	221	0.992	`+x`	$+x$	$d_2 = -R\theta_1$ (13.11)
gilmore-lie-groups_F02270	221	1.000	`\theta_{1}, \theta_{2}`	θ_1, θ_2	As the radius of the sphere becomes very large, the two angles θ_1, θ_2 become
gilmore-lie-groups_F02271	221	1.000	`d_{1}, d_{2}`	d_1, d_2	As the radius of the sphere becomes very large, the two angles θ_1, θ_2 become
gilmore-lie-groups_F02272	221	1.000	`R \theta_{i}(i=1,2)`	$R\theta_i (i = 1, 2)$	
gilmore-lie-groups_F02273	221	1.000	`\theta_{2}=d_{1} / R`	$\theta_2 = d_1 / R$	

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gilmore-lie-groups_F02274	221	1.000	`d_{1}`	d_1	
gilmore-lie-groups_F02275	221	1.000	`\theta_{1}=d_{2} / R`	$\theta_1 = d_2/R$	
gilmore-lie-groups_F02276	221	1.000	`-d_{2}`	$-d_2$	
gilmore-lie-groups_F02277	222	0.737	`\mathrm{SO}(4) \rightarrow \operatorname{ISO}(3)`	$\mathrm{SO}(4) \rightarrow \mathrm{ISO}(3)$	$V_i = x_i\partial_4 - x_4\partial_i \qquad 1 \leq i \neq j \neq k \leq 3$
gilmore-lie-groups_F02278	223	0.418	`P_{i}`	P_i	group, on R^3.
gilmore-lie-groups_F02279	223	0.418	`i=1,2,3`	$i = 1, 2, 3$	group, on R^3.
gilmore-lie-groups_F02280	223	1.000	`I S O(3)`	$ISO(3)$	As in the case $SO(3) \rightarrow ISO(2)$, we can contract the second order Casimir
gilmore-lie-groups_F02281	223	1.000	`S O(3) \rightarrow I S O(2)`	$SO(3) \rightarrow ISO(2)$	$C_2^2[ISO(3)] = \lim (1/R^2)(\mathbf{L}\cdot\mathbf{L} + \mathbf{V}\cdot\mathbf{V})$
gilmore-lie-groups_F02282	223	1.000	`\mathbf{P} \cdot \mathbf{P}=\nabla^{2}`	$\mathbf{P} \cdot \mathbf{P} = \nabla^2$	
gilmore-lie-groups_F02283	223	1.000	`\mathbf{L} \cdot \mathbf{P}=-\mathbf{L} \cdot \nabla`	$\mathbf{L} \cdot \mathbf{P} = -\mathbf{L} \cdot \nabla$	
gilmore-lie-groups_F02284	224	0.994	`\operatorname{SO}(4,1) \rightarrow \operatorname{ISO}(3,1)`	$\mathrm{SO}(4,1) \rightarrow \mathrm{ISO}(3,1)$	***13.3.3 The contraction*** SO(4, 1) → ISO(3, 1)
gilmore-lie-groups_F02285	224	0.592	`[S O(3,1)]`	$[SO(3,1)]$	The group $ISO(3,1)$ consists of proper Lorentz transformations $[SO(3,1)]$ that
gilmore-lie-groups_F02286	224	0.997	`S O(3,2)`	$SO(3,2)$	We choose as infinitesimal generators for the group $SO(4,1)$
gilmore-lie-groups_F02287	224	0.998	`\epsilon^{\alpha \beta \gamma \mu \nu}`	$\epsilon^{\alpha\beta\gamma\mu\nu}$	$\lim_{R\to\infty}(1/R)^n \to \lim_{R\to\infty} \epsilon^{\qquad} X_{\beta\gamma}[(1/R)X_{\mu 5}]$
gilmore-lie-groups_F02288	224	1.000	`W_{\alpha}`	W_α	$= \epsilon^{\alpha\beta\gamma\mu 5} X_{\beta\gamma}(\partial/\partial x^\mu) \qquad (13.24)$
gilmore-lie-groups_F02289	224	1.000	`W^{\alpha}`	W^α	$= \epsilon^{\alpha\beta\gamma\mu 5} X_{\beta\gamma}(\partial/\partial x^\mu) \qquad (13.24)$
gilmore-lie-groups_F02290	224	0.615	`v`	v	
gilmore-lie-groups_F02291	225	1.000	`\epsilon^{\alpha \beta \gamma \mu 5} X_{\beta \gamma} \left(\partial / \partial x^{\mu}\right)`	$\epsilon^{\alpha\beta\gamma\mu 5} X_{\beta\gamma}\left(\partial/\partial x^\mu\right)$	The four vector $\epsilon^{\alpha\beta\gamma\mu 5} X_{\beta\gamma}(\partial/\partial x^\mu)$ is fairly complicated. Since $W^\alpha W_\alpha$ is invariant,
gilmore-lie-groups_F02292	225	1.000	`W^{\alpha} W_{\alpha}`	$W^\alpha W_\alpha$	The four vector $\epsilon^{\alpha\beta\gamma\mu 5} X_{\beta\gamma}(\partial/\partial x^\mu)$ is fairly complicated. Since $W^\alpha W_\alpha$ is invariant,
gilmore-lie-groups_F02293	225	1.000	`\mathbf{P} \cdot \mathbf{P}=\sum P_{\mu} P^{\mu}=-(mc)^{2}`	$\mathbf{P} \cdot \mathbf{P} = \sum P_\mu P^\mu = -(mc)^2$	It should be emphasized that if a interpretation is desired, the operator
gilmore-lie-groups_F02294	225	0.862	`\mathfrak{u}(2)`	$\mathfrak{u}(2)$	$[J_+, J_-] = 2J_3 \qquad (13.28)$
gilmore-lie-groups_F02295	225	0.862	`J_{3}, J_{ \pm}, J_{0}`	$J_3, J_\pm, J_0$	$[J_+, J_-] = 2J_3 \qquad (13.28)$
gilmore-lie-groups_F02296	225	0.996	`h_{3}, h_{ \pm}, h_{0}`	$h_3, h_\pm, h_0$	$\begin{vmatrix} h_3 \\ h_0 \end{vmatrix} \quad \begin{vmatrix} 2c^2 \\ 1 \end{vmatrix} \begin{vmatrix} h_3 \\ J_0 \end{vmatrix}$
gilmore-lie-groups_F02297	226	1.000	`c \rightarrow 0`	$c \rightarrow 0$	commutation relations (Eq. (13.30)) converge to a well-defined limit satisfied by
gilmore-lie-groups_F02298	226	1.000	`J_{0} \rightarrow h_{0}`	$J_0 \rightarrow h_0$	$\lim c^2 C^2 = \lim c^2 \left(h_3 - \frac{1}{2}h_0\right)^2 + \frac{1}{2}[(cL_+)(cL_-) + (cL_-)(cL_+)]$
gilmore-lie-groups_F02299	226	1.000	`\left(h_{0} / 2 c\right)^{2}`	$(h_0/2c)^2$	in the Lie algebra in the limit $c \to 0$, (6.43) $\to 0$ and the remaining operators go to a well-defined limit

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gilmore-lie-groups_F02300	226	1.000	`c \rightarrow 0,\left(c h_{3}\right)^{2} \rightarrow 0`	$c \rightarrow 0, \left(c h_{3}\right)^{2} \rightarrow 0$	1
gilmore-lie-groups_F02301	227	1.000	`\hat{n}+\frac{1}{2} I, a^{\dagger}, a`	$\hat{n}+\frac{1}{2} I, a^{\dagger}, a$	This is a quadratic operator in the generators $\hat{n}+\frac{1}{2}I, a^{\dagger}, a$, and I of H_4. The value
gilmore-lie-groups_F02302	227	1.000	`\mathfrak{h}_{4}`	$\mathfrak{h}_{4}$	with basis h_3, h_+, h_0 is (Arecchi *et al.*, 1972; Gilmore, 1974b)
gilmore-lie-groups_F02303	227	1.000	`\theta_{0}`	θ_{0}	***13.4.4 Contraction of representations***
gilmore-lie-groups_F02304	227	1.000	`\theta_{0}-\theta_{3} / 2 c^{2}`	$\theta_{0}-\theta_{3} / 2 c^{2}$	***13.4.4 Contraction of representations***
gilmore-lie-groups_F02305	227	0.999	`h_{3}`	h_{3}	$\|M\rangle$ $2c^2$ $\|M\rangle$ $2c^2$ $\|M\rangle$
gilmore-lie-groups_F02306	227	0.999	`|J, M\rangle`	$\|J, M\rangle$	$\|M\rangle$ $2c^2$ $\|M\rangle$ $2c^2$ $\|M\rangle$
gilmore-lie-groups_F02307	227	1.000	`|J,-J\rangle`	$\|J,-J\rangle$	$n = J + M$ (13.38)
gilmore-lie-groups_F02308	227	1.000	`M=-J`	$M=-J$	In order for the action of h_3 on $\|J, l$
gilmore-lie-groups_F02309	227	0.985	`J`	J	
gilmore-lie-groups_F02310	227	0.985	`(2 J+1)`	$(2 J+1)$	
gilmore-lie-groups_F02311	228	1.000	`n=J+M`	$n=J+M$	state $\|J,-J\rangle$. These states are contracted to the harmonic oscillator states as
gilmore-lie-groups_F02312	229	1.000	`\lim _{c \rightarrow 0} \zeta / c \rightarrow \alpha`	$\lim_{c \rightarrow 0} \zeta / c \rightarrow \alpha$	$\alpha = \lim \zeta /$
gilmore-lie-groups_F02313	229	1.000	`P_{m}^{l}(\cos \theta)`	$P_{m}^{l}(\cos \theta)$	$\sqrt{2\pi}$
gilmore-lie-groups_F02314	229	1.000	`u \rightarrow`	$u \rightarrow$	
gilmore-lie-groups_F02315	229	1.000	`x / \sqrt{l}`	$x / \sqrt{l}$	$=$
gilmore-lie-groups_F02316	229	1.000	`l+m=n`	$l+m=n$	$=$
gilmore-lie-groups_F02317	230	1.000	`c \rightarrow 0, l \rightarrow \infty, l+m=n, 2 l c^{2}=1`	$c \rightarrow 0, l \rightarrow \infty, l+m=n, 2 l c^{2}=1$	The limit is taken as $c \rightarrow 0, l \rightarrow \infty, l+m=n, 2 l c^{2}=1$. The limit inside the
gilmore-lie-groups_F02318	230	1.000	`1 / \sqrt{\pi}`	$1 / \sqrt{\pi}$	first square root is $1/\sqrt{\pi}$, that within the second is $(2^n n!)^{-1}$. The result of this
gilmore-lie-groups_F02319	230	1.000	`\left(2^{n} n!\right)^{-1}`	$\left(2^{n} n!\right)^{-1}$	first square root is $1/\sqrt{\pi}$, that within the second is $(2^n n!)^{-1}$. The result of this
gilmore-lie-groups_F02320	230	1.000	`H_{n}(x)`	$H_{n}(x)$	Under contraction the orthogonality
gilmore-lie-groups_F02321	231	1.000	`I S O(2)`	$I S O(2)$	representations of $ISO(2)$. Since $ISO(2)$ is a noncompact group it has no faith-
gilmore-lie-groups_F02322	231	1.000	`P_{ \pm}`	$P_{\pm}$	$\lim$
gilmore-lie-groups_F02323	231	1.000	`\mathfrak{i s o}(2)`	$\mathfrak{iso}(2)$	$\lim$
gilmore-lie-groups_F02324	231	1.000	`J_{k}(x)`	$J_{k}(x)$	$\sqrt{2\pi}$
gilmore-lie-groups_F02325	231	0.992	`A_{k}^{l}`	A_{k}^{l}	operator on $S^2 = SO(3)/SO(2)$ when restricted to the sphere surface, and this

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gilmore-lie-groups_F02326	231	0.992	`\theta^{\prime}, \phi^{\prime}`	θ', ϕ'	operator on $S^2 = SO(3)/SO(2)$ when restricted to the sphere surface, and this
gilmore-lie-groups_F02327	231	0.998	`\mathbf{L} \cdot \mathbf{L}`	$\mathbf{L} \cdot \mathbf{L}$	Under the contraction $\mathfrak{u}(2) \rightarrow \mathfrak{h}_4$ the representations of the unitar
gilmore-lie-groups_F02328	231	0.998	`\nabla^{2}`	∇^2	Under the contraction $\mathfrak{u}(2) \rightarrow \mathfrak{h}_4$ the representations of the unitar
gilmore-lie-groups_F02329	231	1.000	`\mathfrak{u}(2) \rightarrow \mathfrak{h}_{4}`	$\mathfrak{u}(2) \rightarrow \mathfrak{h}_4$	
gilmore-lie-groups_F02330	232	1.000	`N_{n}`	N_n	**c.** Carry out steps **c–f** of the previous problem. The results are obtained by making the following replacements:
gilmore-lie-groups_F02331	232	0.993	`N_{n}=1 / \sqrt{2^{n} n!\sqrt{\pi}}`	$N_n = 1/\sqrt{2^n n! \sqrt{\pi}}$	the following r
gilmore-lie-groups_F02332	232	0.984	`J_{3}, J_{ \pm}\left(\left[J_{3}, J_{ \pm}\right]= \pm J_{ \pm},\left[J_{+}, J_{-}\right]=2 J_{3}\right)`	$J_3, J_\pm \left(\left[J_3, J_\pm\right] = \pm J_\pm, \left[J_+, J_-\right] = 2J_3\right)$	$\lim_{c \to 0} \epsilon(2J_3) \rightarrow P \quad P' = \partial_x$
gilmore-lie-groups_F02333	232	0.993	`\left(P^{\prime}, T^{\prime}, V^{\prime}\right)`	$\left(P', T', V'\right)$	4. Contract $SO(n+1)$ with respect to the subgroup $SO(n)$ and show how the invariant
gilmore-lie-groups_F02334	232	0.991	`\partial_{x}, \partial_{t}, t \partial_{x}`	$\partial_x, \partial_t, t\partial_x$	metric and measure on the sphere $S^n = SO(n+1)/SO(n)$ reduce to the familiar
gilmore-lie-groups_F02335	232	1.000	`\mathfrak{a}_{1}`	$\mathfrak{a}_1$	metric and measure on $R^n = ISO(n)/SO(n)$.
gilmore-lie-groups_F02336	232	0.985	`\mathfrak{g a l}(1)`	$\mathfrak{gal}(1)$	
gilmore-lie-groups_F02337	232	1.000	`S^{n}=S O(n+1) / S O(n)`	$S^n = SO(n+1)/SO(n)$	
gilmore-lie-groups_F02338	232	1.000	`R^{n}=I S O(n) / S O(n)`	$R^n = ISO(n)/SO(n)$	
gilmore-lie-groups_F02339	233	1.000	`\tau=(\zeta /|\zeta|) \tan (|\zeta|)`	$\tau = (\zeta/\|\zeta\|) \tan(\|\zeta\|)$	. Use a faithful matrix representat
gilmore-lie-groups_F02340	233	1.000	`\alpha=\lim _{c \rightarrow 0} \zeta / c`	$\alpha = \lim_{c \rightarrow 0} \zeta / c$	hermal expectation
gilmore-lie-groups_F02341	233	1.000	`\langle X\rangle=\operatorname{tr} X e^{-\beta \mathcal{H}} / \operatorname{tr} e^{-\beta \mathcal{H}}`	$\langle X \rangle = \operatorname{tr} X e^{-\beta \mathcal{H}} / \operatorname{tr} e^{-\beta \mathcal{H}}$	Lie algebra these expectation values can often be computed rather simply.
gilmore-lie-groups_F02342	233	1.000	`\left\langle e^{\alpha X}\right\rangle=`	$\left\langle e^{\alpha X} \right\rangle =$	Lie algebra these expectation values can often be computed rather simply.
gilmore-lie-groups_F02343	233	1.000	`\operatorname{tr} e^{\alpha X} e^{-\beta \mathcal{H}} / \operatorname{tr} e^{-\beta \mathcal{H}}`	$\operatorname{tr} e^{\alpha X} e^{-\beta \mathcal{H}} / \operatorname{tr} e^{-\beta \mathcal{H}}$	**a.** Assume $\mathcal{H} = \epsilon J_3$ and X is in the Lie algebra $\mathfrak{su}(2)$. Show that in the 2×2 defining
gilmore-lie-groups_F02344	233	0.998	`\mathcal{H}=\epsilon J_{3}`	$\mathcal{H} = \epsilon J_3$	$\begin{bmatrix} \cosh(\theta/2) + (\theta_z/\theta)\sinh(\theta/2) & (\theta_x - i\theta_y)/\theta \sinh(\theta/2) \end{bmatrix}$
gilmore-lie-groups_F02345	233	1.000	`2 j+1=2`	$2j + 1 = 2$	**d.** Show that in the $(2j+1) \times (2j+1)$ dimensional representation,
gilmore-lie-groups_F02346	234	0.974	`\mathcal{C}^{2}=\sum_{i j} X_{i j}^{2}, \mathcal{C}^{3}= \epsilon^{\text {abcdef }} X_{a b} X_{c d} X_{e f}`	$\mathcal{C}^2 = \sum_{ij} X_{ij}^2, \mathcal{C}^3 = \epsilon^{\text{abcdef}} X_{ab} X_{cd} X_{ef}$	are analytic continuations of $\mathcal{C}^2 = \sum_{ij} X_{ij}^2$, $\mathcal{C}^3 = \epsilon^{abcdef} X_{ab} X_{cd} X_{ef}$, and $\mathcal{C}^4 =$
gilmore-lie-groups_F02347	234	0.974	`\mathcal{C}^{4}=`	$\mathcal{C}^4 =$	are analytic continuations of $\mathcal{C}^2 = \sum_{ij} X_{ij}^2$, $\mathcal{C}^3 = \epsilon^{abcdef} X_{ab} X_{cd} X_{ef}$, and $\mathcal{C}^4 =$
gilmore-lie-groups_F02348	234	0.812	`\sum_{i j} Y_{i j}^{2}`	$\sum_{ij} Y_{ij}^2$	$\sum_{ij} Y_{ij}^2$, where $Y_{ij} = \epsilon^{ijcdef} X_{cd} X_{ef}$ of the group $SO(6)$ **b.** Contract $SO(4,2)$ with respect to the subgroup $SO(4) \otimes$
gilmore-lie-groups_F02349	234	0.812	`Y_{i j}=\epsilon^{i j c d e f} X_{c d} X_{e f}`	$Y_{ij} = \epsilon^{ijcdef} X_{cd} X_{ef}$	$\sum_{ij} Y_{ij}^2$, where $Y_{ij} = \epsilon^{ijcdef} X_{cd} X_{ef}$ of the group $SO(6)$ **b.** Contract $SO(4,2)$ with respect to the subgroup $SO(4) \otimes$
gilmore-lie-groups_F02350	234	0.812	`S O(6)`	$SO(6)$	$\sum_{ij} Y_{ij}^2$, where $Y_{ij} = \epsilon^{ijcdef} X_{cd} X_{ef}$ of the group $SO(6)$ **b.** Contract $SO(4,2)$ with respect to the subgroup $SO(4) \otimes$
gilmore-lie-groups_F02351	234	0.995	`S O(4) \otimes S O(2)`	$SO(4) \otimes SO(2)$	**b.** Contract $SO(4,2)$ with respect to the subgroup $SO(4) \otimes SO(2)$. **c.** Construct the quadratic, cubic, and quartic Casimir operators o

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02352	234	0.933	`A_{i}=\lim _{\epsilon \rightarrow 0} \epsilon X_{i 5}`	$A_i = \lim_{\epsilon \to 0} \epsilon X_{i5}$	the Casimir operators contract to
gilmore-lie-groups_F02353	234	0.933	`B_{i}=\lim _{\epsilon \rightarrow 0} \epsilon X_{i 6}`	$B_i = \lim_{\epsilon \to 0} \epsilon X_{i6}$	the Casimir operators contract to
gilmore-lie-groups_F02354	234	1.000	`S O(4,2) /[S O(4) \otimes S O(2)]`	$SO(4,2)/[SO(4) \otimes SO(2)]$	8. Riemannian symmetric spaces have been classified using the Cartan decompo
gilmore-lie-groups_F02355	234	1.000	`I[S O(4) \otimes S O(2)] /[S O(4) \otimes S O(2)]`	$I[SO(4) \otimes SO(2)]/[SO(4) \otimes SO(2)]$	8. Riemannian symmetric spaces have been classified using the Cartan decompo
gilmore-lie-groups_F02356	234	1.000	`X_{\alpha}`	X_α	$g_{\alpha,\beta}$
gilmore-lie-groups_F02357	234	0.987	`Y_{\alpha}=\lim _{\epsilon \rightarrow 0} \in X_{\alpha}`	$Y_\alpha = \lim_{\epsilon \to 0} \in X_\alpha$	$g(Y_{\alpha,\beta} = \lim_{\epsilon \to 0}(X_\alpha, X_\beta)/\epsilon = (X_\alpha, X_\beta)$
gilmore-lie-groups_F02358	236	1.000	`|\psi\rangle`	$\|\psi\rangle$	among observers forms a group. If observer S' wants to determine what observer
gilmore-lie-groups_F02359	236	1.000	`\langle S \mid \psi\rangle`	$\langle S \mid \psi\rangle$	S has seen, he applies the appropriate transformation, $\langle S\|S'\rangle$, to his mathematical
gilmore-lie-groups_F02360	236	1.000	`\left\langle S^{\prime} \mid \psi\right\rangle`	$\left\langle S^{\prime} \mid \psi\right\rangle$	S has seen, he applies the appropriate transformation, $\langle S\|S'\rangle$, to his mathematical
gilmore-lie-groups_F02361	236	0.998	`\left\langle S^{\prime} \mid S\right\rangle`	$\left\langle S^{\prime} \mid S\right\rangle$	
gilmore-lie-groups_F02362	236	1.000	`\left\langle S \mid S^{\prime}\right\rangle`	$\left\langle S \mid S^{\prime}\right\rangle$	
gilmore-lie-groups_F02363	237	1.000	`\left|\psi^{\prime}\right\rangle`	$\left\|\psi^{\prime}\right\rangle$	$\langle S\|\psi'\rangle = \langle S$
gilmore-lie-groups_F02364	237	0.997	`S O(3))`	$SO(3))$	$\langle S\|H\|S\rangle$, and the existence of a $2p_z$ state in a system with spherical symmetry
gilmore-lie-groups_F02365	237	0.997	`\left\langle S^{\prime}\right| H\left|S^{\prime}\right\rangle=\left\langle S^{\prime} \mid S\right\rangle \langle S| H|S\rangle\left\langle S \mid S^{\prime}\right\rangle`	$\left\langle S^{\prime}\right\| H \left\|S^{\prime}\right\rangle = \left\langle S^{\prime} \mid S\right\rangle \langle S\|H\|S\rangle \left\langle S \mid S^{\prime}\right\rangle$	$\langle S\|H\|S\rangle$, and the existence of a $2p_z$ state in a system with spherical symmetry
gilmore-lie-groups_F02366	237	1.000	`\left\langle S^{\prime}\right| H\left|S^{\prime}\right\rangle=`	$\left\langle S^{\prime}\right\| H \left\|S^{\prime}\right\rangle =$	implies the existence (by the Principle of Equivalence) of $2p_x$ and $2p_y$ states, as
gilmore-lie-groups_F02367	237	1.000	`\langle S| H|S\rangle`	$\langle S\|H\|S\rangle$	well as arbitrary linear combinations of these three states.
gilmore-lie-groups_F02368	237	1.000	`2 p_{z}`	$2p_z$	well as arbitrary linear combinations of these three states.
gilmore-lie-groups_F02369	237	1.000	`2 p_{x}`	$2p_x$	
gilmore-lie-groups_F02370	237	1.000	`2 p_{y}`	$2p_y$	
gilmore-lie-groups_F02371	237	0.996	`p^{\mu} p_{\mu}=g_{\mu \nu} p^{\mu} p^{\nu}=(m c)^{2}`	$p^{\mu} p_{\mu}=g_{\mu \nu} p^{\mu} p^{\nu}=(m c)^{2}$	$E = (\mathbf{p}c)^2 = (mc^2)^2$ (14.5)
gilmore-lie-groups_F02372	237	1.000	`\mathbf{p}`	$\mathbf{p}$	Interaction of a particle of charge q with the electromagnetic field i
gilmore-lie-groups_F02373	237	1.000	`p_{\mu} \rightarrow \pi_{\mu}=p_{\mu}-(q / c) A_{\mu}`	$p_{\mu} \rightarrow \pi_{\mu}=p_{\mu}-(q / c) A_{\mu}$	field established by a proton, $\Phi = e/r$ and $\mathbf{A} = \mathbf{0}$, so that $E \to E + e^2/r$. Here
gilmore-lie-groups_F02374	237	0.974	`\Phi`	Φ	r is the proton–electron distance. The Schrödinger prescription for converting a
gilmore-lie-groups_F02375	237	0.997	`\mathbf{B}=\nabla \times \mathbf{A}`	$\mathbf{B}=\nabla \times \mathbf{A}$	dispersion relation to a wave equation is to replace $\mathbf{p} \to (h/i)\nabla$ and allow the
gilmore-lie-groups_F02376	237	0.997	`\mathbf{E}=-\nabla \Phi-(1 / c)(\partial \mathbf{A} / \partial t)`	$\mathbf{E}=-\nabla \Phi-(1 / c)(\partial \mathbf{A} / \partial t)$	dispersion relation to a wave equation is to replace $\mathbf{p} \to (h/i)\nabla$ and allow the
gilmore-lie-groups_F02377	237	0.997	`q=`	$q=$	dispersion relation to a wave equation is to replace $\mathbf{p} \to (h/i)\nabla$ and allow the

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gilmore-lie-groups_F02378	237	0.928	`-e`	$-e$	resulting equation to act on a spacial function $\psi(\mathbf{x})$. This prescription results in the
gilmore-lie-groups_F02379	237	1.000	`\Phi=e / r`	$\Phi = e/r$	
gilmore-lie-groups_F02380	237	1.000	`\mathbf{A}=\mathbf{0}`	$\mathbf{A} = \mathbf{0}$	
gilmore-lie-groups_F02381	237	1.000	`E \rightarrow E+e^{2} / r`	$E \rightarrow E + e^{2}/r$	
gilmore-lie-groups_F02382	237	1.000	`\mathbf{p} \rightarrow(\hbar / i) \nabla`	$\mathbf{p} \rightarrow (\hbar/i)\nabla$	
gilmore-lie-groups_F02383	237	1.000	`\psi(\mathbf{x})`	$\psi(\mathbf{x})$	
gilmore-lie-groups_F02384	238	0.999	`\left\langle S^{\prime}\right| H\left|S^{\prime}\right\rangle=\langle S| H|S\rangle`	$\left\langle S^{\prime}\right\| H \left\|S^{\prime}\right\rangle = \langle S\|H\|S\rangle$	Schrödinger solved this equation, compared its predictions with the spectral en-
gilmore-lie-groups_F02385	238	0.999	`\left\langle S^{\prime} \mid S\right\rangle \in S O(3)`	$\left\langle S^{\prime} \mid S\right\rangle \in SO(3)$	Schrödinger solved this equation, compared its predictions with the spectral en-
gilmore-lie-groups_F02386	238	0.623	`m c^{2}`	mc^{2}	510 000 eV, it makes sense to write $E = mc^2 + W$, where the principal part of the
gilmore-lie-groups_F02387	238	0.906	`E=m c^{2}+W`	$E = mc^{2} + W$	relativistic energy E is the electron rest energy and the nonrelativistic energy W is
gilmore-lie-groups_F02388	238	1.000	`W`	W	terms of order $(W + e^2/r)^2/mc^2$, we obtain the nonrelativistic form of Eq. (14.4),
gilmore-lie-groups_F02389	238	0.884	`(\simeq 0.0025 \%)`	$(\simeq 0.0025\%)$	the Schrödinger equation:
gilmore-lie-groups_F02390	238	1.000	`\left(W+e^{2} / r\right)^{2} / m c^{2}`	$\left(W+e^{2}/r\right)^{2}/mc^{2}$	
gilmore-lie-groups_F02391	238	0.727	`[A, B] / i \hbar=\{A, B\}`	$[A, B]/i\hbar = \{A, B\}$	**14.4 Quantization conditions**
gilmore-lie-groups_F02392	238	0.860	`(r, \theta, \phi)`	(r, θ, ϕ)	
gilmore-lie-groups_F02393	239	1.000	`\mathcal{L}^{2}\left(S^{2}\right)`	$\mathcal{L}^{2}\left(S^{2}\right)$	eigenfunctions are the spherical harmonics $Y_m^l(\theta, \phi)$ and its spectrum of eigenvalues
gilmore-lie-groups_F02394	239	0.980	`\mathcal{L}^{2}\left(S^{2}\right) Y_{m}^{l}(\theta, \phi)=-l(l+1) Y_{m}^{l}(\theta, \phi)`	$\mathcal{L}^{2}\left(S^{2}\right) Y_m^l(\theta, \phi) = -l(l+1) Y_m^l(\theta, \phi)$	and $-l \leq m \leq +l$. The negative sign and discrete spectrum characteristically indi-
gilmore-lie-groups_F02395	239	0.980	`(l, m)`	(l, m)	and $-l \leq m \leq +l$. The negative sign and discrete spectrum characteristically indi-
gilmore-lie-groups_F02396	239	0.980	`l=0,1,2, \ldots`	$l = 0, 1, 2, \ldots$	and $-l \leq m \leq +l$. The negative sign and discrete spectrum characteristically indi-
gilmore-lie-groups_F02397	239	0.999	`-l \leq m \leq+l`	$-l \leq m \leq +l$	cate that S^2 is compact.
gilmore-lie-groups_F02398	239	1.000	`A, B, C`	A, B, C	Equation A B C
gilmore-lie-groups_F02399	239	0.424	`-l(l+1)+\left(e^{2} / \hbar c\right)^{2}`	$-l(l+1)+\left(e^{2}/\hbar c\right)^{2}$	Schrödinger $-l(l+1)$ $2me^2/\hbar^2$ $2mW/\hbar^2$ There is a standard procedure for solving simple ordinary differential equatic of the type presented in Eq. (14.9). This is the Frobenius method. The steps involv in this method, and the result of each step, are summarized in Table 14.1.
gilmore-lie-groups_F02400	239	0.424	`2 E e^{2} /(\hbar c)^{2}`	$2Ee^{2}/(\hbar c)^{2}$	Schrödinger $-l(l+1)$ $2me^2/\hbar^2$ $2mW/\hbar^2$ There is a standard procedure for solving simple ordinary differential equatic of the type presented in Eq. (14.9). This is the Frobenius method. The steps involv in this method, and the result of each step, are summarized in Table 14.1.

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gilmore-lie-groups_FO2401	239	0.424	`\left[E^{2}-\left(m c^{2}\right)^{2}\right] /(\hbar c)^{2}`	$\left[E^2-\left(mc^2\right)^2\right]/(\hbar c)^2$	Schrödinger $-l(l+1)$ $2me^2/\hbar^2$ $2mW/\hbar^2$ There is a standard procedure for solving simple ordinary differential equatic of the type presented in Eq. (14.9). This is the Frobenius method. The steps involv in this method, and the result of each step, are summarized in Table 14.1.
gilmore-lie-groups_FO2402	239	0.424	`2 m e^{2} / \hbar^{2}`	$2me^2/\hbar^2$	Schrödinger $-l(l+1)$ $2me^2/\hbar^2$ $2mW/\hbar^2$ There is a standard procedure for solving simple ordinary differential equatic of the type presented in Eq. (14.9). This is the Frobenius method. The steps involv in this method, and the result of each step, are summarized in Table 14.1.
gilmore-lie-groups_FO2403	239	0.424	`2 \mathrm{~m} \mathrm{~W} / \hbar^{2}`	$2\ \mathrm{m}\ \mathrm{W}/\hbar^2$	Schrödinger $-l(l+1)$ $2me^2/\hbar^2$ $2mW/\hbar^2$ There is a standard procedure for solving simple ordinary differential equatic of the type presented in Eq. (14.9). This is the Frobenius method. The steps involv in this method, and the result of each step, are summarized in Table 14.1.
gilmore-lie-groups_FO2404	239	1.000	`n=`	$n=$	[illegible]
gilmore-lie-groups_FO2405	239	1.000	`0,1,2, \ldots`	$0,1,2,\ldots$	$\alpha = \frac{e}{\hbar c} = \frac{1}{137.035\,999\,706(70)} = 0.007\,297\,352\,531\,3(3\,8)$ (14.11)
gilmore-lie-groups_FO2406	239	1.000	`m_{\text {red }}^{-1}=m_{e}^{-1}+M_{p}^{-1}`	$m_{\text{red}}^{-1}=m_e^{-1}+M_p^{-1}$	
gilmore-lie-groups_FO2407	240	0.655	`0, \infty`	$0,\infty$	Procedure / Result 1 Locate singularities: $0, \infty$ 2 Determine analytic behavior at singular points: $r\to 0:\ R\simeq r^\gamma,\ \gamma(\gamma-1)+A=0$; $r\to\infty: R\simeq e^{\lambda r},\ \lambda^2+C=0$ 3 Keep only $\mathcal{L}^2$ solutions: $\gamma=\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A},\ \lambda=-\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior: $R=r^\gamma e^{\lambda r} f(r)$ 5 Construct differential equation for $f(r)$: $\left[\left(rD^2+2\gamma D\right)+(2\lambda\gamma+B+2\lambda r D)\right] f(r)=0$ 6 Construct recursion relation: $f_{j+1}=-\frac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)} f_j$ 7 Look at asymptotic behavior: $f\simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda<0)$ 8 Construct quantization condition: $2\lambda(n+\gamma)+B=0$ or $n+\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}=\frac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions: $E=\frac{mc^2}{\sqrt{1+(\alpha/N')^2}},\ W=-\frac{1}{2}mc^2\alpha^2\frac{1}{N^2}$; $N'=n+\frac{1}{2}+\sqrt{(l+\frac{1}{2})^2-\alpha^2},\ N=n+l+1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),
gilmore-lie-groups_FO2408	240	—	`\begin{aligned} & r \rightarrow 0: R \simeq r^{\gamma}, \gamma(\gamma-1)+A=0 \\ & r \rightarrow \infty: R \simeq e^{\lambda r}, \quad \lambda^{2}+C=0 \end{aligned}`	$r\to 0: R\simeq r^\gamma, \gamma(\gamma-1)+A=0$ $r\to\infty: R\simeq e^{\lambda r}, \quad \lambda^2+C=0$	—

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02409	240	0.655	`\mathcal{L}^{2}`	$\mathcal{L}^2$	Procedure / Result 1 Locate singularities: $0, \infty$ 2 Determine analytic behavior at singular points: $r \to 0: \; R \simeq r^\gamma, \; \gamma(\gamma-1)+A=0$; $r \to \infty: R \simeq e^{\lambda r}, \; \lambda^2+C=0$ 3 Keep only $\mathcal{L}^2$ solutions: $\gamma = \frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}, \; \lambda = -\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior: $R = r^\gamma e^{\lambda r} f(r)$ 5 Construct differential equation for $f(r)$: $\left[\left(rD^2+2\gamma D\right)+(2\lambda\gamma+B+2\lambda r D)\right] f(r)=0$ 6 Construct recursion relation: $f_{j+1} = -\dfrac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)} f_j$ 7 Look at asymptotic behavior: $f \simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda<0)$ 8 Construct quantization condition: $2\lambda(n+\gamma)+B=0$ or $n+\dfrac{1}{2}+\sqrt{(\frac{1}{2})^2-A} = \dfrac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions: $E = \dfrac{mc^2}{\sqrt{1+(\alpha/N')^2}}, \; W = -\dfrac{1}{2}mc^2\alpha^2 \dfrac{1}{N^2}$; $N' = n+\frac{1}{2}+\sqrt{(l+\frac{1}{2})^2-\alpha^2}, \; N = n+l+1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),
gilmore-lie-groups_F02410	240	0.655	`\gamma=\frac{1}{2}+\sqrt{\left(\frac{1}{2}\right)^{2}-A}, \lambda=-\sqrt{-C}`	$\gamma = \frac{1}{2}+\sqrt{\left(\frac{1}{2}\right)^2-A}, \lambda = -\sqrt{-C}$	Procedure / Result 1 Locate singularities: $0, \infty$ 2 Determine analytic behavior at singular points: $r \to 0: \; R \simeq r^\gamma, \; \gamma(\gamma-1)+A=0$; $r \to \infty: R \simeq e^{\lambda r}, \; \lambda^2+C=0$ 3 Keep only $\mathcal{L}^2$ solutions: $\gamma = \frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}, \; \lambda = -\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior: $R = r^\gamma e^{\lambda r} f(r)$ 5 Construct differential equation for $f(r)$: $\left[\left(rD^2+2\gamma D\right)+(2\lambda\gamma+B+2\lambda r D)\right] f(r)=0$ 6 Construct recursion relation: $f_{j+1} = -\dfrac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)} f_j$ 7 Look at asymptotic behavior: $f \simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda<0)$ 8 Construct quantization condition: $2\lambda(n+\gamma)+B=0$ or $n+\dfrac{1}{2}+\sqrt{(\frac{1}{2})^2-A} = \dfrac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions: $E = \dfrac{mc^2}{\sqrt{1+(\alpha/N')^2}}, \; W = -\dfrac{1}{2}mc^2\alpha^2 \dfrac{1}{N^2}$; $N' = n+\frac{1}{2}+\sqrt{(l+\frac{1}{2})^2-\alpha^2}, \; N = n+l+1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),

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gilmore-lie-groups_F02411	240	0.655	`R=r^{\gamma} e^{\lambda r} f(r)`	$R = r^{\gamma} e^{\lambda r} f(r)$	Procedure / Result 1 Locate singularities: $0, \infty$ 2 Determine analytic behavior at singular points: $r \to 0: \; R \simeq r^{\gamma}, \; \gamma(\gamma-1)+A=0$; $r \to \infty: R \simeq e^{\lambda r}, \; \lambda^2 + C = 0$ 3 Keep only $\mathcal{L}^2$ solutions: $\gamma = \frac{1}{2} + \sqrt{(\frac{1}{2})^2 - A}, \; \lambda = -\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior: $R = r^{\gamma} e^{\lambda r} f(r)$ 5 Construct differential equation for $f(r)$: $\left[\left(rD^2 + 2\gamma D\right) + (2\lambda\gamma + B + 2\lambda r D)\right] f(r) = 0$ 6 Construct recursion relation: $f_{j+1} = -\frac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)} f_j$ 7 Look at asymptotic behavior: $f \simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda < 0)$ 8 Construct quantization condition: $2\lambda(n+\gamma)+B=0$ or $n + \frac{1}{2} + \sqrt{(\frac{1}{2})^2 - A} = \frac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions: $E = \frac{mc^2}{\sqrt{1+(\alpha/N')^2}}, \; W = -\frac{1}{2} mc^2 \alpha^2 \frac{1}{N^2}$; $N' = n + \frac{1}{2} + \sqrt{(l+\frac{1}{2})^2 - \alpha^2}, \; N = n + l + 1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),
gilmore-lie-groups_F02412	240	0.655	`f(r)`	$f(r)$	Procedure / Result 1 Locate singularities: $0, \infty$ 2 Determine analytic behavior at singular points: $r \to 0: \; R \simeq r^{\gamma}, \; \gamma(\gamma-1)+A=0$; $r \to \infty: R \simeq e^{\lambda r}, \; \lambda^2 + C = 0$ 3 Keep only $\mathcal{L}^2$ solutions: $\gamma = \frac{1}{2} + \sqrt{(\frac{1}{2})^2 - A}, \; \lambda = -\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior: $R = r^{\gamma} e^{\lambda r} f(r)$ 5 Construct differential equation for $f(r)$: $\left[\left(rD^2 + 2\gamma D\right) + (2\lambda\gamma + B + 2\lambda r D)\right] f(r) = 0$ 6 Construct recursion relation: $f_{j+1} = -\frac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)} f_j$ 7 Look at asymptotic behavior: $f \simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda < 0)$ 8 Construct quantization condition: $2\lambda(n+\gamma)+B=0$ or $n + \frac{1}{2} + \sqrt{(\frac{1}{2})^2 - A} = \frac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions: $E = \frac{mc^2}{\sqrt{1+(\alpha/N')^2}}, \; W = -\frac{1}{2} mc^2 \alpha^2 \frac{1}{N^2}$; $N' = n + \frac{1}{2} + \sqrt{(l+\frac{1}{2})^2 - \alpha^2}, \; N = n + l + 1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),

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gilmore-lie-groups_F02413	240	0.655	`\left[\left(r D^{2}+2 \gamma D\right)+(2 \lambda \gamma+B+2 \lambda r D)\right] f(r)=0`	$\left[\left(rD^2+2\gamma D\right)+(2\lambda\gamma+B+2\lambda rD)\right]f(r)=0$	Procedure / Result 1 Locate singularities — $0, \infty$ 2 Determine analytic behavior at singular points — $r\to 0: \ R\simeq r^\gamma, \ \gamma(\gamma-1)+A=0$; $r\to\infty: R\simeq e^{\lambda r}, \ \lambda^2+C=0$ 3 Keep only $\mathcal{L}^2$ solutions — $\gamma=\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}, \ \lambda=-\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior — $R=r^\gamma e^{\lambda r}f(r)$ 5 Construct differential equation for $f(r)$ — $\left[\left(rD^2+2\gamma D\right)+(2\lambda\gamma+B+2\lambda rD)\right]f(r)=0$ 6 Construct recursion relation — $f_{j+1}=-\frac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)}f_j$ 7 Look at asymptotic behavior — $f\simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda<0)$ 8 Construct quantization condition — $2\lambda(n+\gamma)+B=0$ or $n+\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}=\frac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions — $E=\frac{mc^2}{\sqrt{1+(\alpha/N')^2}}, \ W=-\frac{1}{2}mc^2\alpha^2\frac{1}{N^2}$; $N'=n+\frac{1}{2}+\sqrt{(l+\frac{1}{2})^2-\alpha^2}, \ N=n+l+1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),
gilmore-lie-groups_F02414	240	0.655	`f_{j+1}=-\frac{2 \lambda(j+\gamma)+B}{j(j+1)+2 \gamma(j+1)} f_{j}`	$f_{j+1}=-\frac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)}f_j$	Procedure / Result 1 Locate singularities — $0, \infty$ 2 Determine analytic behavior at singular points — $r\to 0: \ R\simeq r^\gamma, \ \gamma(\gamma-1)+A=0$; $r\to\infty: R\simeq e^{\lambda r}, \ \lambda^2+C=0$ 3 Keep only $\mathcal{L}^2$ solutions — $\gamma=\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}, \ \lambda=-\sqrt{-C}$ 4 Look for solutions with proper asymptotic behavior — $R=r^\gamma e^{\lambda r}f(r)$ 5 Construct differential equation for $f(r)$ — $\left[\left(rD^2+2\gamma D\right)+(2\lambda\gamma+B+2\lambda rD)\right]f(r)=0$ 6 Construct recursion relation — $f_{j+1}=-\frac{2\lambda(j+\gamma)+B}{j(j+1)+2\gamma(j+1)}f_j$ 7 Look at asymptotic behavior — $f\simeq e^{-2\lambda r}$ if series does not terminate; $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda<0)$ 8 Construct quantization condition — $2\lambda(n+\gamma)+B=0$ or $n+\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}=\frac{B}{2\sqrt{-C}}$ 9 Construct explicit solutions — $E=\frac{mc^2}{\sqrt{1+(\alpha/N')^2}}, \ W=-\frac{1}{2}mc^2\alpha^2\frac{1}{N^2}$; $N'=n+\frac{1}{2}+\sqrt{(l+\frac{1}{2})^2-\alpha^2}, \ N=n+l+1$ This is a dimensionless ratio of three physical constants that are fundamental in three "different" areas of physics: e (electromagnetism), $\hbar$ (quantum mechanics),
gilmore-lie-groups_F02415	240	—	`\begin{aligned} & f \simeq e^{-2 \lambda r} \text { if series does not terminate } \\ & \simeq e^{+1 \lambda r} \text { if series does terminate }(\lambda<0) \end{aligned}`	$f\simeq e^{-2\lambda r}$ if series does not terminate $\simeq e^{+1\lambda r}$ if series does terminate $(\lambda<0)$	—
gilmore-lie-groups_F02416	240	—	`\begin{aligned} & 2 \lambda(n+\gamma)+B=0 \text { or } \\ & n+\frac{1}{2}+\sqrt{\left(\frac{1}{2}\right)^{2}-A}= \frac{B}{2 \sqrt{-C}} \end{aligned}`	$2\lambda(n+\gamma)+B=0$ or $n+\frac{1}{2}+\sqrt{\left(\frac{1}{2}\right)^2-A}=\frac{B}{2\sqrt{-C}}$	—

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gilmore-lie-groups_F02417	240	—	\begin{aligned} & E=\frac{m c^{2}}{\sqrt{1+\left(\alpha / N^{\prime}\right)^{2}}}, W=-\frac{1}{2} m c^{2} \alpha^{2} \frac{1}{N^{2}} \\ & N^{\prime}=n+\frac{1}{2}+\sqrt{\left(l+\frac{1}{2}\right)^{2}-\alpha^{2}}, \quad N=n+l+1 \end{aligned}	$E=\frac{mc^2}{\sqrt{1+(\alpha/N')^2}}, W=-\frac{1}{2}mc^2\alpha^2\frac{1}{N^2}$ $N'=n+\frac{1}{2}+\sqrt{\left(l+\frac{1}{2}\right)^2-\alpha^2}, \quad N=n+l+1$	—
gilmore-lie-groups_F02418	240	■1.000	\hbar	$\hbar$	Klein–Gordon equation Schrödinger equation
gilmore-lie-groups_F02419	241	■1.000	Z=50	$Z=50$	
gilmore-lie-groups_F02420	241	■1.000	\alpha \rightarrow Z \alpha	$\alpha \rightarrow Z\alpha$	ound state energy $\lvert W_1\rvert = \frac{1}{2}mc^2\alpha$
gilmore-lie-groups_F02421	241	■1.000	\left|W_{1}\right|=\frac{1}{2} m c^{2} \alpha^{2}	$\lvert W_1\rvert=\frac{1}{2}mc^2\alpha^2$	gies are displayed as a function of the orbital angular momentum l. The relativistic
gilmore-lie-groups_F02422	241	■0.999	1 / N^{2}	$1/N^2$	energies of the bound states for the proton–electron system converge to the rest en-
gilmore-lie-groups_F02423	241	■0.999	N=n+l+1	$N=n+l+1$	energies of the bound states for the proton–electron system converge to the rest en-
gilmore-lie-groups_F02424	241	■1.000	N^{\prime}	N'	we have instead computed and plotted the bound state spectrum for a single elec-
gilmore-lie-groups_F02425	241	■1.000	\frac{1}{2} m c^{2} \alpha^{2}	$\frac{1}{2}mc^2\alpha^2$	tron in a potential with positive charge Z. The energies in this case are obtained
gilmore-lie-groups_F02426	241	■1.000	\frac{1}{2} m c^{2}(Z \alpha)^{2}	$\frac{1}{2}mc^2(Z\alpha)^2$	**14.5 Geometric symmetry $SO(3)$**
gilmore-lie-groups_F02427	241	■1.000	1 s	$1s$	**14.5 Geometric symmetry $SO(3)$**
gilmore-lie-groups_F02428	242	■1.000	g_{i}|\psi\rangle	$g_i\lvert\psi\rangle$	eigenstate of H with eigenvalue E, then $g_i\lvert\psi\rangle$ is also an eigenstate of H with the
gilmore-lie-groups_F02429	242	■1.000	|\psi\rangle=\psi_{2 p_{z}}(\mathbf{x})	$\lvert\psi\rangle=\psi_{2p_z}(\mathbf{x})$	the y-axis maps this state to $\psi_{2p_x}(\mathbf{x})$ and a rotation by $\pi/2$ radians about the x-axis
gilmore-lie-groups_F02430	242	■1.000	\pi / 2	$\pi/2$	the y-axis maps this state to $\psi_{2p_x}(\mathbf{x})$ and a rotation by $\pi/2$ radians about the x-axis
gilmore-lie-groups_F02431	242	■1.000	\psi_{2 p_{x}}(\mathbf{x})	$\psi_{2p_x}(\mathbf{x})$	maps this state to $-\psi_{2p_y}(\mathbf{x})$. By invariance (of the hamiltonian) under the rotation
gilmore-lie-groups_F02432	242	■1.000	-\psi_{2 p_{y}}(\mathbf{x})	$-\psi_{2p_y}(\mathbf{x})$	group and the principle of equivalence, these new functions describe possible states
gilmore-lie-groups_F02433	242	■1.000	H=\mathbf{p} \cdot \mathbf{p} / 2 m-e^{2} / r	$H=\mathbf{p}\cdot\mathbf{p}/2m-e^2/r$	terms of the infinitesimal generators of rotations about axis i: $\epsilon_{ijk}x_j\partial_k$. These ge-
gilmore-lie-groups_F02434	242	■1.000	\mathbf{p} \cdot \mathbf{p}=-\hbar^{2} \nabla^{2}	$\mathbf{p}\cdot\mathbf{p}=-\hbar^2\nabla^2$	terms of the infinitesimal generators of rotations about axis i: $\epsilon_{ijk}x_j\partial_k$. These ge-
gilmore-lie-groups_F02435	242	■1.000	-e^{2} / r	$-e^2/r$	ometric operators are proportional to the physical angular momentum operators
gilmore-lie-groups_F02436	242	■1.000	i: \epsilon_{i j k} x_{j} \partial_{k}	$i:\epsilon_{ijk}x_j\partial_k$	$\mathbf{L}_i=(\mathbf{r}\times\mathbf{p})_i=(\hbar/i)\epsilon_{ijk}x_j\partial_k$. Finite rotations can be expressed as exponentials
gilmore-lie-groups_F02437	242	■1.000	\mathbf{L}_{i}=(\mathbf{r} \times \mathbf{p})_{i}=(\hbar / i) \epsilon_{i j k} x_{j} \partial_{k}	$\mathbf{L}_i=(\mathbf{r}\times\mathbf{p})_i=(\hbar/i)\epsilon_{ijk}x_j\partial_k$	$R(\theta)=e^{\epsilon_{ijk}\theta_i x_j\partial_k}=e^{i\theta\cdot\mathbf{L}/\hbar}$ (14.15)
gilmore-lie-groups_F02438	242	■0.998	\mathbf{L}=\mathbf{r} \times \mathbf{p}	$\mathbf{L}=\mathbf{r}\times\mathbf{p}$	
gilmore-lie-groups_F02439	242	■0.992	\mathbf{r} \times \nabla	$\mathbf{r}\times\nabla$	$[L_i, L_j]=i\hbar\epsilon_{ijk}L_k$ (14.16)
gilmore-lie-groups_F02440	242	■1.000	\hbar / i	$\hbar/i$	It is useful to construct linear co

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gilmore-lie-groups_F02441	242	1.000	`\left(L_{+}\right)`	(L_{+})	$[L_+, L_-] = 2\hbar L_z$ (14.18)
gilmore-lie-groups_F02442	242	1.000	`\left(L_{-}\right)`	(L_{-})	$[L_+, L_-] = 2\hbar L_z$ (14.18)
gilmore-lie-groups_F02443	242	1.000	`L_{ \pm}=L_{x} \pm i L_{y}`	$L_{\pm}=L_{x} \pm i L_{y}$	$[L_+, L_-] = 2\hbar L_z$ (14.18)
gilmore-lie-groups_F02444	242	1.000	`L_{z}=\hbar \frac{1}{2}\left(a_{1}^{\dagger} a_{1}-a_{2}^{\dagger} a_{2}\right), L_{+}=\hbar a_{1}^{ \dagger} a_{2}, L_{-}=\hbar a_{2}^{\dagger} a_{1}`	$L_{z}=\hbar \frac{1}{2}\left(a_{1}^{\dagger} a_{1}-a_{2}^{\dagger} a_{2}\right), L_{+}=\hbar a_{1}^{ \dagger} a_{2}, L_{-}=\hbar a_{2}^{\dagger} a_{1}$	
gilmore-lie-groups_F02445	242	1.000	`\left|n_{1} n_{2}\right\rangle`	$\left\|n_{1} n_{2}\right\rangle$	
gilmore-lie-groups_F02446	242	0.838	`\left.=\left.\right|_{m} ^{j}\right\rangle`	$=\left.\left\|{}_{m}^{j}\right\rangle\right.$	
gilmore-lie-groups_F02447	242	0.838	`n_{1}=0,1,2, \ldots, n_{2}=0,1,2, \ldots, n_{1}+n_{2}=2 j, n_{1}-n_{2}=2 m`	$n_{1}=0,1,2, \ldots, n_{2}=0,1,2, \ldots, n_{1}+n_{2}=2 j, n_{1}-n_{2}=2 m$	
gilmore-lie-groups_F02448	243	1.000	`-j \leq m \leq+j`	$-j \leq m \leq+j$	$-j \leq m \leq +j$. These basis vectors describe the finite-dimensional irreducible
gilmore-lie-groups_F02449	243	0.994	`((x, y, z) \rightarrow(r, \theta, \phi)`	$((x, y, z) \rightarrow(r, \theta, \phi)$	operators. In spherical coordinates $((x, y, z) \rightarrow(r, \theta, \phi)$ with $x=r \sin \theta \cos \phi)$ these operators are
gilmore-lie-groups_F02450	243	0.994	`x=r \sin \theta \cos \phi)`	$x=r \sin \theta \cos \phi)$	operators. In spherical coordinates $((x, y, z) \rightarrow(r, \theta, \phi)$ with $x=r \sin \theta \cos \phi)$ these operators are
gilmore-lie-groups_F02451	243	1.000	`Y_{-l}^{l}(\theta, \phi)`	$Y_{-l}^{l}(\theta, \phi)$	
gilmore-lie-groups_F02452	243	1.000	`L_{-} Y_{-l}^{l}(\theta, \phi)=0`	$L_{-} Y_{-l}^{l}(\theta, \phi)=0$	
gilmore-lie-groups_F02453	244	0.998	`l=0`	$l=0$	m $l=0$ $l=1$ $l=2$ $l=3$ 0 $\sqrt{\frac{1}{4\pi}}$ $\sqrt{\frac{3}{4\pi}}\cos\theta$ $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02454	244	0.998	`l=2`	$l=2$	m $l=0$ $l=1$ $l=2$ $l=3$ 0 $\sqrt{\frac{1}{4\pi}}$ $\sqrt{\frac{3}{4\pi}}\cos\theta$ $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02455	244	0.998	`l=3`	$l=3$	m $l=0$ $l=1$ $l=2$ $l=3$ 0 $\sqrt{\frac{1}{4\pi}}$ $\sqrt{\frac{3}{4\pi}}\cos\theta$ $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$

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gilmore-lie-groups_F02456	244	■0.998	`\sqrt{\frac{1}{4 \pi}}`	$\sqrt{\frac{1}{4\pi}}$	$\begin{array}{c\|cccc} m & l=0 & l=1 & l=2 & l=3 \\ \hline 0 & \sqrt{\frac{1}{4\pi}} & \sqrt{\frac{3}{4\pi}}\cos\theta & \sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1) & \sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta) \\ \pm1 & & \mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi} \\ \pm2 & & & \sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi} & \sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi} \\ \pm3 & & & & \mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi} \end{array}$
gilmore-lie-groups_F02457	244	■0.998	`\sqrt{\frac{3}{4 \pi}} \cos \theta`	$\sqrt{\frac{3}{4\pi}}\cos\theta$	$\begin{array}{c\|cccc} m & l=0 & l=1 & l=2 & l=3 \\ \hline 0 & \sqrt{\frac{1}{4\pi}} & \sqrt{\frac{3}{4\pi}}\cos\theta & \sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1) & \sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta) \\ \pm1 & & \mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi} \\ \pm2 & & & \sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi} & \sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi} \\ \pm3 & & & & \mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi} \end{array}$
gilmore-lie-groups_F02458	244	■0.998	`\sqrt{\frac{5}{16 \pi}}\left(3 \cos ^{2} \theta-1\right)`	$\sqrt{\frac{5}{16\pi}}\left(3\cos^2\theta-1\right)$	$\begin{array}{c\|cccc} m & l=0 & l=1 & l=2 & l=3 \\ \hline 0 & \sqrt{\frac{1}{4\pi}} & \sqrt{\frac{3}{4\pi}}\cos\theta & \sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1) & \sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta) \\ \pm1 & & \mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi} \\ \pm2 & & & \sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi} & \sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi} \\ \pm3 & & & & \mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi} \end{array}$
gilmore-lie-groups_F02459	244	■0.998	`\sqrt{\frac{7}{16 \pi}}\left(5 \cos ^{3} \theta-3 \cos \theta\right)`	$\sqrt{\frac{7}{16\pi}}\left(5\cos^3\theta-3\cos\theta\right)$	$\begin{array}{c\|cccc} m & l=0 & l=1 & l=2 & l=3 \\ \hline 0 & \sqrt{\frac{1}{4\pi}} & \sqrt{\frac{3}{4\pi}}\cos\theta & \sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1) & \sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta) \\ \pm1 & & \mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi} \\ \pm2 & & & \sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi} & \sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi} \\ \pm3 & & & & \mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi} \end{array}$
gilmore-lie-groups_F02460	244	■0.998	`\mp \sqrt{\frac{3}{8 \pi}} \sin \theta e^{ \pm i \phi}`	$\mp\sqrt{\frac{3}{8\pi}}\sin\theta e^{\pm i\phi}$	$\begin{array}{c\|cccc} m & l=0 & l=1 & l=2 & l=3 \\ \hline 0 & \sqrt{\frac{1}{4\pi}} & \sqrt{\frac{3}{4\pi}}\cos\theta & \sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1) & \sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta) \\ \pm1 & & \mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi} & \mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi} \\ \pm2 & & & \sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi} & \sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi} \\ \pm3 & & & & \mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi} \end{array}$

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gilmore-lie-groups_F02461	244	0.998	`\mp \sqrt{\frac{15}{8 \pi}} \cos \theta \sin \theta e^{ \pm i \phi}`	$\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta e^{\pm i\phi}$	m | $l=0$ | $l=1$ | $l=2$ | $l=3$ 0 | $\sqrt{\frac{1}{4\pi}}$ | $\sqrt{\frac{3}{4\pi}}\cos\theta$ | $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ | $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 | | $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 | | | $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ | $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 | | | | $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02462	244	0.998	`\mp \sqrt{\frac{21}{64 \pi}} \sin \theta\left(5 \cos ^{2} \theta-1\right) e^{ \pm i \phi}`	$\mp\sqrt{\frac{21}{64\pi}}\sin\theta\left(5\cos^2\theta-1\right)e^{\pm i\phi}$	m | $l=0$ | $l=1$ | $l=2$ | $l=3$ 0 | $\sqrt{\frac{1}{4\pi}}$ | $\sqrt{\frac{3}{4\pi}}\cos\theta$ | $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ | $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 | | $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 | | | $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ | $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 | | | | $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02463	244	0.998	`\sqrt{\frac{15}{32 \pi}} \sin ^{2} \theta e^{ \pm 2 i \phi}`	$\sqrt{\frac{15}{32\pi}}\sin^2\theta e^{\pm 2i\phi}$	m | $l=0$ | $l=1$ | $l=2$ | $l=3$ 0 | $\sqrt{\frac{1}{4\pi}}$ | $\sqrt{\frac{3}{4\pi}}\cos\theta$ | $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ | $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 | | $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 | | | $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ | $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 | | | | $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02464	244	0.998	`\sqrt{\frac{105}{32 \pi}} \sin ^{2} \theta \cos \theta e^{ \pm 2 i \phi}`	$\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta e^{\pm 2i\phi}$	m | $l=0$ | $l=1$ | $l=2$ | $l=3$ 0 | $\sqrt{\frac{1}{4\pi}}$ | $\sqrt{\frac{3}{4\pi}}\cos\theta$ | $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ | $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 | | $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 | | | $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ | $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 | | | | $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02465	244	0.998	`\mp \sqrt{\frac{35}{64 \pi}} \sin ^{3} \theta e^{ \pm 3 i \phi}`	$\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta e^{\pm 3i\phi}$	m | $l=0$ | $l=1$ | $l=2$ | $l=3$ 0 | $\sqrt{\frac{1}{4\pi}}$ | $\sqrt{\frac{3}{4\pi}}\cos\theta$ | $\sqrt{\frac{5}{16\pi}}(3\cos^2\theta-1)$ | $\sqrt{\frac{7}{16\pi}}(5\cos^3\theta-3\cos\theta)$ ±1 | | $\mp\sqrt{\frac{3}{8\pi}}\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{15}{8\pi}}\cos\theta\sin\theta\, e^{\pm i\phi}$ | $\mp\sqrt{\frac{21}{64\pi}}\sin\theta(5\cos^2\theta-1)\, e^{\pm i\phi}$ ±2 | | | $\sqrt{\frac{15}{32\pi}}\sin^2\theta\, e^{\pm 2i\phi}$ | $\sqrt{\frac{105}{32\pi}}\sin^2\theta\cos\theta\, e^{\pm 2i\phi}$ ±3 | | | | $\mp\sqrt{\frac{35}{64\pi}}\sin^3\theta\, e^{\pm 3i\phi}$
gilmore-lie-groups_F02466	244	1.000	`L_{+}`	L_+	L_+Y
gilmore-lie-groups_F02467	244	0.815	`(l=0,1,2,3)`	$(l=0,1,2,3)$	**Remark** The spectrum of the Casimir invariant for the rotation group SO
gilmore-lie-groups_F02468	244	0.662	`\theta, \phi`	θ, ϕ	which these operators act, is compact. By the same token, the spectrum of the square

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gilmore-lie-groups_F02469	244	1.000	`\hbar^{2} l(l+1)`	$\hbar^2 l(l+1)$	and is quantized by integer angular momentum values, measured in units of Planck's constant $\hbar$
gilmore-lie-groups_F02470	244	1.000	`E_{N}=-\frac{1}{2} m c^{2} \alpha^{2} \frac{1}{N^{2}}`	$E_N = -\frac{1}{2} mc^2 \alpha^2 \frac{1}{N^2}$	If we believe the converse, that degeneracy implies symmetry, then we might be led to expect that the hydrogen atom exhibits more symmetry than meets the eye.
gilmore-lie-groups_F02471	244	1.000	`\sum_{l=0}^{l=N-1}(2 l+1)=N^{2}`	$\sum_{l=0}^{l=N-1} (2l+1) = N^2$	In fact this symmetry, called a dynamical symmetry (Schiff, 1968), exists and is
gilmore-lie-groups_F02472	244	1.000	`1 / r^{2}`	$1/r^2$	
gilmore-lie-groups_F02473	244	1.000	`d \mathbf{p} / d t=-K \mathbf{r} / r^{3}`	$d\mathbf{p}/dt = -K\mathbf{r}/r^3$	
gilmore-lie-groups_F02474	245	1.000	`K=G M m, G`	$K = GMm, G$	$K = GMm, G$ is the universal gravitational constant, M and m are the two attracting
gilmore-lie-groups_F02475	245	1.000	`\mathbf{r}=x \hat{\mathbf{i}}+y \hat{\mathbf{j}}+z \hat{\mathbf{k}}`	$\mathbf{r} = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + z\hat{\mathbf{k}}$	masses, and $\mathbf{r} = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + z\hat{\mathbf{k}}$ is the vector from one mass to the other. The time
gilmore-lie-groups_F02476	245	1.000	`\mathbf{p} \times \mathbf{L}`	$\mathbf{p} \times \mathbf{L}$	derivative of the vector $\mathbf{p} \times \mathbf{L}$ is
gilmore-lie-groups_F02477	245	0.999	`\mathbf{L}`	$\mathbf{L}$	a constant of motion in any spherically symmetric potential. We also use the force
gilmore-lie-groups_F02478	245	1.000	`1 / r`	$1/r$	cross product $\mathbf{r} \times \mathbf{L}$ in terms of (generally) nonparallel vectors $\mathbf{r}$ and $\dot{\mathbf{r}}$. We also use the identity $(d/dt)(\mathbf{r}/r) = \dot{\mathbf{r}}/\mathbf{r} - (\dot{\mathbf{r}} \cdot \mathbf{r})\,\mathbf{r}/r^3$. The result is that the Laplace–
gilmore-lie-groups_F02479	245	0.967	`\mathbf{r} \times \mathbf{L}`	$\mathbf{r} \times \mathbf{L}$	Runge–Lenz vector $\mathbf{M}$ is a constant of motion: $d\mathbf{M}/dt = 0$, where
gilmore-lie-groups_F02480	245	0.967	`\dot{\mathbf{r}}`	$\dot{\mathbf{r}}$	Runge–Lenz vector $\mathbf{M}$ is a constant of motion: $d\mathbf{M}/dt = 0$, where
gilmore-lie-groups_F02481	245	1.000	`(d / d t)(\mathbf{r} / r)=\dot{\mathbf{r}} / \mathbf{r}-(\dot{\mathbf{r}} \cdot \mathbf{r}) \mathbf{r} / r^{3}`	$(d/dt)(\mathbf{r}/r) = \dot{\mathbf{r}}/\mathbf{r} - (\dot{\mathbf{r}} \cdot \mathbf{r})\mathbf{r}/r^3$	
gilmore-lie-groups_F02482	245	0.985	`d \mathbf{M} / d t=0`	$d\mathbf{M}/dt = 0$	$\mathbf{M} = \frac{\mathbf{p} \times \mathbf{L}}{} - K\frac{\mathbf{r}}{}$
gilmore-lie-groups_F02483	245	1.000	`[H, \mathbf{M}]=0`	$[H, \mathbf{M}] = 0$	$[L_i, M_j] = i\hbar\epsilon_{ijk} M_k$ (14.25)
gilmore-lie-groups_F02484	245	1.000	`L_{i}, M_{j}`	L_i, M_j	$[L_i, M_j] = i\hbar\epsilon_{ijk} M_k$ (14.25)
gilmore-lie-groups_F02485	245	0.993	`(E<0)`	$(E < 0)$	
gilmore-lie-groups_F02486	245	0.993	`(E>0)`	$(E > 0)$	
gilmore-lie-groups_F02487	246	1.000	`\mathbf{M}^{\prime}=(-m / 2 H)^{1 / 2} \mathbf{M}`	$\mathbf{M}' = (-m/2H)^{1/2}\mathbf{M}$	(For $E > 0$ change $- \to +$ and $SO(4) \to SO(3,1)$.) The commutation relations
gilmore-lie-groups_F02488	246	1.000	`E>0`	$E > 0$	of these operators are now
gilmore-lie-groups_F02489	246	1.000	`-\rightarrow+`	$- \to +$	of these operators are now
gilmore-lie-groups_F02490	246	1.000	`S O(4) \rightarrow S O(3,1)`	$SO(4) \to SO(3,1)$	of these operators are now
gilmore-lie-groups_F02491	246	0.834	`\mathbf{A}`	$\mathbf{A}$	$\mathbf{A} = \frac{1}{2}(\mathbf{L} + \mathbf{M}')$
gilmore-lie-groups_F02492	246	0.834	`\mathbf{B}`	$\mathbf{B}$	$\mathbf{A} = \frac{1}{2}(\mathbf{L} + \mathbf{M}')$
gilmore-lie-groups_F02493	246	0.996	`A_{3}=\frac{1}{2}\left(a_{1}^{\dagger} a_{1}-\right.`	$A_3 = \frac{1}{2}\left(a_1^\dagger a_1 - \right.$	b_1, b_2 and their creation operators is also introduced.
gilmore-lie-groups_F02494	246	0.910	`a_{2}^{\dagger} a_{2}`	$a_2^\dagger a_2$	Basis states for a representation of the algebra spanned by the operators $\mathbf{A}$ have the

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gilmore-lie-groups_F02495	246	0.910	`A_{+}=a_{1}^{\dagger} a_{2}, A_{-}=a_{2}^{\dagger} a_{1}`	$A_+ = a_1^\dagger a_2, A_- = a_2^\dagger a_1$	Basis states for a representation of the algebra spanned by the operators **A** have the
gilmore-lie-groups_F02496	246	0.910	`\hbar \rightarrow 1`	$\hbar \rightarrow 1$	Basis states for a representation of the algebra spanned by the operators **A** have the
gilmore-lie-groups_F02497	246	1.000	`b_{1}, b_{2}`	b_1, b_2	states correspond to $p_1 = 2j_a$, $p_2 = 0$; $p_1 = 2j_a -$
gilmore-lie-groups_F02498	246	1.000	`\left|p_{1}, p_{2}\right\rangle`	$\left\|p_1, p_2\right\rangle$	Problem 14.15) $i_+ = i_b$ and the set of states related by the shift operators is $(2\,i +$
gilmore-lie-groups_F02499	246	1.000	`p_{1}+p_{2}=2 j_{a}`	$p_1 + p_2 = 2j_a$	Problem 14.15) $i_+ = i_b$ and the set of states related by the shift operators is $(2\,i +$
gilmore-lie-groups_F02500	246	1.000	`p_{1}-p_{2}=m_{a}`	$p_1 - p_2 = m_a$	Problem 14.15) $i_+ = i_b$ and the set of states related by the shift operators is $(2\,i +$
gilmore-lie-groups_F02501	246	1.000	`2 j_{a}+1`	$2j_a + 1$	Problem 14.15) $i_+ = i_b$ and the set of states related by the shift operators is $(2\,i +$
gilmore-lie-groups_F02502	246	0.968	`p_{1}=2 j_{a}, p_{2}=0 ; p_{1}=2 j_{a}-1, p_{2}=1`	$p_1 = 2j_a, p_2 = 0; p_1 = 2j_a - 1, p_2 = 1$	$1)^2$ fold degenerate. where $2\,i + 1 = N = n + l + 1$.
gilmore-lie-groups_F02503	246	1.000	`\left|q_{1}, q_{2}\right\rangle`	$\left\|q_1, q_2\right\rangle$	States with good l and m quantum numbers can be constructed from these states
gilmore-lie-groups_F02504	246	1.000	`q_{1}+q_{2}=2 j_{b}`	$q_1 + q_2 = 2j_b$	States with good l and m quantum numbers can be constructed from these states
gilmore-lie-groups_F02505	246	1.000	`q_{1}-q_{2}=m_{b}`	$q_1 - q_2 = m_b$	States with good l and m quantum numbers can be constructed from these states
gilmore-lie-groups_F02506	246	1.000	`\mathbf{A} \cdot \mathbf{A}=j_{a}\left(j_{a}+1\right)`	$\mathbf{A} \cdot \mathbf{A} = j_a\left(j_a + 1\right)$	using Clebsch-Gordon coefficients:
gilmore-lie-groups_F02507	246	1.000	`\mathbf{B} \cdot \mathbf{B}=j_{b}\left(j_{b}+1\right)`	$\mathbf{B} \cdot \mathbf{B} = j_b\left(j_b + 1\right)$	using Clebsch-Gordon coefficients:
gilmore-lie-groups_F02508	246	1.000	`\mathbf{A} \cdot \mathbf{A}=\mathbf{B} \cdot \mathbf{B}`	$\mathbf{A} \cdot \mathbf{A} = \mathbf{B} \cdot \mathbf{B}$	using Clebsch-Gordon coefficients:
gilmore-lie-groups_F02509	246	1.000	`j_{a}=j_{b}`	$j_a = j_b$	
gilmore-lie-groups_F02510	246	1.000	`(2 j+`	$(2j+$	
gilmore-lie-groups_F02511	246	1.000	`2 j+1=N=n+l+1`	$2j + 1 = N = n + l + 1$	
gilmore-lie-groups_F02512	246	0.996	`\operatorname{good} l`	$\operatorname{good}\, l$	
gilmore-lie-groups_F02513	247	1.000	`M_{+}^{\prime}=`	$M_+^\prime =$	spherical harmonics, is determined in a straightforward way. For example, $M_+^\prime =$
gilmore-lie-groups_F02514	247	1.000	`A_{+}-B_{+}=a_{1}^{\dagger} a_{2}-b_{1}^{\dagger} b_{2}`	$A_+ - B_+ = a_1^\dagger a_2 - b_1^\dagger b_2$	$A_+ - B_+ = a_1^\dagger a_2 - b_1^\dagger b_2$, so that
gilmore-lie-groups_F02515	247	0.998	`\mathbf{M}^{\prime}`	$\mathbf{M}^\prime$	of a particle in a $1/r$ potential is equivalent to motion of a free particle in the sphere
gilmore-lie-groups_F02516	247	0.608	`\mathbf{W}=\mathbf{L} \times \mathbf{M}`	$\mathbf{W} = \mathbf{L} \times \mathbf{M}$	
gilmore-lie-groups_F02517	247	1.000	`\mathbf{r} \cdot \mathbf{L}=0`	$\mathbf{r} \cdot \mathbf{L} = 0$	
gilmore-lie-groups_F02518	247	1.000	`\mathbf{p} \cdot \mathbf{L}=0`	$\mathbf{p} \cdot \mathbf{L} = 0$	
gilmore-lie-groups_F02519	248	0.986	`\mathbf{W}`	$\mathbf{W}$	of **M** and **W**. In this coordinate system $p_z = 0$, $p_x = \mathbf{p} \cdot \mathbf{M}/\sqrt{\mathbf{M} \cdot \mathbf{M}}$ and $p_y =$
gilmore-lie-groups_F02520	248	0.986	`p_{z}=0, p_{x}=\mathbf{p} \cdot \mathbf{M} / \sqrt{ \mathbf{M} \cdot \mathbf{M}}`	$p_z = 0, p_x = \mathbf{p} \cdot \mathbf{M}/\sqrt{\mathbf{M} \cdot \mathbf{M}}$	of **M** and **W**. In this coordinate system $p_z = 0$, $p_x = \mathbf{p} \cdot \mathbf{M}/\sqrt{\mathbf{M} \cdot \mathbf{M}}$ and $p_y =$

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gilmore-lie-groups_F02521	248	0.986	`p_{y}=`	$p_y =$	of **M** and **W**. In this coordinate system $p_z = 0$, $p_x = \mathbf{p} \cdot \mathbf{M}/\sqrt{\mathbf{M} \cdot \mathbf{M}}$ and $p_y =$
gilmore-lie-groups_F02522	248	1.000	`\mathbf{p} \cdot \mathbf{W} / \sqrt{\mathbf{W} \cdot \mathbf{W}}`	$\mathbf{p} \cdot \mathbf{W}/\sqrt{\mathbf{W} \cdot \mathbf{W}}$	$\mathbf{p} \cdot \mathbf{W}/\sqrt{\mathbf{W} \cdot \mathbf{W}}$. The two nonzero components of the momentum vector are not
gilmore-lie-groups_F02523	248	1.000	`m K / L`	mK/L	center displaced from the origin by mM/L.
gilmore-lie-groups_F02524	248	1.000	`m M / L`	mM/L	The circle in R^3 is lifted to a circle in
gilmore-lie-groups_F02525	248	1.000	`p_{0}=\sqrt{-2 E / m}`	$p_0 = \sqrt{-2E/m}$	$\mathbf{p} \cdot \mathbf{p} - p_0^2$ $2p_0$
gilmore-lie-groups_F02526	248	1.000	`\hat{\mathbf{u}} \in S^{3} \subset R^{4}`	$\hat{\mathbf{u}} \in S^3 \subset R^4$	$\mathbf{p} \cdot \mathbf{p} - p_0^2$ $2p_0$
gilmore-lie-groups_F02527	248	1.000	`\hat{\mathbf{w}}`	$\hat{\mathbf{w}}$	preserves angles (conformal). It is a simple matter to check that $\hat{\mathbf{u}}$ is a unit vector. The circular trajectory in R^3 (Eq. (14.33)) lifts to a circle in S^3. Reversibly, circles in
gilmore-lie-groups_F02528	248	0.995	`\hat{\mathbf{u}}`	$\hat{\mathbf{u}}$	Rotations in $SO(4)$ rigidly rotate the sphere S^3 into itself. They rotate circles into
gilmore-lie-groups_F02529	248	1.000	`S^{3}`	S^3	circles, which then project down to circular momentum trajectories in the physical
gilmore-lie-groups_F02530	248	0.803	`S O(4) / S O(3)`	$SO(4)/SO(3)$	
gilmore-lie-groups_F02531	248	1.000	`p_{0}`	p_0	
gilmore-lie-groups_F02532	249	1.000	`N^{2}=(n+l+1)^{2}`	$N^2 = (n + l + 1)^2$	irreducible representations of dimension $N^2 = (n + l + 1)^2$.
gilmore-lie-groups_F02533	249	1.000	`-N^{3}`	$-N^3$	The rescaled energies have been plotted as a function of N (vertically) and orbital angular momentum quantum number l (horizontally). In this format, the eigen-
gilmore-lie-groups_F02534	249	1.000	`\mathbf{x}^{\prime}=M \mathbf{x}`	$\mathbf{x}' = M\mathbf{x}$	condition leads to $M^t G M = G$. It is useful to define a new N-vector $\mathbf{y}$ as a scaled version of the original vector:
gilmore-lie-groups_F02535	249	1.000	`(\mathbf{x}, \mathbf{x})_{N}=\mathbf{x}^{t} \mathbf{g x}=x_{i} g_{i j} x_{j}`	$(\mathbf{x}, \mathbf{x})_N = \mathbf{x}^t \mathbf{g} \mathbf{x} = x_i g_{ij} x_j$	$\mathbf{y} = \lambda \mathbf{x}$. We introduce two additional coordinates by defining $z_1 = \lambda$ and $z_2 =$
gilmore-lie-groups_F02536	249	0.749	`\mathbf{y}`	$\mathbf{y}$	$(\mathbf{x}, \mathbf{x})_N$ $z_1 = (1/\lambda, \lambda x)$ $\lambda^2 [(\mathbf{x}, \mathbf{x})_N - 1] = 0$ (14.37)
gilmore-lie-groups_F02537	249	1.000	`\mathbf{y}=\lambda \mathbf{x}`	$\mathbf{y} = \lambda \mathbf{x}$	$(\mathbf{x}, \mathbf{x})_N$ $z_1 = (1/\lambda, \lambda x)$ $\lambda^2 [(\mathbf{x}, \mathbf{x})_N - 1] = 0$ (14.37)
gilmore-lie-groups_F02538	249	1.000	`z_{1}=\lambda`	$z_1 = \lambda$	$(\mathbf{x}, \mathbf{x})_N$ $z_1 = (1/\lambda, \lambda x)$ $\lambda^2 [(\mathbf{x}, \mathbf{x})_N - 1] = 0$ (14.37)
gilmore-lie-groups_F02539	249	1.000	`z_{2}=`	$z_2 =$	$(\mathbf{x}, \mathbf{x})_N$ $z_1 = (1/\lambda, \lambda x)$ $\lambda^2 [(\mathbf{x}, \mathbf{x})_N - 1] = 0$ (14.37)
gilmore-lie-groups_F02540	249	1.000	`\lambda(\mathbf{x}, \mathbf{x})_{N}`	$\lambda(\mathbf{x}, \mathbf{x})_N$	The conformal condition defines an inner product in the $N + 2$ dimens
gilmore-lie-groups_F02541	249	1.000	`N+2`	$N + 2$	$\lceil \quad \rceil$ $\lceil \quad \rceil$
gilmore-lie-groups_F02542	249	0.998	`\mathbf{y}, z_{1}, z_{2}`	$\mathbf{y}, z_1, z_2$	G $\mathbf{y}$ G $\mathbf{y}$
gilmore-lie-groups_F02543	249	0.986	`\mathbf{y}, y_{N+1}, y_{N+2}`	$\mathbf{y}, y_{N+1}, y_{N+2}$	(14.38)
gilmore-lie-groups_F02544	249	0.986	`y_{N+1}=\frac{1}{2}\left(z_{1}+z_{2}\right)`	$y_{N+1} = \frac{1}{2}(z_1 + z_2)$	(14.38)
gilmore-lie-groups_F02545	249	0.986	`y_{N+2}=\frac{1}{2}\left(z_{1}-z_{2}\right)`	$y_{N+2} = \frac{1}{2}(z_1 - z_2)$	(14.38)

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gilmore-lie-groups_F02546	249	1.000	`R^{N}`	R^{N}	
gilmore-lie-groups_F02547	250	0.999	`R^{N+2}`	R^{N+2}	The connection with the Kepler problem is made as follows. The momenta $\mathbf{p}$ are lifted to the coordinates on a sphere $S^3 \subset R^4(E<0)$ or a two-sheeted hyperboloid
gilmore-lie-groups_F02548	250	0.999	`S O(p+1, q+1)`	$SO(p+1, q+1)$	The connection with the Kepler problem is made as follows. The momenta $\mathbf{p}$ are lifted to the coordinates on a sphere $S^3 \subset R^4(E<0)$ or a two-sheeted hyperboloid
gilmore-lie-groups_F02549	250	1.000	`S^{3} \subset R^{4}(E<0)`	$S^3 \subset R^4(E<0)$	$\hat{\mathbf{u}} = \frac{\frac{1}{2}(p_0^2 - \mathbf{p}\cdot\mathbf{p})}{\frac{1}{2}(p_0^2 + \mathbf{p}\cdot\mathbf{p})}\mathbf{u} + \frac{p_0\mathbf{p}}{\frac{1}{2}(p_0^2 + \mathbf{p}\cdot\mathbf{p})}$ $E<0$
gilmore-lie-groups_F02550	250	1.000	`H^{3} \subset R^{4}(E>0)`	$H^3 \subset R^4(E>0)$	$\hat{\mathbf{u}} = \frac{\frac{1}{2}(p_0^2 - \mathbf{p}\cdot\mathbf{p})}{\frac{1}{2}(p_0^2 + \mathbf{p}\cdot\mathbf{p})}\mathbf{u} + \frac{p_0\mathbf{p}}{\frac{1}{2}(p_0^2 + \mathbf{p}\cdot\mathbf{p})}$ $E<0$
gilmore-lie-groups_F02551	250	1.000	`\mathbf{u}^{t} G \mathbf{u}=1`	$\mathbf{u}^t G\mathbf{u} = 1$	
gilmore-lie-groups_F02552	251	0.999	`\operatorname{diag}\left(1, \pm I_{3},-1,+1\right)`	$\operatorname{diag}(1, \pm I_3, -1, +1)$	lows. The group that leaves invariant the conformal metric diag$(1, \pm I_3, -1, +1)$ is
gilmore-lie-groups_F02553	251	0.984	`S O(5,1)`	$SO(5,1)$	$SO(5,1)$ for $E<0$ and $SO(2,4)$ for $E>0$. On the surfaces (sphere, hyperboloid)
gilmore-lie-groups_F02554	251	0.984	`E<0`	$E<0$	$SO(5,1)$ for $E<0$ and $SO(2,4)$ for $E>0$. On the surfaces (sphere, hyperboloid)
gilmore-lie-groups_F02555	251	0.984	`S O(2,4)`	$SO(2,4)$	$SO(5,1)$ for $E<0$ and $SO(2,4)$ for $E>0$. On the surfaces (sphere, hyperboloid)
gilmore-lie-groups_F02556	251	1.000	`z_{1}=z_{2}, y_{4}=\lambda`	$z_1 = z_2, y_4 = \lambda$	the condition $\mathbf{u}^t G\mathbf{u} = 1$ is satisfied, so that $z_1 = z_2$, $y_4 = \lambda$ and $y_5 = 0$ (the six
gilmore-lie-groups_F02557	251	1.000	`y_{5}=0`	$y_5 = 0$	the condition $\mathbf{u}^t G\mathbf{u} = 1$ is satisfied, so that $z_1 = z_2$, $y_4 = \lambda$ and $y_5 = 0$ (the six
gilmore-lie-groups_F02558	251	0.934	`\left(y_{0}, \mathbf{y}=\lambda \mathbf{u}, y_{4}= \frac{1}{2}\left(z_{1}+z_{2}\right), y_{5}=\frac{1}{2} \left(z_{1}-z_{2}\right)\right)`	$\left(y_0, \mathbf{y} = \lambda\mathbf{u}, y_4 = \frac{1}{2}(z_1 + z_2), y_5 = \frac{1}{2}(z_1 - z_2)\right)$	coordinates are labeled $(y_0, \mathbf{y} = \lambda\mathbf{u}, y_4 = \frac{1}{2}(z_1 + z_2), y_5 = \frac{1}{2}(z_1 - z_2))$. Transformations that map the algebraic surface to itself must map $y_5 = 0$ to $y_5 = 0$. It is a
gilmore-lie-groups_F02559	251	0.908	`\left[\begin{array}{cc}M & 0 \\ 0 & 1\end{array}\right]`	$\left[\begin{array}{cc}M & 0 \\ 0 & 1\end{array}\right]$	metric diag$(1, \pm I_3, -1)$ in R^5. This is $SO(4,1)$ for $E<0$ and $SO(1,4)$ for $E>0$.
gilmore-lie-groups_F02560	251	0.997	`\operatorname{diag}\left(1, \pm I_{3},-1\right)`	$\operatorname{diag}(1, \pm I_3, -1)$	It remains to show that this group maps these algebraic surfaces into themselves.
gilmore-lie-groups_F02561	251	0.997	`R^{5}`	R^5	It remains to show that this group maps these algebraic surfaces into themselves.
gilmore-lie-groups_F02562	251	0.997	`S O(1,4)`	$SO(1,4)$	It remains to show that this group maps these algebraic surfaces into themselves.
gilmore-lie-groups_F02563	251	0.761	`\mathbf{u}^{\prime}`	$\mathbf{u}'$	$(\mathbf{u}')^t G\mathbf{u}' - 1 = \frac{\quad}{(C\lambda\mathbf{u} + D}$
gilmore-lie-groups_F02564	251	1.000	`A^{t} G A-C^{t} C=G`	$A^t GA - C^t C = G$	$(\mathbf{u}', \mathbf{u}')_N - 1 = \frac{\quad}{(C\mathbf{u} + D)^t(C\mathbf{u} + D)}$ (14.44)
gilmore-lie-groups_F02565	251	1.000	`u`	u	
gilmore-lie-groups_F02566	251	1.000	`\left(u_{0} \rightarrow u_{4}\right)`	$(u_0 \rightarrow u_4)$	
gilmore-lie-groups_F02567	252	0.967	`1 / \sqrt{2 m|E|}`	$1/\sqrt{2m\|E\|}$	vector $\mathbf{L}$ and the scaled (by $1/\sqrt{2m\|E\|}$) Runge–Lenz vector $\mathbf{M}'$ as follows:
gilmore-lie-groups_F02568	252	1.000	`L_{i}, M_{i}^{\prime}`	L_i, M_i'	for $E<0$.
gilmore-lie-groups_F02569	252	1.000	`B_{\mu}`	B_μ	for $E<0$.
gilmore-lie-groups_F02570	252	0.993	`a_{i}, a_{j}^{\dagger}`	$a_i, a_j^\dagger$	for example

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gilmore-lie-groups_F02571	252	1.000	b_{i}, b_{j}^{\dagger}	$b_i, b_j^\dagger$	$a_1^\dagger a_2 \lvert m_1, m_2; n_1, n_2\rangle = \lvert m_1+1, m_2-1; n_1 n_2\rangle \sqrt{m_1+1}\sqrt{m_2}$
gilmore-lie-groups_F02572	252	1.000	\left|m_{1}, m_{2} ; n_{1}, n_{2}\right\rangle	$\lvert m_1, m_2; n_1, n_2\rangle$	
gilmore-lie-groups_F02573	252	1.000	j_{a}=\frac{1}{2}\left(m_{1}+m_{2}\right)	$j_a = \frac{1}{2}\left(m_1+m_2\right)$	
gilmore-lie-groups_F02574	252	1.000	j_{b}=\frac{1}{2}\left(n_{1}+n_{2}\right)	$j_b = \frac{1}{2}\left(n_1+n_2\right)$	
gilmore-lie-groups_F02575	253	1.000	N=2 j_{a}+1=2 j_{b}+1=\left(j_{a}+j_{b}\right)+1	$N = 2j_a+1 = 2j_b+1 = (j_a+j_b)+1$	principal quantum number $N = 2j_a+1 = 2j_b+1 = (j_a+j_b)+1$ must change
gilmore-lie-groups_F02576	253	1.000	j_{a}	j_a	$j_a = j_b$. Operators that change j_a have the form $a_i^\dagger$ or $a_i^\dagger a_j^\dagger$, but they do not simul-
gilmore-lie-groups_F02577	253	1.000	j_{b}	j_b	taneously change j_b. Only operators that simultaneously add or subtract one exci-
gilmore-lie-groups_F02578	253	0.991	\left(H_{1}, H_{2}, H_{3}, H_{4}\right)=\left(a_{1}^{\dagger} a_{1}, a_{2}^{\dagger} a_{2}, b_{1}^{\dagger} b_{1}\right.	$(H_1, H_2, H_3, H_4) = \Big(a_1^\dagger a_1, a_2^\dagger a_2, b_1^\dagger b_1$	$b_2^\dagger b_2)$. The remaining twelve operators have eigenoperator commutation relations with this set:
gilmore-lie-groups_F02579	253	0.829	b_{2}^{\dagger} b_{2}	$b_2^\dagger b_2$	with this set.
gilmore-lie-groups_F02580	253	1.000	\pm \frac{1}{2}	$\pm\frac{1}{2}$	$(a_1^\dagger a_1 + a_2^\dagger a_2) - (b_1^\dagger b_1 + b_2^\dagger b_2)$
gilmore-lie-groups_F02581	253	1.000	\pi / 4	$\pi/4$	
gilmore-lie-groups_F02582	253	1.000	3 \pi / 4	$3\pi/4$	
gilmore-lie-groups_F02583	253	1.000	A_{3}=D_{3}	$A_3 = D_3$	$a_1^\dagger a_2$
gilmore-lie-groups_F02584	254	1.000	a_{1}^{\dagger} a_{1}+a_{2}^{\dagger} a_{2}+b_{1}^{\dagger} b_{1}+b_{2}^{\dagger} b_{2}	$a_1^\dagger a_1 + a_2^\dagger a_2 + b_1^\dagger b_1 + b_2^\dagger b_2$	onal operator $a_1^\dagger a_1 + a_2^\dagger a_2 + b_1^\dagger b_1 + b_2^\dagger b_2$. This is the algebra $\mathfrak{so}(4) + \mathfrak{so}(2)$. The
gilmore-lie-groups_F02585	254	1.000	\mathfrak{s o}(4)+\mathfrak{s o}(2)	$\mathfrak{so}(4) + \mathfrak{so}(2)$	onal operator $a_1^\dagger a_1 + a_2^\dagger a_2 + b_1^\dagger b_1 + b_2^\dagger b_2$. This is the algebra $\mathfrak{so}(4) + \mathfrak{so}(2)$. The
gilmore-lie-groups_F02586	254	0.890	\mathfrak{s} \mathfrak{o}(4,2)=\mathfrak{s} \mathfrak{u}(2,2)	$\mathfrak{so}(4,2) = \mathfrak{su}(2,2)$	$\mathfrak{so}(4,2) = \mathfrak{su}(2,2)$. This is the conformal algebr
gilmore-lie-groups_F02587	254	1.000	\left(q_{1}, q_{2}, q_{3}, q_{4}\right)	(q_1, q_2, q_3, q_4)	$\lceil Q_1 \rceil \quad \lceil q_1 \rceil \quad \lceil q_1 \quad -q_2 \quad -q_3 \quad q_4 \rceil \lceil q_1 \rceil$
gilmore-lie-groups_F02588	254	0.559	\left(Q_{1}, Q_{2}, Q_{3}\right)	(Q_1, Q_2, Q_3)	$\lvert Q_2 \rvert _ M \quad \lvert q_2 \rvert _ \lvert q_2 \quad q_1 \quad -q_4 \quad -q_3$
gilmore-lie-groups_F02589	254	1.000	Q_{4}	Q_4	in R^4 are related by $R = a^2$.
gilmore-lie-groups_F02590	254	1.000	q_{1}^{2}+q_{2}^{2}+q_{3}^{2}+q_{4}^{2} \neq 0	$q_1^2 + q_2^2 + q_3^2 + q_4^2 \neq 0$	The other half of the canonical transformation, involving the momenta in the
gilmore-lie-groups_F02591	254	1.000	R=\sqrt{Q_{1}^{2}+Q_{2}^{2}+Q_{3}^{2}}	$R = \sqrt{Q_1^2 + Q_2^2 + Q_3^2}$	real and fictitious spaces, is
gilmore-lie-groups_F02592	254	1.000	q=\sqrt{q_{1}^{2}+q_{2}^{2}+q_{3}^{2}+q_{4}^{2}}	$q = \sqrt{q_1^2 + q_2^2 + q_3^2 + q_4^2}$	real and fictitious spaces, is
gilmore-lie-groups_F02593	254	1.000	R=q^{2}	$R = q^2$	$(P_1, \ldots$
gilmore-lie-groups_F02594	254	1.000	P_{4}=0	$P_4 = 0$	$(1/4R)(p_1^2 + p_2^2 + p_3^2 + p_4^2)$. With these transformations the hamiltonian

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gilmore-lie-groups_F02595	254	1.000	`P^{2}=P_{1}^{2}+P_{2}^{2}+P_{3}^{2}=\left(1 / 4 R p^{2} \right)-\left(\zeta^{2} / 4 R^{2}\right) \rightarrow`	$P^2 = P_1^2 + P_2^2 + P_3^2 = \left(1/4Rp^2\right) - \left(\zeta^2/4R^2\right) \rightarrow$	
gilmore-lie-groups_F02596	254	0.980	`(1 / 4 R)\left(p_{1}^{2}+p_{2}^{2}+p_{3}^{2}+p_{4}^{2} \right)`	$(1/4R)\left(p_1^2 + p_2^2 + p_3^2 + p_4^2\right)$	
gilmore-lie-groups_F02597	255	1.000	`\left(q_{1}, q_{2}, q_{3}, q_{4} ; p_{1}, p_{2}, p_{3}, p_{4}\right)`	$(q_1, q_2, q_3, q_4; p_1, p_2, p_3, p_4)$	momenta that
gilmore-lie-groups_F02598	255	1.000	`\zeta=0`	$\zeta = 0$	momenta. Preservin
gilmore-lie-groups_F02599	255	1.000	`M^{t} G_{1} M=G_{1}`	$M^t G_1 M = G_1$	$\begin{bmatrix} 0 & M_i \end{bmatrix}$
gilmore-lie-groups_F02600	255	1.000	`M^{t} G_{2} M=G_{2}`	$M^t G_2 M = G_2$	
gilmore-lie-groups_F02601	256	0.988	`\operatorname{Sp}(8 ; \mathbb{R})`	$\operatorname{Sp}(8; \mathbb{R})$	group that preserves the symmetric metric is $SO(4, 4)$. The group that satisfies both
gilmore-lie-groups_F02602	256	1.000	`S O(4,4)`	$SO(4, 4)$	metric-preserving conditions is their intersection:
gilmore-lie-groups_F02603	256	0.998	`(q, p)`	(q, p)	$\begin{bmatrix} s_1 \end{bmatrix} = \frac{1}{\ldots} \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} q_1 \end{bmatrix}$
gilmore-lie-groups_F02604	256	0.998	`(s, r)`	(s, r)	$\begin{bmatrix} s_1 \end{bmatrix} = \frac{1}{\ldots} \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} q_1 \end{bmatrix}$
gilmore-lie-groups_F02605	256	1.000	`U(2,2)`	$U(2, 2)$	A number of workers have shown that the hamiltonian describing the ir
gilmore-lie-groups_F02606	256	0.825	`\left(V(r)=-e^{2} / r\right)`	$\left(V(r) = -e^2/r\right)$	
gilmore-lie-groups_F02607	257	1.000	`\mathfrak{s o}(4,1)`	$\mathfrak{so}(4, 1)$	Five additional operators can be introduced that extend the algebra to $\mathfrak{so}(4, 2)$.
gilmore-lie-groups_F02608	257	1.000	`\mathfrak{s o}(4,2)`	$\mathfrak{so}(4, 2)$	These include one vector operator and two additional operators:
gilmore-lie-groups_F02609	257	1.000	`J_{i}, M_{i}, A_{i}, \Gamma_{i}(i=1,2,3)`	$J_i, M_i, A_i, \Gamma_i (i = 1, 2, 3)$	The Schrödinger and Klein–Gordon hamiltonians for an electron of charge $-e$
gilmore-lie-groups_F02610	257	0.996	`A_{4}, \Gamma_{4}, \Gamma_{5}`	A_4, Γ_4, Γ_5	in the Coulomb field $\Phi(r) = e/r$ of a proton can be expressed in terms of operators
gilmore-lie-groups_F02611	257	1.000	`\Phi(r)=e / r`	$\Phi(r) = e/r$	
gilmore-lie-groups_F02612	257	1.000	`A_{4}, \Gamma_{4}`	A_4, Γ_4	**14.10 Spin angular momentum**
gilmore-lie-groups_F02613	257	1.000	`\Gamma_{5}`	Γ_5	**14.10 Spin angular momentum**
gilmore-lie-groups_F02614	257	0.860	`(\mathbf{E}, \mathbf{B})`	$(\mathbf{E}, \mathbf{B})$	
gilmore-lie-groups_F02615	257	1.000	`A_{\mu}=(\phi, \mathbf{A})`	$A_\mu = (\phi, \mathbf{A})$	
gilmore-lie-groups_F02616	257	1.000	`q=-e`	$q = -e$	
gilmore-lie-groups_F02617	257	1.000	`H_{D} \psi=E \psi`	$H_D \psi = E \psi$	

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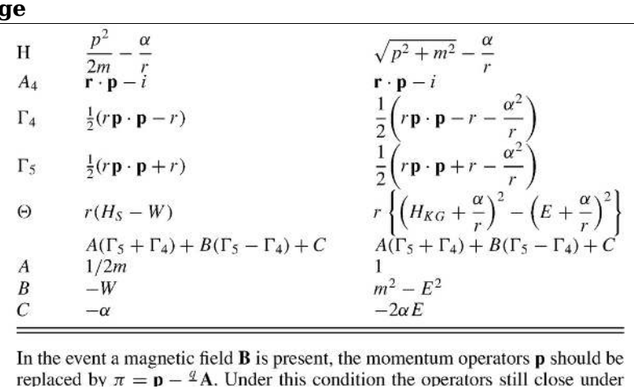
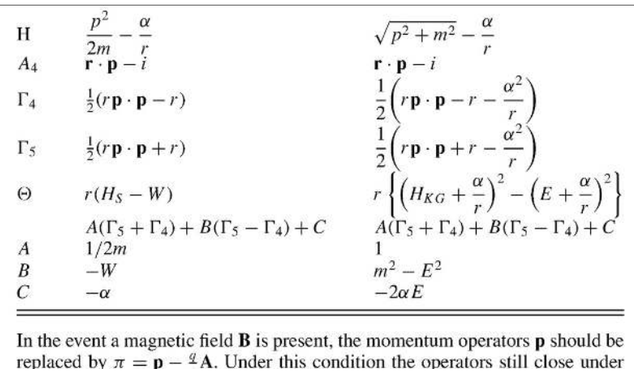
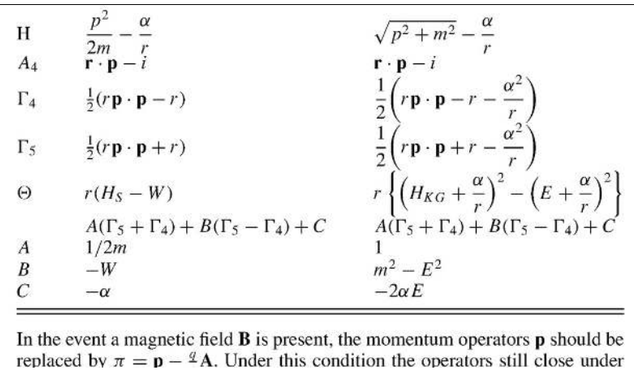
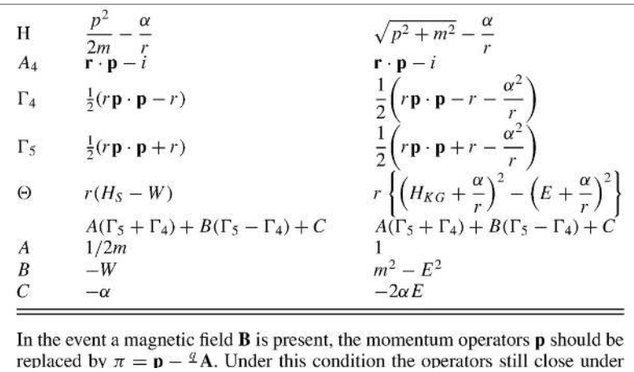
gilmore-lie-groups_F02618	258	0.721	`\frac{p^{2}}{2 m}-\frac{\alpha}{r}`	$\frac{p^{2}}{2m}-\frac{\alpha}{r}$	
gilmore-lie-groups_F02619	258	0.721	`\sqrt{p^{2}+m^{2}}-\frac{\alpha}{r}`	$\sqrt{p^{2}+m^{2}}-\frac{\alpha}{r}$	
gilmore-lie-groups_F02620	258	0.721	`\mathbf{r} \cdot \mathbf{p}-i`	$\mathbf{r}\cdot\mathbf{p}-i$	
gilmore-lie-groups_F02621	258	0.721	`\Gamma_{4}`	Γ_{4}	

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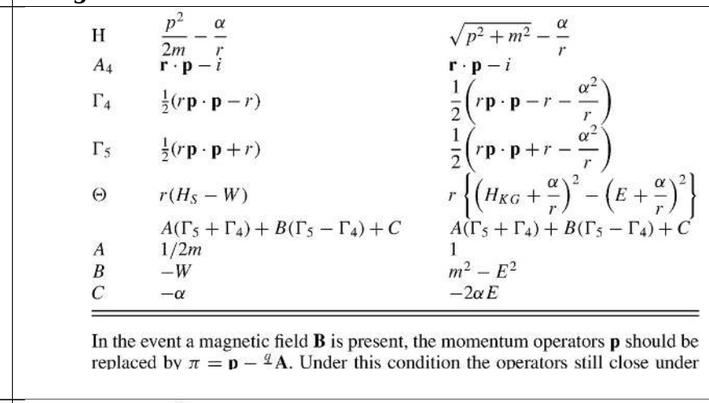
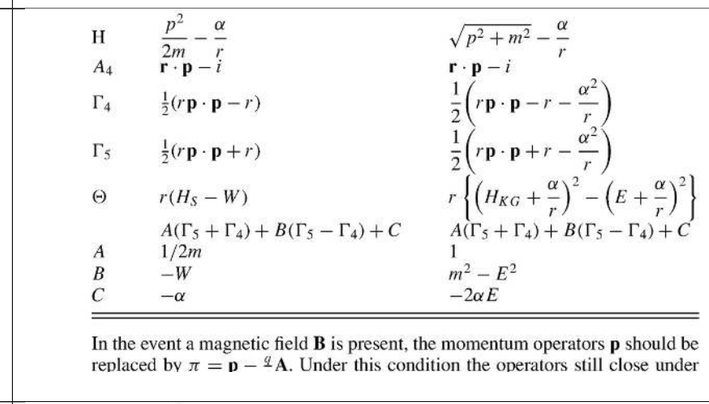
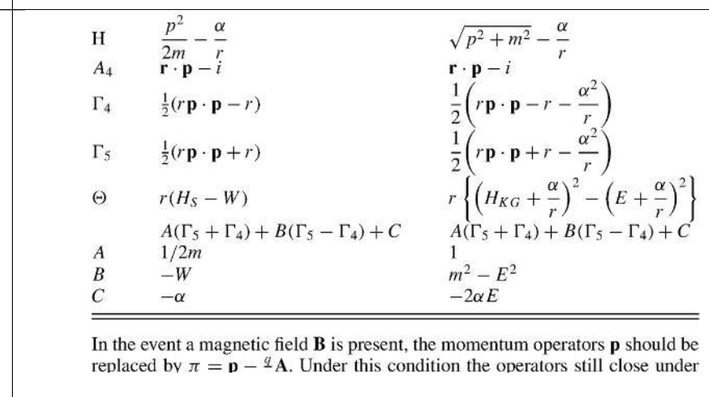
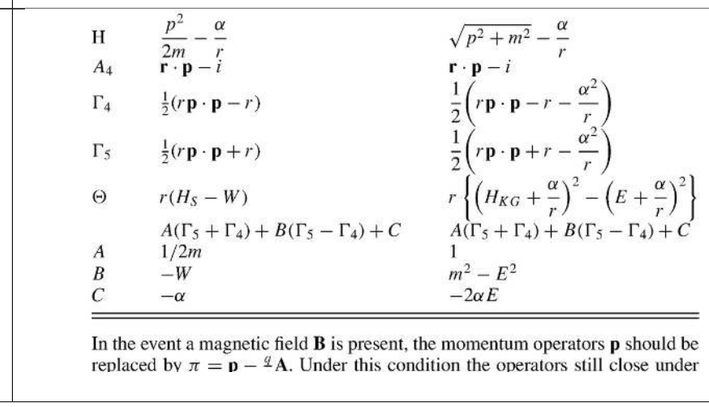
gilmore-lie-groups_F02622	258	0.721	`\frac{1}{2}(r \mathbf{p} \cdot \mathbf{p}-r)`	$\frac{1}{2}(r\mathbf{p}\cdot\mathbf{p}-r)$	
gilmore-lie-groups_F02623	258	0.721	`\frac{1}{2}\left(r \mathbf{p} \cdot \mathbf{p}-r-\frac{\alpha^{2}}{r}\right)`	$\frac{1}{2}\left(r\mathbf{p}\cdot\mathbf{p}-r-\frac{\alpha^2}{r}\right)$	
gilmore-lie-groups_F02624	258	0.721	`\frac{1}{2}(r \mathbf{p} \cdot \mathbf{p}+r)`	$\frac{1}{2}(r\mathbf{p}\cdot\mathbf{p}+r)$	
gilmore-lie-groups_F02625	258	0.721	`\frac{1}{2}\left(r \mathbf{p} \cdot \mathbf{p}+r-\frac{\alpha^{2}}{r}\right)`	$\frac{1}{2}\left(r\mathbf{p}\cdot\mathbf{p}+r-\frac{\alpha^2}{r}\right)$	

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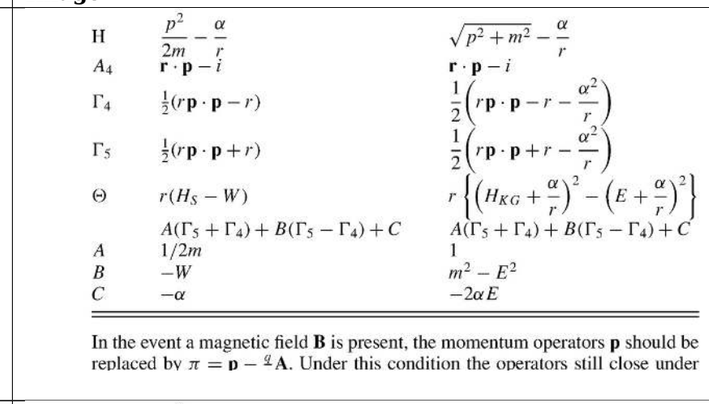
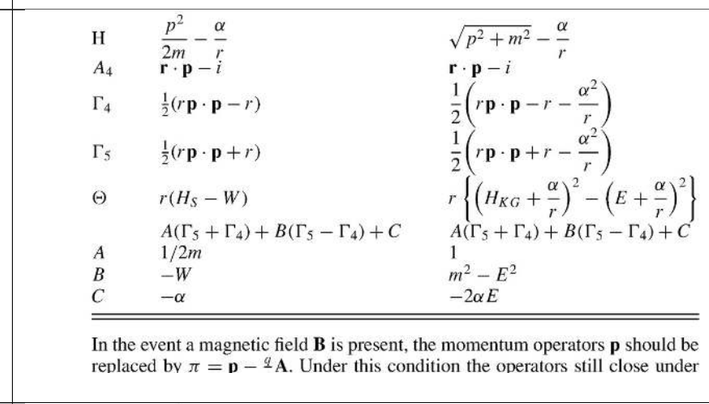
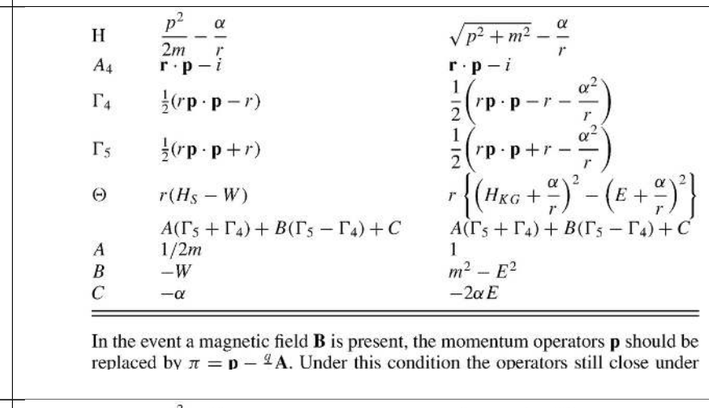
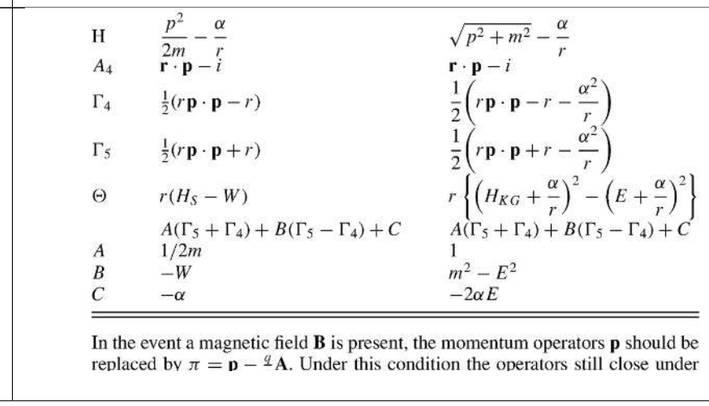
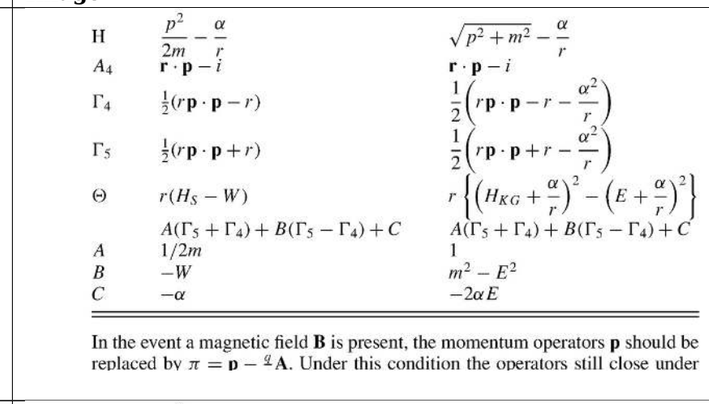
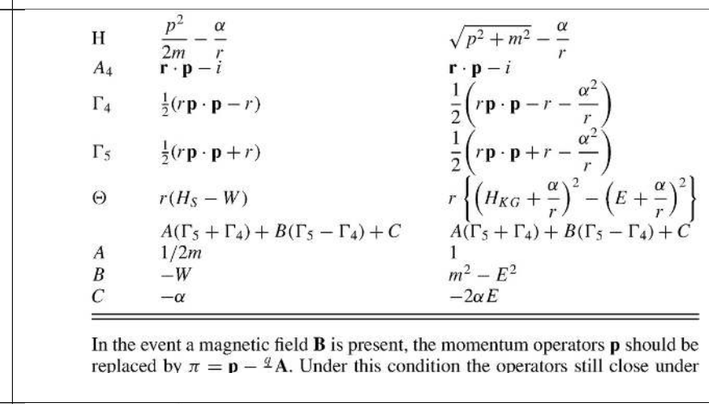
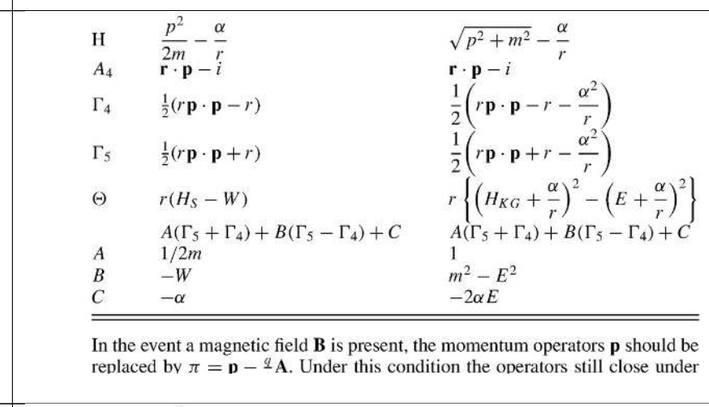
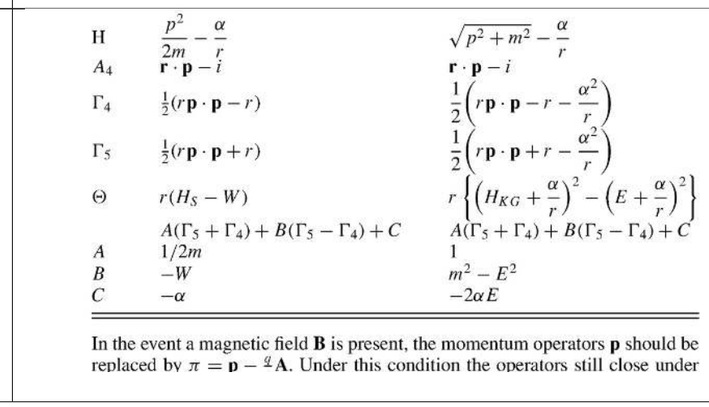
gilmore-lie-groups_F02626	258	0.721	`\Theta`	Θ	
gilmore-lie-groups_F02627	258	0.721	`r\left(H_{S}-W\right)`	$r\left(H_{S}-W\right)$	
gilmore-lie-groups_F02628	258	0.721	`r\left\{\left(H_{K G}+\frac{\alpha}{r}\right)^{2}-\left(E+\frac{\alpha}{r}\right)^{2}\right\}`	$r\left\{\left(H_{KG}+\frac{\alpha}{r}\right)^{2}-\left(E+\frac{\alpha}{r}\right)^{2}\right\}$	
gilmore-lie-groups_F02629	258	0.721	`A\left(\Gamma_{5}+\Gamma_{4}\right)+B\left(\Gamma_{5}-\Gamma_{4}\right)+C`	$A\left(\Gamma_{5}+\Gamma_{4}\right)+B\left(\Gamma_{5}-\Gamma_{4}\right)+C$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02630	258	0.721	`1 / 2 m`	$1/2m$	
gilmore-lie-groups_F02631	258	0.721	`-W`	$-W$	
gilmore-lie-groups_F02632	258	0.721	`m^{2}-E^{2}`	$m^2 - E^2$	
gilmore-lie-groups_F02633	258	0.721	`-2 \alpha E`	$-2\alpha E$	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02634	258	1.000	`\pi=\mathbf{p}-\frac{q}{c} \mathbf{A}`	$\pi = \mathbf{p} - \frac{q}{c}\mathbf{A}$	differential equation of first order:
gilmore-lie-groups_F02635	258	0.971	`\gamma_{i}`	γ_i	$\lfloor 0 \quad -I_2 \rfloor$
gilmore-lie-groups_F02636	258	0.982	`\sigma_{i}`	σ_i	The latter two are modified to allow a treatment of the Dirac operator along the
gilmore-lie-groups_F02637	259	1.000	`\mathbf{p} \rightarrow \pi=\mathbf{p}-\frac{q}{c} \mathbf{A}`	$\mathbf{p} \rightarrow \pi = \mathbf{p} - \frac{q}{c}\mathbf{A}$	As before, the substitution $\mathbf{p} \rightarrow \pi = \mathbf{p} - \frac{q}{c}\mathbf{A}$ is in order in the event there is a
gilmore-lie-groups_F02638	259	1.000	`J_{i}, M_{i}, A_{i}, \Gamma_{i}`	J_i, M_i, A_i, Γ_i	three-vectors J_i, M_i, A_i, Γ_i defined in Table 14.5. The Dirac hamiltonian is ex-
gilmore-lie-groups_F02639	259	0.990	`\Gamma_{4}, \Gamma_{5}`	Γ_4, Γ_5	the relation among these operators in the algebraic representation of the relativistic
gilmore-lie-groups_F02640	259	1.000	`D=d / d r`	$D = d/dr$	
gilmore-lie-groups_F02641	259	1.000	`r D^{2}+r`	$rD^2 + r$	
gilmore-lie-groups_F02642	259	1.000	`r D^{2}-r`	$rD^2 - r$	
gilmore-lie-groups_F02643	260	1.000	`C^{2}=\Gamma_{5}^{2}-\Gamma_{4}^{2}-M_{4}^{2}=-a`	$C^2 = \Gamma_5^2 - \Gamma_4^2 - M_4^2 = -a$	The radial equation Eq. (14.63) is expressed in terms of the three operators as
gilmore-lie-groups_F02644	260	0.978	`a \rightarrow A`	$a \rightarrow A$	
gilmore-lie-groups_F02645	260	1.000	`C<0`	$C < 0$	where $u(r) = e^{-\theta}R(r)$. If A is the Casimir invariant of this representation of su(1,1), the discrete spectrum of the compact operator Γ_z is $N = -\frac{1}{2} +$
gilmore-lie-groups_F02646	260	1.000	`e^{-\theta}+C e^{\theta}=0`	$e^{-\theta} + Ce^{\theta} = 0$	where $u(r) = e^{-\theta}R(r)$. If A is the Casimir invariant of this representation of su(1,1), the discrete spectrum of the compact operator Γ_z is $N = -\frac{1}{2} +$
gilmore-lie-groups_F02647	260	1.000	`u(r)=e^{\theta M_{4}} R(r)`	$u(r) = e^{\theta M_4}R(r)$	
gilmore-lie-groups_F02648	260	0.798	`N=-\frac{1}{2}+`	$N = -\frac{1}{2}+$	
gilmore-lie-groups_F02649	260	1.000	`\sqrt{\left(\frac{1}{2}\right)^{2}-A}+1+n, n=0,1,2, \ldots`	$\sqrt{\left(\frac{1}{2}\right)^2 - A} + 1 + n, n = 0, 1, 2, \ldots$	
gilmore-lie-groups_F02650	261	1.000	`W=-\frac{1}{2} m c^{2} \alpha^{2}\left(1 / N^{2}\right)`	$W = -\frac{1}{2}mc^2\alpha^2\left(1/N^2\right)$	Here N is the principal quantum number. The result is that this algebra acts to
gilmore-lie-groups_F02651	261	1.000	`N=l+1+k, k=0,1,2, \ldots`	$N = l + 1 + k, k = 0, 1, 2, \ldots$	Here N is the principal quantum number. The result is that this algebra acts to
gilmore-lie-groups_F02652	261	1.000	`m_{l}`	m_l	the action of these operators. The states connected by the operators of this so(2, 1)
gilmore-lie-groups_F02653	261	0.449	`|N, \ln \rangle \leftrightarrow|N \pm 1, l m\rangle`	$\|N, \ln\rangle \leftrightarrow \|N \pm 1, lm\rangle$	organized in angular momentum towers. These states are organized vertically in Fig. 14.2
gilmore-lie-groups_F02654	261	1.000	`L_{z}, L_{ \pm}`	$L_z, L_\pm$	with the Laplace–Runge–Lenz vector act horizontally on the levels shown in these
gilmore-lie-groups_F02655	261	1.000	`M_{z}, M_{ \pm}`	$M_z, M_\pm$	two figures. The operators $\Gamma_z, \Gamma_\pm = \Gamma_4 \pm iM_4$ act vertically on the levels shown
gilmore-lie-groups_F02656	261	0.997	`\Gamma_{z}, \Gamma_{ \pm}=\Gamma_{4} \pm i M_{4}`	$\Gamma_z, \Gamma_\pm = \Gamma_4 \pm iM_4$	hydrogenic states.
gilmore-lie-groups_F02657	261	1.000	`[\mathbf{L}, \Gamma]=0`	$[\mathbf{L}, \Gamma] = 0$	**Remark** The shift down operator Γ_- annihilates the ground state in a given an-
gilmore-lie-groups_F02658	261	1.000	`\Gamma_{-}`	Γ_-	mine the radial wavefunction $\langle r\|N, l = N - 1\rangle$.

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02659	261	0.535	`\Gamma_{-}\left\langle r \mid N^{l=N-1}\right\rangle=0`	$\Gamma_{-}\left\langle r \mid N^{l=N-1}\right\rangle=0$	
gilmore-lie-groups_F02660	261	1.000	`L_{-} Y_{m=-l}^{l}(\theta, \phi)=0`	$L_{-} Y_{m=-l}^{l}(\theta, \phi)=0$	
gilmore-lie-groups_F02661	261	1.000	`\langle r \mid N, l=N-1\rangle`	$\langle r \mid N, l=N-1\rangle$	14.11.2 Scattering sta
gilmore-lie-groups_F02662	261	1.000	`C>0`	$C>0$	where as before $u(r)=e^{\theta M_4} R(r)$. Since the generator Γ_4 is noncompact, it has
gilmore-lie-groups_F02663	261	1.000	`e^{-\theta}-C e^{\theta}=0`	$e^{-\theta}-C e^{\theta}=0$	where as before $u(r)=e^{\theta M_4} R(r)$. Since the generator Γ_4 is noncompact, it has
gilmore-lie-groups_F02664	261	1.000	`k \simeq e^{-\theta}`	$k \simeq e^{-\theta}$	
gilmore-lie-groups_F02665	261	1.000	`E=\hbar^{2} k^{2} / 2 m`	$E=\hbar^{2} k^{2} / 2 m$	
gilmore-lie-groups_F02666	262	1.000	`\delta(j)=\arg [\Gamma(j+1-i(\alpha / k)]`	$\delta(j)=\arg [\Gamma(j+1-i(\alpha / k)]$	where $\delta(j)=\arg [\Gamma(j+1-i(\alpha / k)]$ is part of the scattering phase shift, and the
gilmore-lie-groups_F02667	262	1.000	`j=-\frac{1}{2}+\sqrt{\left(\frac{1}{2}\right)^{2}-A}`	$j=-\frac{1}{2}+\sqrt{\left(\frac{1}{2}\right)^{2}-A}$	expression for j is given by $j=-\frac{1}{2}+\sqrt{(\frac{1}{2})^2-A}$
gilmore-lie-groups_F02668	262	1.000	`-1 / r`	$-1 / r$	extra attraction by adding a term of the form $-1/r^2$ to the potential to represent
gilmore-lie-groups_F02669	262	1.000	`-1 / r^{2}`	$-1 / r^{2}$	penetration of the core electrons. To this end the potential used in the Schrodinger
gilmore-lie-groups_F02670	262	1.000	`V(r)=-e^{2} / r \rightarrow-e^{2} / r-\mu_{l}\left(\hbar^{2} / 2 m\right) / r^{2}`	$V(r)=-e^{2} / r \rightarrow-e^{2} / r-\mu_{l}\left(\hbar^{2} / 2 m\right) / r^{2}$	encapsulated entirely in the change
gilmore-lie-groups_F02671	262	1.000	`j \rightarrow j^{\prime}=j+\Delta j`	$j \rightarrow j^{\prime}=j+\Delta j$	bound state energy spectrum:
gilmore-lie-groups_F02672	262	1.000	`\Delta j=`	$\Delta j=$	bound state energy spectrum:
gilmore-lie-groups_F02673	262	1.000	`-\mu_{l} /(2 l+1)`	$-\mu_{l} /(2 l+1)$	$mc^2\alpha^2$ $mc^2\alpha^2$
gilmore-lie-groups_F02674	262	1.000	`\Delta j`	Δj	The excess phase shift is
gilmore-lie-groups_F02675	263	1.000	`G \supset S O(3)`	$G \supset S O(3)$	generators include both the angular momentum operators and the components of
gilmore-lie-groups_F02676	264	0.987	`3^{\text {deg }}`	$3^{\text {deg }}$	incompatible with the first of Galileo's assumptions. Does this create a problem for
gilmore-lie-groups_F02677	264	1.000	`\mathbf{F}=m \mathbf{g}`	$\mathbf{F}=m \mathbf{g}$	experiences an acceleration **g** in the "up" direction. If the "rest of the universe" "looks
gilmore-lie-groups_F02678	264	1.000	`\mathbf{A}=\frac{1}{2} \mathbf{B} \times \mathbf{r}`	$\mathbf{A}=\frac{1}{2} \mathbf{B} \times \mathbf{r}$	these two fields.
gilmore-lie-groups_F02679	264	0.996	`(r, \theta, \phi)=\left(\theta_{3}, \theta_{2}, \theta_{1}\right)`	$(r, \theta, \phi)=\left(\theta_{3}, \theta_{2}, \theta_{1}\right)$	$x=x_1=\theta_3 \sin \theta_2 \sin \theta_1$
gilmore-lie-groups_F02680	264	1.000	`\mathcal{L}^{2}\left(S^{1}\right)=\partial^{2} / \partial \theta_{1}^{2}`	$\mathcal{L}^{2}\left(S^{1}\right)=\partial^{2} / \partial \theta_{1}^{2}$	Generalize this result to $\mathcal{L}^2(S^3)$ rect more generally for $\mathcal{L}^2(S^n)$
gilmore-lie-groups_F02681	264	1.000	`\mathcal{L}^{2}\left(S^{3}\right)`	$\mathcal{L}^{2}\left(S^{3}\right)$	
gilmore-lie-groups_F02682	264	1.000	`\left(\partial / \partial \cos \theta_{3}\right)^{2}`	$\left(\partial / \partial \cos \theta_{3}\right)^{2}$	
gilmore-lie-groups_F02683	264	1.000	`\mathcal{L}^{2}\left(S^{n}\right)`	$\mathcal{L}^{2}\left(S^{n}\right)$	
gilmore-lie-groups_F02684	265	1.000	`r \rightarrow \infty`	$r \rightarrow \infty$	**a.** Show that the singular points of Eq. (14.9) occur at $r=0$ and $r \rightarrow \infty$.

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02685	265	1.000	`\gamma=\frac{1}{2} \pm \sqrt{\left(\frac{1}{2}\right)^{2}-A}`	$\gamma=\frac{1}{2} \pm \sqrt{\left(\frac{1}{2}\right)^{2}-A}$	. Show that if $\sqrt{(\frac{1}{2})^2 - A}$ is real, the solution with the po
gilmore-lie-groups_F02686	265	1.000	`\lambda= \pm \sqrt{-C}`	$\lambda= \pm \sqrt{-C}$	. Show that if $\sqrt{(\frac{1}{2})^2 - A}$ is real, the solution with the po
gilmore-lie-groups_F02687	265	1.000	`\sqrt{\left(\frac{1}{2}\right)^{2}-A}`	$\sqrt{\left(\frac{1}{2}\right)^{2}-A}$	integrable in the neighborhood of $r = 0$. Under what conditions is the solution with the negative sign square integrable? Show that if $C < 0$ the solution $\pm\sqrt{-C}$
gilmore-lie-groups_F02688	265	1.000	`\pm \sqrt{-C}`	$\pm \sqrt{-C}$	. Show that a solution of the form $R(r) = r^{\gamma} e^{\lambda r} f(r)$ can be found where the function
gilmore-lie-groups_F02689	265	1.000	`R(r)=r^{\gamma} e^{\lambda r} f(r)`	$R(r)=r^{\gamma} e^{\lambda r} f(r)$	**e.** Find the equation that the function $f(r)$ satisfies. Show that it is equivalent to the
gilmore-lie-groups_F02690	265	1.000	`f(r)=\sum_{j=0}^{\infty} f_{j} r^{j}`	$f(r)=\sum_{j=0}^{\infty} f_{j} r^{j}$	recursion relation is
gilmore-lie-groups_F02691	265	1.000	`j \rightarrow \infty`	$j \rightarrow \infty$	$f_{n+3} = \cdots = 0$), show that the quantization conditon $2\lambda(n+\gamma)+B=0$ must be
gilmore-lie-groups_F02692	265	1.000	`f(r) \rightarrow e^{-2 \lambda r}`	$f(r) \rightarrow e^{-2 \lambda r}$	$f_{n+3} = \cdots = 0$), show that the quantization conditon $2\lambda(n+\gamma)+B=0$ must be
gilmore-lie-groups_F02693	265	1.000	`\lambda<0`	$\lambda<0$	$f_{n+3} = \cdots = 0$), show that the quantization conditon $2\lambda(n+\gamma)+B=0$ must be
gilmore-lie-groups_F02694	265	0.963	`r^{n}`	r^{n}	
gilmore-lie-groups_F02695	265	0.963	`f_{n} \neq 0`	$f_{n} \neq 0$	
gilmore-lie-groups_F02696	265	0.963	`f_{n+1}=0\left(\Rightarrow f_{n+2}=\right.`	$f_{n+1}=0\left(\Rightarrow f_{n+2}=\right.$	
gilmore-lie-groups_F02697	265	1.000	`f_{n+3}=\cdots=0`	$f_{n+3}=\cdots=0$	
gilmore-lie-groups_F02698	265	1.000	`2 \lambda(n+\gamma)+B=0`	$2\lambda(n+\gamma)+B=0$	
gilmore-lie-groups_F02699	266	1.000	`\frac{1}{r} r^{\gamma} f(r) e^{\lambda r}`	$\frac{1}{r} r^{\gamma} f(r) e^{\lambda r}$	interval $(0, \infty)$.
gilmore-lie-groups_F02700	266	0.907	`(0, \infty)`	$(0, \infty)$	6. For a highly i
gilmore-lie-groups_F02701	266	1.000	`Z e / r`	Ze/r	the relativistic solution is clearly incorrect? (Hint: set $l = 0$.)
gilmore-lie-groups_F02702	266	1.000	`N^{\prime}=n+\frac{1}{2}+\sqrt{\left(l+\frac{1}{2}\right)^{2}-\alpha^{2}}`	$N^{\prime}=n+\frac{1}{2}+\sqrt{\left(l+\frac{1}{2}\right)^{2}-\alpha^{2}}$	$E(n,l) = \frac{mc^2}{\sqrt{1+(\frac{\alpha}{N'})^2}} \rightarrow mc^2 - mc^2\frac{\alpha^2}{2N^2}$.
gilmore-lie-groups_F02703	266	1.000	`e^{\lambda r}`	$e^{\lambda r}$	relativistic $a(n,l) = \sqrt{(N')^2 + \alpha^2}\, a_B$ $N' = n + \frac{1}{2} + \sqrt{(l+\frac{1}{2})^2 - \alpha^2}$
gilmore-lie-groups_F02704	266	1.000	`\lambda^{-1}`	λ^{-1}	relativistic $a(n,l) = \sqrt{(N')^2 + \alpha^2}\, a_B$ $N' = n + \frac{1}{2} + \sqrt{(l+\frac{1}{2})^2 - \alpha^2}$ nonrelativistic $a(n,l) = Na_B$ $N = n + l + 1$
gilmore-lie-groups_F02705	266	1.000	`a \simeq 1 /|\lambda|`	$a \simeq 1/\|\lambda\|$	relativistic $a(n,l) = \sqrt{(N')^2 + \alpha^2}\, a_B$ $N' = n + \frac{1}{2} + \sqrt{(l+\frac{1}{2})^2 - \alpha^2}$ nonrelativistic $a(n,l) = Na_B$ $N = n + l + 1$
gilmore-lie-groups_F02706	266	0.910	`(n, l)`	(n, l)	

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02707	267	0.953	`e^{ \pm}`	$e^{\pm}$	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02708	267	0.953	`\mu^{ \pm}`	$\mu^{\pm}$	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02709	267	0.953	`\tau^{ \pm}`	$\tau^{\pm}$	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02710	267	0.953	`p^{ \pm}`	$p^{\pm}$	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02711	267	0.953	`d^{+}`	d^{+}	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02712	267	0.953	`t^{+}`	t^{+}	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02713	267	0.953	`\pi^{ \pm}`	$\pi^{ \pm}$	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02714	267	0.953	`\Sigma^{ \pm}`	$\Sigma^{ \pm}$	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F02715	267	0.953	`\Xi^{-}`	Ξ^{-}	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02716	267	0.953	`\Omega^{-}`	Ω^{-}	Particle / Rest energy (MeV) electron $e^{\pm}$ 0.511 mu meson $\mu^{\pm}$ 105.7 tau meson $\tau^{\pm}$ 1784.0 proton, antiproton $p^{\pm}$ 938.26 deuteron d^{+} 1875.6 tritium t^{+} 2809.4 pi meson $\pi^{\pm}$ 139.6 sigma meson $\Sigma^{\pm}$ 1385.0 cascade meson Ξ^{-} 1533.0 omega Ω^{-} 1672.0
gilmore-lie-groups_F02717	267	1.000	`a_{B}=\hbar^{2} / m e^{2}=0.529 \times 10^{-8} \mathrm{~cm}`	$a_B = \hbar^2/me^2 = 0.529 \times 10^{-8}$ cm	sizes of the atoms in the (n, l) states differ between the relativistic and nonrelativistic
gilmore-lie-groups_F02718	267	0.906	`n, l`	n, l	Many charged particles can form hydrogen-like atoms through their electrostatic
gilmore-lie-groups_F02719	267	1.000	`W=-\frac{1}{2} m c^{2} \alpha^{2} / N^{2}`	$W = -\frac{1}{2}mc^2\alpha^2/N^2$	The motion of a classical nonrelativistic particle in a $1/r^2$ radial force field is a conic section: an elliptical orbit for bound states ($E < 0$); hyperbolic for scattering states
gilmore-lie-groups_F02720	267	1.000	`1 / m=1 / m_{1}+1 / m_{2}`	$1/m = 1/m_1 + 1/m_2$	The motion of a classical nonrelativistic particle in a $1/r^2$ radial force field is a conic section: an elliptical orbit for bound states ($E < 0$); hyperbolic for scattering states
gilmore-lie-groups_F02721	267	1.000	`(E=0)`	$(E = 0)$	r^2 r^3
gilmore-lie-groups_F02722	267	1.000	`1 / r^{3}`	$1/r^3$	the trajectory has the form
gilmore-lie-groups_F02723	267	1.000	`\alpha=\sqrt{1-\eta}, \eta=C / K a`	$\alpha = \sqrt{1-\eta}, \eta = C/Ka$	potential.
gilmore-lie-groups_F02724	267	1.000	`\alpha \simeq 1`	$\alpha \simeq 1$	
gilmore-lie-groups_F02725	267	1.000	`\eta`	η	
gilmore-lie-groups_F02726	268	0.651	`E=\sqrt{\left(m c^{2}\right)^{2}+(\mathbf{p} c)^{2}}-K / r`	$E = \sqrt{\left(mc^2\right)^2 + (\mathbf{p}c)^2} - K/r$	**a.** Expand the relativistic energy $E = \sqrt{(mc^2)^2 + (\mathbf{p}c)^2} - K/r$ to fourth order in $\mathbf{p}$
gilmore-lie-groups_F02727	268	1.000	`E=\left(m c^{2}\right)+\left(p^{2} / 2 m\right)-\left(p^{2} / 2 m\right)^{2} /\left(2 m c^{2}\right)-K / r=m c^{2}+W`	$E = \left(mc^2\right) + \left(p^2/2m\right) - \left(p^2/2m\right)^2 / \left(2mc^2\right) - K/r = mc^2 + W$	and show $E = (mc^2) + (p^2/2m) - (p^2/2m)^2/(2mc^2) - K/r = mc^2 + W$.
gilmore-lie-groups_F02728	268	1.000	`-\left(p^{2} / 2 m\right)^{2} /\left(2 m c^{2}\right)`	$-\left(p^2/2m\right)^2 / \left(2mc^2\right)$	**b.** Replace the quartic term $-(p^2/2m)^2/(2mc^2)$ by $-(W + K/r)^2/(2mc^2)$ and ex-
gilmore-lie-groups_F02729	268	1.000	`-(W+K / r)^{2} /\left(2 m c^{2}\right)`	$-(W + K/r)^2 / \left(2mc^2\right)$	**b.** Replace the quartic term $-(p^2/2m)^2/(2mc^2)$ by $-(W + K/r)^2/(2mc^2)$ and ex-
gilmore-lie-groups_F02730	268	1.000	`K^{\prime}`	K'	**c.** Argue that the classical motion involves a renormalized coupling $K \to K'$ as w

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gilmore-lie-groups_F02731	268	1.000	`C^{\prime}`	C'	**c.** Argue that the classical motion involves a renormalized coupling $K \rightarrow K'$ as w
gilmore-lie-groups_F02732	268	1.000	`K^{\prime}=K\left(1+W / m c^{2}\right)`	$K'=K\left(1+W / m c^{2}\right)$	**c.** Argue that the classical motion involves a renormalized coupling $K \rightarrow K'$ as w
gilmore-lie-groups_F02733	268	1.000	`C^{\prime}=-K^{2} /\left(2 m c^{2}\right)`	$C'=-K^{2} /\left(2 m c^{2}\right)$	**c.** Argue that the classical motion involves a renormalized coupling $K \rightarrow K'$ as w
gilmore-lie-groups_F02734	268	1.000	`K \rightarrow K^{\prime}`	$K \rightarrow K'$	as a $1/r^3$ component to the force, with $C = 2C'$.
gilmore-lie-groups_F02735	268	1.000	`C=2 C^{\prime}`	$C=2 C'$	**d.** Show that the advance in the perihelion of the (
gilmore-lie-groups_F02736	268	1.000	`\delta \theta \simeq \eta / 2`	$\delta \theta \simeq \eta / 2$	**e.** Evaluate η for the planet Mercury, for which $\epsilon = 0.206$ and the period is $T =$
gilmore-lie-groups_F02737	268	1.000	`\epsilon=0.206`	$\epsilon=0.206$	correction is larger by a factor of 6, and accounts for the observed advance in
gilmore-lie-groups_F02738	268	1.000	`T=0.24`	$T=0.24$	correction is larger by a factor of 6, and accounts for the observed advance in
gilmore-lie-groups_F02739	268	1.000	`m=`	$m=$	(nonrelativistic) equations of motion are not correct for relativistic particles, and
gilmore-lie-groups_F02740	268	1.000	`m_{0} / \sqrt{1-(v / c)^{2}}`	$m_{0} / \sqrt{1-(v / c)^{2}}$	must be modified. The author feels the second interperetation is far superior to the
gilmore-lie-groups_F02741	268	1.000	`\mathbf{F}(r)=\left(-K / r^{2}+p(r)\right) \hat{ \mathbf{r}}`	$\mathbf{F}(r)=\left(-K / r^{2}+p(r)\right) \hat{\mathbf{r}}$	$\omega = \frac{\partial}{\partial I}\left(\frac{1}{T}\int_0 p(r)\,dt\right) = \frac{\partial}{\partial I}\left(\frac{1}{IT}\oint r^2 p(r)\,d\theta\right)$
gilmore-lie-groups_F02742	268	1.000	`p(r)`	$p(r)$	$\omega = \frac{\partial}{\partial I}\left(\frac{1}{T}\int_0 p(r)\,dt\right) = \frac{\partial}{\partial I}\left(\frac{1}{IT}\oint r^2 p(r)\,d\theta\right)$
gilmore-lie-groups_F02743	268	1.000	`1 / r=\left(m K / L^{2}\right)(1+(M / m K) \cos \theta)`	$1 / r=\left(m K / L^{2}\right)(1+(M / m K) \cos \theta)$	special relativity $C = \frac{KL^2}{\ldots}$ $\omega = \frac{\pi K^2}{\ldots}$
gilmore-lie-groups_F02744	268	1.000	`L`	L	special relativity $C = \frac{KL^2}{\ldots}$ $\omega = \frac{\pi K^2}{\ldots}$
gilmore-lie-groups_F02745	268	1.000	`C / r^{3}`	C / r^{3}	$2m^2c^2$ TL^2c^2
gilmore-lie-groups_F02746	268	1.000	`C \times 2 \pi \frac{m K}{L^{2}}`	$C \times 2 \pi \frac{m K}{L^{2}}$	KL^2 $6\pi K^2$
gilmore-lie-groups_F02747	268	1.000	`K=G M m`	$K=G M m$	
gilmore-lie-groups_F02748	268	1.000	`M \gg m, \omega`	$M \gg m, \omega$	
gilmore-lie-groups_F02749	269	1.000	`\omega=42^{\prime \prime}`	$\omega=42^{\prime \prime}$	planetary distance from the Sun. What is the precession for the Earth? Use $\omega = 42''$
gilmore-lie-groups_F02750	269	1.000	`L_{-}`	L_{-}	spherical harmonic for a given value of l is zero: $L_- Y^l_{-l}(\theta, \phi) = 0$. Use the coor-
gilmore-lie-groups_F02751	269	1.000	`Y_{m}^{l}(\theta, \phi)=P_{-l}^{l}(\theta) e^{-i l \phi}`	$Y_{m}^{l}(\theta, \phi)=P_{-l}^{l}(\theta) e^{-i l \phi}$	$\cos\theta\ \partial$
gilmore-lie-groups_F02752	269	1.000	`P_{-l}^{l}=(\sin \theta)^{l}`	$P_{-l}^{l}=(\sin \theta)^{l}$	**c.** This function is not normalized to unity over the s
gilmore-lie-groups_F02753	269	1.000	`N_{l}`	N_{l}	$\int^{\pi} d\theta\ \sin\theta \int^{2\pi} d\phi\, \lvert N_l \sin^l \theta e^{-il\phi}\rvert^2 = 1$
gilmore-lie-groups_F02754	269	1.000	`Y_{ \pm l}^{l}(\theta, \phi)`	$Y_{\pm l}^{l}(\theta, \phi)$	
gilmore-lie-groups_F02755	269	0.999	`N_{0}=\sqrt{1 / 4 \pi}`	$N_{0}=\sqrt{1 / 4 \pi}$	$\delta_{m',m+1}$ and the coordinate representation of the shift up operator L_+ to construct
gilmore-lie-groups_F02756	269	1.000	`N_{3}`	N_{3}	the coni

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gilmore-lie-groups_F02757	269	0.999	`\left\langle{ }_{m^{\prime}}^{l}\right| L_{+}\left|{ }_{m}^{l}\right\rangle=\sqrt{\left(l+m^{\prime}\right)(l-m)}`	$\left\langle{}_{m'}^{l}\right\| L_{+} \left\|{}_{m}^{l}\right\rangle=\sqrt{\left(l+m^{\prime}\right)(l-m)}$	Use methods similar to those described in Problem 12 to construct the radial wave-
gilmore-lie-groups_F02758	269	1.000	`\delta_{m^{\prime}, m+1}`	$\delta_{m^{\prime}, m+1}$	nctions for hydrogenic atoms with extreme orbital angular momentum quantum
gilmore-lie-groups_F02759	269	1.000	`l=N-1`	$l=N-1$	[illegible]
gilmore-lie-groups_F02760	269	0.980	`n=0`	$n=0$	[illegible]
gilmore-lie-groups_F02761	269	0.848	`\mathbf{r}`	$\mathbf{r}$	
gilmore-lie-groups_F02762	270	1.000	`\mathbf{M} \cdot \mathbf{L}=\mathbf{0}`	$\mathbf{M} \cdot \mathbf{L}=\mathbf{0}$	**a.** $\mathbf{M} \cdot$ [illegible]
gilmore-lie-groups_F02763	270	1.000	`\mathbf{M} \cdot \mathbf{M}=(2 \mathbf{L} \cdot \mathbf{L} / m)(\mathbf{p} \cdot \mathbf{p} / 2 m-K / r)+K^{2}`	$\mathbf{M} \cdot \mathbf{M}=(2 \mathbf{L} \cdot \mathbf{L} / m)(\mathbf{p} \cdot \mathbf{p} / 2 m-K / r)+K^{2}$	**b.** $\mathbf{M} \cdot \mathbf{M}=(2 \mathbf{L} \cdot \mathbf{L} / m)(\mathbf{p} \cdot \mathbf{p} / 2 m-K / r)+K$
gilmore-lie-groups_F02764	270	1.000	`\mathbf{M} \cdot \mathbf{r}=\mathbf{L} \cdot \mathbf{L} / m-K r`	$\mathbf{M} \cdot \mathbf{r}=\mathbf{L} \cdot \mathbf{L} / m-K r$	**c.** $\mathbf{M} \cdot \mathbf{r}=\mathbf{L} \cdot \mathbf{L} / m-$
gilmore-lie-groups_F02765	270	0.999	`\mathbf{M} \cdot \mathbf{r}=M r \cos \theta`	$\mathbf{M} \cdot \mathbf{r}=M r \cos \theta$	**d.** $\mathbf{M} \cdot \mathbf{r}=M r$ [illegible]
gilmore-lie-groups_F02766	270	1.000	`r=(\mathbf{L} \cdot \mathbf{L} / m K / 1+(M / K) \cos \theta)`	$r=(\mathbf{L} \cdot \mathbf{L} / m K / 1+(M / K) \cos \theta)$	**e.** $r=(\mathbf{L} \cdot \mathbf{L} / m K / 1+(M / K) \cos$ [illegible] **f.** Compare this result to the stande[illegible]
gilmore-lie-groups_F02767	270	1.000	`L^{2} / m K`	$L^{2} / m K$	[illegible] orbit and $\epsilon=M / K$ is the eccentricity of the orbit.
gilmore-lie-groups_F02768	270	1.000	`\epsilon=M / K`	$\epsilon=M / K$	**g.** Conclude that the Laplace–Runge–Lenz vector is
gilmore-lie-groups_F02769	270	1.000	`\mathbf{A} \cdot \mathbf{A}=\left(-1 / 4 \hbar^{2}\right) \left(\mathbf{L} \cdot \mathbf{L}+\mathbf{M}^{\prime} \cdot \mathbf{M}^{\prime}+\mathbf{M}^{\prime} \cdot \mathbf{L}+\mathbf{L} \cdot \mathbf{M}^{\prime}\right)`	$\mathbf{A} \cdot \mathbf{A}=\left(-1 / 4 \hbar^{2}\right)\left(\mathbf{L} \cdot \mathbf{L}+\mathbf{M}^{\prime} \cdot \mathbf{M}^{\prime}+\mathbf{L} \cdot \mathbf{M}^{\prime}+\mathbf{M}^{\prime} \cdot \mathbf{L}\right)$	has a similar expression. Show that the two expressions are equal since [illegible]
gilmore-lie-groups_F02770	270	1.000	`\mathbf{B} \cdot \mathbf{B}`	$\mathbf{B} \cdot \mathbf{B}$	has a similar expression. Show that the two expressions are equal since [illegible]
gilmore-lie-groups_F02771	270	0.880	`\mathbf{L} \cdot \mathbf{M}=\mathbf{M} \cdot \mathbf{L}=\mathbf{0}`	$\mathbf{L} \cdot \mathbf{M}=\mathbf{M} \cdot \mathbf{L}=\mathbf{0}$	17. Show that the [illegible]
gilmore-lie-groups_F02772	270	1.000	`p_{x}=\mathbf{p} \cdot \mathbf{M} / M`	$p_{x}=\mathbf{p} \cdot \mathbf{M} / M$	Show that circles in R^3 lift to circles in $S^3 \subset R^4$ under the stereographic projection [illegible]
gilmore-lie-groups_F02773	270	1.000	`p_{y}=\mathbf{p} \cdot \mathbf{W} / W`	$p_{y}=\mathbf{p} \cdot \mathbf{W} / W$	Show that circles in R^3 lift to circles in $S^3 \subset R^4$ under the stereographic projection [illegible]
gilmore-lie-groups_F02774	270	1.000	`p_{x}^{2}+\left(p_{y}-a\right)^{2}=r^{2}`	$p_{x}^{2}+\left(p_{y}-a\right)^{2}=r^{2}$	Show that circles in R^3 lift to circles in $S^3 \subset R^4$ under the stereographic projection [illegible]
gilmore-lie-groups_F02775	270	0.900	`0, a`	$0, a$	of Eq. (14.33). Show that circles in S^3 project back down to circles in R^3 under the [illegible]
gilmore-lie-groups_F02776	270	1.000	`x^{a} y^{b} z^{c}`	$x^{a} y^{b} z^{c}$	l in $x_1, x_2, \ldots, x_N$ is obtained by replacing $3 \rightarrow N$ in this expression. This is the
gilmore-lie-groups_F02777	270	0.996	`a+b+c=l`	$a+b+c=l$	*Bose–Einstein counting* statistic.
gilmore-lie-groups_F02778	270	0.996	`N(l, 3)=(l+3-1) / l!(3-1)!`	$N(l, 3)=(l+3-1) / l!(3-1)!$	*Bose–Einstein counting* statistic.
gilmore-lie-groups_F02779	270	0.997	`x_{1}, x_{2}, \ldots, x_{N}`	$x_{1}, x_{2}, \ldots, x_{N}$	degree l. [illegible]
gilmore-lie-groups_F02780	270	0.997	`3 \rightarrow N`	$3 \rightarrow N$	degree l. [illegible]
gilmore-lie-groups_F02781	270	1.000	`r^{l} Y_{m}^{l}(\theta, \phi)`	$r^{l} Y_{m}^{l}(\theta, \phi)$	[illegible] on three variables: $\dim\{Y^l\} = N(l, 3) - N(l-2, 3) = 2l+1$

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gilmore-lie-groups_F02782	270	1.000	`x, y, z`	x, y, z	ference between the number of homogeneous polynomials of degree l and $l-2$ on three variables: dim $\{Y^l\} = N(l,3) - N(l-2,3) = 2l+1$
gilmore-lie-groups_F02783	270	1.000	`l-2`	$l-2$	(Bander and Itzykson, 1966a). Show that the number of spherical harmonics of
gilmore-lie-groups_F02784	270	1.000	`\operatorname{dim}\left\{Y_{m}^{l}\right\}=N(l, 3)-N(l-2,3)=2 l+1`	$\operatorname{dim}\left\{Y_{m}^{l}\right\}=N(l, 3)-N(l-2,3)=2 l+1$	degree n is dim $\{\mathcal{Y}_{lm}^n\} = N(n,4) - N(n-2,4) = (n+1)^2$.
gilmore-lie-groups_F02785	270	0.999	`\operatorname{dim}\left\{\mathcal{Y}_{l m}^{n}\right\}=N(n, 4)-N(n-2,4)=(n+1)^{2}`	$\operatorname{dim}\left\{\mathcal{Y}_{l m}^{n}\right\}=N(n, 4)-N(n-2,4)=(n+1)^{2}$	$\psi(\mathbf{x})_{nlm}$ for $n = 0, 1, 2, l = 0, \ldots, n-1$, and $-l \leq m \leq +l$.
gilmore-lie-groups_F02786	270	0.995	`\psi(\mathbf{x})_{n l m}`	$\psi(\mathbf{x})_{n l m}$	
gilmore-lie-groups_F02787	270	0.995	`n=0,1,2 ; l=0, \ldots, n-1`	$n=0,1,2 ; l=0, \ldots, n-1$	
gilmore-lie-groups_F02788	271	1.000	`\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots`	$\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots$	where a and b are half odd integers. $\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots$. Show homogeneous polynomials satisfy the recu
gilmore-lie-groups_F02789	271	1.000	`N(l, d)=`	$N(l, d)=$	$N(l, d-1) + N(l-1, d)$.
gilmore-lie-groups_F02790	271	1.000	`N(l, d-1)+N(l-1, d)`	$N(l, d-1)+N(l-1, d)$	. Use this result to derive the fo
gilmore-lie-groups_F02791	271	1.000	`S^{n-1}`	S^{n-1}	dim $\mathcal{Y}^l(S^n)$ = dim $\mathcal{Y}^{l-1}(S^n)$ + dim $\mathcal{Y}^l(S^{n-1}$
gilmore-lie-groups_F02792	271	1.000	`(l+1)^{2}=l^{2}+(2 l+1)`	$(l+1)^{2}=l^{2}+(2 l+1)$	is $\mathcal{Y}^0(S^n) = 1 =$ dim $\mathcal{Y}^0(S^n)$. dim $\mathcal{Y}^l(S^n) = \frac{(l+n-2)!}{l!(n-1)!}(2l+n-1)$
gilmore-lie-groups_F02793	271	1.000	`\mathcal{Y}^{0}\left(S^{n}\right)=1=\operatorname{dim}\mathcal{Y}^{0}\left(S^{n}\right)`	$\mathcal{Y}^{0}\left(S^{n}\right)=1=\operatorname{dim}\mathcal{Y}^{0}\left(S^{n}\right)$	. dim $\mathcal{Y}^l(S^n) = \frac{(l+n-2)!}{l!(n-1)!}(2l+n-1)$
gilmore-lie-groups_F02794	271	1.000	`\operatorname{dim} \mathcal{Y}^{l}\left(S^{n}\right)=\frac{(l+n-2)!}{l!(n-1)!}(2 l+n-1)`	$\operatorname{dim}\mathcal{Y}^{l}\left(S^{n}\right)=\frac{(l+n-2)!}{l!(n-1)!}(2 l+n-1)$	**D-dimensional Coulomb problem** In D tion for the Kepler problem is Eq. (14.4) is
gilmore-lie-groups_F02795	271	1.000	`S^{D-1}`	S^{D-1}	operator with eigenvalue $[(l+\alpha)^2 - \alpha^2]$, and α is a quantity that depends on the Lie algebra of $SO(D)$; it is half the sum over all positive roots of the algebra. For
gilmore-lie-groups_F02796	271	1.000	`\mathcal{Y}^{l}\left(S^{D-1}\right)`	$\mathcal{Y}^{l}\left(S^{D-1}\right)$	the Lie algebras of the orthogonal roots the coefficient of the sum that is important is
gilmore-lie-groups_F02797	271	1.000	`-\left[(l+\alpha)^{2}-\alpha^{2}\right]`	$-\left[(l+\alpha)^{2}-\alpha^{2}\right]$	$\alpha = D-2$.
gilmore-lie-groups_F02798	271	0.709	`S O(D)`	$SO(D)$	**a.** Show that $\psi(\mathbf{x}) = (1/r^{(D-1)/2})\mathcal{Y}^l$(angles) is a clever ansatz that reduces the
gilmore-lie-groups_F02799	271	1.000	`\alpha=D-2`	$\alpha=D-2$	case and
gilmore-lie-groups_F02800	271	1.000	`\psi(\mathbf{x})=\left(1 / r^{(D-1) / 2}\right)\mathcal{Y}^{l}`	$\psi(\mathbf{x})=\left(1 / r^{(D-1) / 2}\right)\mathcal{Y}^{l}$	**b.** Show that the only change in Eq. (14.10) is the replacement
gilmore-lie-groups_F02801	272	1.000	`\mathrm{a}-1 / r^{2}`	$\mathrm{a}-1 / r^{2}$	a $-1/r^2$ perturbation. Show that the bound state energy and scattering phase shifts
gilmore-lie-groups_F02802	272	0.999	`l(l+1) \rightarrow l(l+1)-\mu_{l}`	$l(l+1) \rightarrow l(l+1)-\mu_{l}$	are given by the substitution $l(l+1) \to l(l+1) - \mu_l$. Argue that electrons in the s
gilmore-lie-groups_F02803	272	0.999	`s`	s	are given by the substitution $l(l+1) \to l(l+1) - \mu_l$. Argue that electrons in the s
gilmore-lie-groups_F02804	272	0.953	`\mu_{0} \gg \mu_{1}>\cdots`	$\mu_{0} \gg \mu_{1}>\cdots$	a-state electrons, ...) so that $\mu_0 \gg \mu_1 > \cdots$
gilmore-lie-groups_F02805	272	1.000	`L_{i j}=a_{i}^{\dagger} a_{j}-a_{j}^{\dagger} a_{i}=-L_{j i}`	$L_{ij}=a_{i}^{\dagger} a_{j}-a_{j}^{\dagger} a_{i}=-L_{j i}$	**b.** Show that the Lie algebra of its dynamical symmetry g angular momentum operators together with the quadrupole $a_i^\dagger a_j + a_j^\dagger a_i = +Q_{ji}$.
gilmore-lie-groups_F02806	272	1.000	`Q_{i j}=`	$Q_{i j}=$	**c.** Show that one spectrum generating algebra includes the operators **L** and **Q** as well
gilmore-lie-groups_F02807	272	1.000	`a_{i}^{\dagger} a_{j}+a_{j}^{\dagger} a_{i}=+Q_{j i}`	$a_{i}^{\dagger} a_{j}+a_{j}^{\dagger} a_{i}=+Q_{j i}$	**c.** Show that one sp as the single bos

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gilmore-lie-groups_F02808	272	1.000	`\left[a_{i}, a_{j}^{\dagger}\right]=1`	$\left[a_i, a_j^\dagger\right] = 1$	**d.** Show that another spectrum generating algebra consists of the operators **L** and **Q** as
gilmore-lie-groups_F02809	272	1.000	`a_{i} a_{j}`	$a_i a_j$	an invariant, where "parity" is even or odd according to whether the number of excitations in the spectrum is even or odd.
gilmore-lie-groups_F02810	273	0.999	`\mathbf{E}(\mathbf{x}, t), \mathbf{B}(\mathbf{x}, t)`	$\mathbf{E}(\mathbf{x}, t), \mathbf{B}(\mathbf{x}, t)$	In the momentum representation, obtained by taking a Fourier transform
gilmore-lie-groups_F02811	273	0.935	`\mathbf{E}(k), \mathbf{B}(k)`	$\mathbf{E}(k), \mathbf{B}(k)$	each photon momentum state there are only two degrees of freedom,
gilmore-lie-groups_F02812	274	1.000	`\mathbf{E}(\mathbf{x}, t)`	$\mathbf{E}(\mathbf{x}, t)$	The quantum description involves arbitrary superpositions of two helicity compo-
gilmore-lie-groups_F02813	274	1.000	`\mathbf{B}(\mathbf{x}, t)`	$\mathbf{B}(\mathbf{x}, t)$	The quantum description involves arbitrary superpositions of two helicity compo-
gilmore-lie-groups_F02814	274	1.000	`\mathbf{E}(k)`	$\mathbf{E}(k)$	nents for each momentum vector. The helicity states involve an angular momentum
gilmore-lie-groups_F02815	274	1.000	`\mathbf{B}(k)`	$\mathbf{B}(k)$	nents for each momentum vector. The helicity states involve an angular momentum
gilmore-lie-groups_F02816	274	1.000	`k \cdot k=\mathbf{k} \cdot \mathbf{k}-k_{4} k_{4}=0`	$k \cdot k = \mathbf{k} \cdot \mathbf{k} - k_4 k_4 = 0$	nents for each momentum vector. The helicity states involve an angular momentum
gilmore-lie-groups_F02817	274	0.798	`k_{4}`	k_4	aligned along the direction of motion (helicity $+1$ and right-handed polarization)
gilmore-lie-groups_F02818	274	1.000	`j=1`	$j = 1$	terms.
gilmore-lie-groups_F02819	274	1.000	`k \cdot k=0`	$k \cdot k = 0$	
gilmore-lie-groups_F02820	275	0.999	`(x, y, z, i c t)`	(x, y, z, ict)	and S' be related by a homogeneous Lorentz transformation
gilmore-lie-groups_F02821	275	0.999	`(x, y, z, i c t)^{\prime}`	$(x, y, z, ict)'$	and S' be related by a homogeneous Lorentz transformation
gilmore-lie-groups_F02822	275	0.865	`\Lambda`	Λ	
gilmore-lie-groups_F02823	275	1.000	`k \cdot a=\Lambda k \cdot`	$k \cdot a = \Lambda k \cdot$	
gilmore-lie-groups_F02824	275	1.000	`\Lambda a`	Λa	$\left[J_i, J_j\right] = -\epsilon_{ijk} J_k$
gilmore-lie-groups_F02825	275	1.000	`\Lambda \in O(3,1)`	$\Lambda \in O(3,1)$	$\left[J_i, J_j\right] = -\epsilon_{ijk} J_k$
gilmore-lie-groups_F02826	275	0.936	`\mathbf{J}, \mathbf{K}`	$\mathbf{J}, \mathbf{K}$	$\left[J_i, K_j\right] = -\epsilon_{ijk} K_k$
gilmore-lie-groups_F02827	276	0.988	`a=(x, y, z, c t)`	$a = (x, y, z, ct)$	tion can be written as a 5×5 matrix, in terms of the 4-vector $a = (x, y, z, ct)$:
gilmore-lie-groups_F02828	276	0.995	`(\partial / \partial x, \partial / \partial y, \partial / \partial z, i \partial / \partial(c t))`	$(\partial/\partial x, \partial/\partial y, \partial/\partial z, i\partial/\partial(ct))$	
gilmore-lie-groups_F02829	276	1.000	`\{\Lambda, 0\}`	$\{\Lambda, 0\}$	
gilmore-lie-groups_F02830	276	1.000	`\{I, a\}`	$\{I, a\}$	
gilmore-lie-groups_F02831	276	1.000	`\Gamma^{k}`	Γ^k	Physically, k has a natural interpretation as the four momentum of the photon
gilmore-lie-groups_F02832	276	1.000	`|k\rangle`	$\|k\rangle$	
gilmore-lie-groups_F02833	277	1.000	`D_{2}=A_{1}+A_{1}`	$D_2 = A_1 + A_1$	The Lie algebra $D_2 = A_1 + A_1$ is semisimple: it is the direct sum of two simple
gilmore-lie-groups_F02834	277	1.000	`\mathbf{J}^{(1)}`	$\mathbf{J}^{(1)}$	can be expressed in a $(2j+1)(2j'+1)$ dimensional representation $D^{jj'}$ as follows

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gilmore-lie-groups_F02835	277	1.000	`D^{j}`	D^{j}	can be expressed in a $(2j+1)(2j'+1)$ dimensional representation $D^{jj'}$ as follows
gilmore-lie-groups_F02836	277	1.000	`\mathbf{J}^{(2)}`	$\mathbf{J}^{(2)}$	can be expressed in a $(2j+1)(2j'+1)$ dimensional representation $D^{jj'}$ as follows
gilmore-lie-groups_F02837	277	0.970	`2 j^{\prime}+1`	$2j'+1$	[illegible]
gilmore-lie-groups_F02838	277	0.970	`D^{j^{\prime}}`	$D^{j'}$	[illegible]
gilmore-lie-groups_F02839	277	1.000	`(2 j+1)\left(2 j^{\prime}+1\right)`	$(2j+1)\left(2j'+1\right)$	[illegible]
gilmore-lie-groups_F02840	277	1.000	`D^{j j^{\prime}}`	$D^{jj'}$	[illegible]
gilmore-lie-groups_F02841	278	1.000	`\mathbf{J}^{(j)}`	$\mathbf{J}^{(j)}$	where $\mathbf{J}^{(j)}$ are the three $(2j+1)\times(2j+1)$ angular momentum matrices. The
gilmore-lie-groups_F02842	278	0.990	`D^{j j^{\prime}}(\Lambda)`	$D^{jj'}(\Lambda)$	puted
gilmore-lie-groups_F02843	278	1.000	`S O(3) \subset S O(3,1)`	$SO(3) \subset SO(3,1)$	[illegible]
gilmore-lie-groups_F02844	278	1.000	`j^{\prime}=0`	$j'=0$	**15.4 Representations of the Poincaré grou**
gilmore-lie-groups_F02845	278	1.000	`j=0`	$j=0$	**15.4 Representations of the Poincaré grou**
gilmore-lie-groups_F02846	278	1.000	`T_{\mu \nu}(x)`	$T_{\mu\nu}(x)$	That is, the field components obviously form a basis on which the Lorentz transfor-
gilmore-lie-groups_F02847	278	1.000	`\Lambda \in S O(3,1)`	$\Lambda \in SO(3,1)$	mation acts. The point at which the transformation acts is fixed, but sin
gilmore-lie-groups_F02848	278	1.000	`x^{\prime}=x \Lambda^{-1}`	$x'=x\Lambda^{-1}$	
gilmore-lie-groups_F02849	279	0.774	`\left|\begin{array}{cc}j & j^{\prime} \\ \mu & \mu^{\prime}\end{array}\right\rangle`	$\left\|\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\rangle$	We define the
gilmore-lie-groups_F02850	280	0.815	`\left.\begin{array}{cc}j & j^{\prime} \\ \mu & \mu^{\prime}\end{array}\right\}`	$\left.\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\}$	$\begin{array}{c\|c\|c} & \|k\rangle & \left\|\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\rangle \\ \hline \{I,a\} & \|k\rangle e^{ik\cdot a} & \left\|\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle \delta_{\nu\nu';\mu\mu'} \\ \{\Lambda,0\} & \|\Lambda k\rangle & \left\|\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle D^{jj'}_{\nu\nu';\mu\mu'}(\Lambda) \end{array}$
gilmore-lie-groups_F02851	280	0.815	`|k\rangle e^{i k \cdot a}`	$\|k\rangle e^{ik\cdot a}$	$\begin{array}{c\|c\|c} & \|k\rangle & \left\|\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\rangle \\ \hline \{I,a\} & \|k\rangle e^{ik\cdot a} & \left\|\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle \delta_{\nu\nu';\mu\mu'} \\ \{\Lambda,0\} & \|\Lambda k\rangle & \left\|\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle D^{jj'}_{\nu\nu';\mu\mu'}(\Lambda) \end{array}$

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gilmore-lie-groups_F02852	280	0.815	`\left.\begin{array}{cc}j & j^{\prime} \\ v & v^{\prime} \end{array}\right\rangle_{v v^{\prime} ; \mu \mu^{ \prime}}`	$\left.\begin{array}{cc}j & j^{\prime} \\ v & v^{\prime}\end{array}\right\rangle_{vv':\mu\mu'}$	$\begin{array}{c\|c\|c} & \|k\rangle & \left.\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\rangle \\ \hline \{I,a\} & \|k\rangle e^{ik\cdot a} & \left.\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle \delta_{\nu\nu':\mu\mu'} \\ \{\Lambda,0\} & \|\Lambda k\rangle & \left.\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle D^{jj'}_{\nu\nu':\mu\mu'}(\Lambda) \end{array}$
gilmore-lie-groups_F02853	280	0.815	`|\Lambda k\rangle`	$\|\Lambda k\rangle$	$\begin{array}{c\|c\|c} & \|k\rangle & \left.\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\rangle \\ \hline \{I,a\} & \|k\rangle e^{ik\cdot a} & \left.\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle \delta_{\nu\nu':\mu\mu'} \\ \{\Lambda,0\} & \|\Lambda k\rangle & \left.\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle D^{jj'}_{\nu\nu':\mu\mu'}(\Lambda) \end{array}$
gilmore-lie-groups_F02854	280	0.815	`\left.\begin{array}{cc}j & j^{\prime} \\ v & v^{\prime} \end{array}\right\rangle D_{v v^{\prime} ; \mu \mu^{ \prime}}^{j j^{\prime}}(\Lambda)`	$\left.\begin{array}{cc}j & j^{\prime} \\ v & v^{\prime}\end{array}\right\rangle D^{jj'}_{vv':\mu\mu'}(\Lambda)$	$\begin{array}{c\|c\|c} & \|k\rangle & \left.\begin{array}{cc}j & j' \\ \mu & \mu'\end{array}\right\rangle \\ \hline \{I,a\} & \|k\rangle e^{ik\cdot a} & \left.\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle \delta_{\nu\nu':\mu\mu'} \\ \{\Lambda,0\} & \|\Lambda k\rangle & \left.\begin{array}{cc}j & j' \\ \nu & \nu'\end{array}\right\rangle D^{jj'}_{\nu\nu':\mu\mu'}(\Lambda) \end{array}$
gilmore-lie-groups_F02855	280	1.000	`\{\Lambda, a\}`	$\{\Lambda, a\}$	der restriction to the subgroup $\{I, a\}$ this reduces to a direct sum of irreducibles $\Gamma^k(\{I, a\})$ of $\{I, a\}$. The basis states are $\|k; \xi\rangle$, where k is defined by the action of
gilmore-lie-groups_F02856	280	1.000	`\Gamma^{k}(\{I, a\})`	$\Gamma^k(\{I, a\})$	the translation $\{I, a\}$
gilmore-lie-groups_F02857	280	1.000	`|k ; \xi\rangle`	$\|k; \xi\rangle$	the translation $\{I, a\}$
gilmore-lie-groups_F02858	280	1.000	`\xi`	ξ	subspace of states parameterized by $k' = \Lambda k$
gilmore-lie-groups_F02859	280	0.999	`k^{\prime}=\Lambda k`	$k' = \Lambda k$	$\{I, a\}\{\Lambda, 0\}\|k; \xi\rangle = \{I$
gilmore-lie-groups_F02860	280	1.000	`M_{\xi^{\prime} \xi}(\Lambda)`	$M_{\xi'\xi}(\Lambda)$	
gilmore-lie-groups_F02861	280	1.000	`k^{\prime}`	k'	
gilmore-lie-groups_F02862	281	1.000	`M(\Lambda)`	$M(\Lambda)$	are present also. To construct the matrix $M(\Lambda)$, we choose one particular four-vector
gilmore-lie-groups_F02863	281	1.000	`k^{0}`	k^0	k^0 for each of the possible cases
gilmore-lie-groups_F02864	281	1.000	`\left|k^{0} ; \xi\right\rangle`	$\left\|k^0; \xi\right\rangle$	ermined by writing each Λ as a product of two group operations
gilmore-lie-groups_F02865	281	0.822	`H_{k^{0}}`	H_{k^0}	$C_k k^0 = k = \Lambda k^0$ (15.34)
gilmore-lie-groups_F02866	281	0.822	`C_{k}`	C_k	$C_k k^0 = k = \Lambda k^0$ (15.34)
gilmore-lie-groups_F02867	282	1.000	`\theta_{1}=\theta_{2}=b_{3}=0, \theta_{3}, b_{1}, b_{2}`	$\theta_1 = \theta_2 = b_3 = 0, \theta_3, b_1, b_2$	The subalgebra leaving k^0 fixed is defined by $\theta_1 = \theta_2 = b_3 = 0$, θ_3, b_1, b_2 arbi-
gilmore-lie-groups_F02868	282	1.000	`(0,0,1,-i)=T(0,0,1,+i)`	$(0, 0, 1, -i) = T(0, 0, 1, +i)$	

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gilmore-lie-groups_F02869	282	1.000	`Y_{1}=J_{1}-K_{2}, Y_{2}=`	$Y_1 = J_1 - K_2, Y_2 =$	
gilmore-lie-groups_F02870	282	1.000	`J_{2}+K_{1}, Y_{3}=J_{3}`	$J_2 + K_1, Y_3 = J_3$	
gilmore-lie-groups_F02871	282	1.000	`\mathbf{b}=0`	$\mathbf{b} = 0$	
gilmore-lie-groups_F02872	283	1.000	`D_{\xi^{\prime} \xi}\left(H_{k^{0}}\right)`	$D_{\xi'\xi}\left(H_{k^0}\right)$	and irreducible. The cases (i)–(iv) are discussed here
gilmore-lie-groups_F02873	283	0.999	`k \cdot k>0`	$k \cdot k > 0$	**Case (ii)** See below
gilmore-lie-groups_F02874	283	1.000	`j=0, \frac{1}{2}, 1, \frac{3}{2}, \ldots`	$j = 0, \frac{1}{2}, 1, \frac{3}{2}, \ldots$	**Case (iv)** The unitary irreducible representations of $SO(3,1)$ are known but not
gilmore-lie-groups_F02875	283	1.000	`\kappa=\left(\kappa_{1}, \kappa_{2}\right)`	$\kappa = (\kappa_1, \kappa_2)$	As before, two cases occur (cf., Cases (i) or (iii) and Case (iv) above):
gilmore-lie-groups_F02876	283	1.000	`\kappa \in R^{2}, \kappa \cdot \kappa \geq 0`	$\kappa \in R^2, \kappa \cdot \kappa \geq 0$	(i) $\kappa \cdot \kappa > 0$ little group = Identity
gilmore-lie-groups_F02877	283	1.000	`|\kappa\rangle`	$\|\kappa\rangle$	(i) $\kappa \cdot \kappa > 0$ little group = Identity
gilmore-lie-groups_F02878	283	0.999	`\left|\kappa^{\prime}\right\rangle`	$\left\|\kappa'\right\rangle$	(ii) $\kappa \cdot \kappa = 0$ little group = $ISO(2)$ (15.43)
gilmore-lie-groups_F02879	283	0.999	`\kappa^{\prime} \cdot \kappa^{\prime}=\kappa \cdot \kappa`	$\kappa' \cdot \kappa' = \kappa \cdot \kappa$	(ii) $\kappa \cdot \kappa = 0$ little group = $ISO(2)$ (15.43)
gilmore-lie-groups_F02880	283	0.999	`\kappa^{\prime}=\left(\kappa_{1}^{\prime}, \kappa_{2}^{ \prime}\right)`	$\kappa' = (\kappa_1', \kappa_2')$	(ii) $\kappa \cdot \kappa = 0$ little group = $ISO(2)$ (15.43)
gilmore-lie-groups_F02881	283	1.000	`\kappa^{\prime}=R(\theta) \kappa`	$\kappa' = R(\theta)\kappa$	
gilmore-lie-groups_F02882	283	1.000	`\kappa \cdot \kappa`	$\kappa \cdot \kappa$	
gilmore-lie-groups_F02883	283	0.999	`\kappa \cdot \kappa>0 \quad`	$\kappa \cdot \kappa > 0$	
gilmore-lie-groups_F02884	283	0.996	`\kappa \cdot \kappa=0 \quad`	$\kappa \cdot \kappa = 0$	
gilmore-lie-groups_F02885	283	0.996	`=I S O(2)`	$= ISO(2)$	
gilmore-lie-groups_F02886	284	1.000	`\kappa^{2}`	κ^2	The first case presents us with two problems. First, κ^2 is a continuous quantum
gilmore-lie-groups_F02887	284	1.000	`\kappa^{2}>0`	$\kappa^2 > 0$	$\kappa^2 > 0$ there must be an infinite number of states with this same continuous index,
gilmore-lie-groups_F02888	284	1.000	`\kappa=0`	$\kappa = 0$	for each four-momentum value. Therefore we require $\kappa = 0$. This leaves us with the
gilmore-lie-groups_F02889	284	0.961	`\left(Y_{1} \rightarrow 0, Y_{2} \rightarrow 0\right)`	$(Y_1 \rightarrow 0, Y_2 \rightarrow 0)$	following physically allowable representations of the little group $(Y_1 \rightarrow 0, Y_2 \rightarrow 0)$
gilmore-lie-groups_F02890	284	1.000	`\left(j, j^{\prime}\right)`	(j, j')	To compare these two ways of describing a massless particle we compare
gilmore-lie-groups_F02891	285	1.000	`\left\{H_{k^{0}}, 0\right\}`	$\{H_{k^0}, 0\}$	**A.** $\{H_{k^0}, 0\}$ **on** $\|k^0; \xi\rangle$
gilmore-lie-groups_F02892	285	1.000	`H_{k^{0}}=\operatorname{EXP}\left(\Theta J_{3}+\theta_{1} Y_{1}+\theta_{2} Y_{2}\right)`	$H_{k^0} = \mathrm{EXP}\left(\Theta J_3 + \theta_1 Y_1 + \theta_2 Y_2\right)$	where $H_{k^0} = \mathrm{EXP}(\Theta J_3 + \theta_1 Y_1 + \theta_2 Y_2)$.
gilmore-lie-groups_F02893	285	0.494	`\left.\left|k^{0}\right\rangle\right|_{\mu} ^{j} \underset{\mu^{\prime}}{j^{\prime}}\right\rangle`	$\left.\left\|k^0\right\rangle\right\|_{\mu}^{j} \underset{\mu'}{j'}\Big\rangle$	**B.** $\{H_{k^0}, 0\}$ **on** $\|k^0; \xi\rangle_{\mu\,\mu'}$ The little group maps k^0 to k^0 but acts in a nontrivial way on the spin states
gilmore-lie-groups_F02894	285	0.119	`\left|k^{0}\right\rangle\left|\begin{array}{ll}j_{0}^{0} & 0 \\ j^{0}\end{array}\right\rangle`	$\left\|k^0\right\rangle \left\|\begin{array}{ll} j_0^0 & 0 \\ j^0 \end{array}\right\rangle$	

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gilmore-lie-groups_F02895	285	0.119	`\xi>0`	$\xi > 0$	
gilmore-lie-groups_F02896	285	0.119	`j=+\xi`	$j = +\xi$	
gilmore-lie-groups_F02897	285	0.983	`\left|k^{0}\right\rangle\left|\begin{array}{cc}0 & j^{\prime} \\ 0 & -j^{\prime}\end{array}\right\rangle`	$\left\|k^{0}\right\rangle\left\|\begin{array}{cc}0 & j^{\prime} \\ 0 & -j^{\prime}\end{array}\right\rangle$	
gilmore-lie-groups_F02898	285	0.983	`\xi<0`	$\xi < 0$	
gilmore-lie-groups_F02899	285	0.983	`j^{\prime}=-\xi`	$j^{\prime} = -\xi$	
gilmore-lie-groups_F02900	286	0.560	`|k\rangle\left|\begin{array}{cc}j & j^{\prime} \\ \mu & \mu^{\prime}\end{array}\right\rangle`	$\left\|k\right\rangle\left\|\begin{array}{cc}j & j^{\prime} \\ \mu & \mu^{\prime}\end{array}\right\rangle$	basis states $\|k;\xi\rangle$ or the direct product states $\|k\rangle\|{}^{j\ j'}_{\mu\ \mu'}$.
gilmore-lie-groups_F02901	286	1.000	`\langle k ; \xi \mid \psi\rangle`	$\langle k;\xi \mid \psi\rangle$	case and $\langle k;{}^{j\ j'}_{\mu\ \mu'}\|\psi\rangle$ in the second. In both cases the sum extends over all k vectors
gilmore-lie-groups_F02902	286	0.741	`\left\langle k ;{ }_{\mu}^{j} j^{\prime} \mid \psi\right\rangle`	$\left\langle k;{}^{j}_{\mu}j^{\prime} \mid \psi\right\rangle$	for which $\Lambda k \cdot \Lambda k = 0, k \neq 0$. In the first case the sum extends over the appropriate
gilmore-lie-groups_F02903	286	1.000	`\Lambda k \cdot \Lambda k=0, k \neq 0`	$\Lambda k \cdot \Lambda k = 0, k \neq 0$	helicity states ξ ($\xi = \pm 1$ for photons). In the second case the sum extends over the
gilmore-lie-groups_F02904	286	1.000	`\xi= \pm 1`	$\xi = \pm 1$	appropriate values of μ, μ' : $-j \leq \mu \leq +j,\ -j' \leq \mu' \leq +j'$.
gilmore-lie-groups_F02905	286	0.712	`\mu, \mu^{\prime}:-j \leq \mu \leq+j,-j^{\prime} \leq \mu^{\prime} \leq+j^{\prime}`	$\mu, \mu' : -j \leq \mu \leq +j, -j' \leq \mu' \leq +j'$	We discuss the positive helicity state $\xi = j > 0$ first. The amp
gilmore-lie-groups_F02906	286	1.000	`\xi=j>0`	$\xi = j > 0$	of the state $\|k^0; j\rangle$ in any physical state $\|\psi\rangle$ may be arbitrary. This is simply the amplitude of the massless particle of helicity j in the state $\|k\rangle$. The amplitude
gilmore-lie-groups_F02907	286	1.000	`\left\langle k^{0} ; j \mid \psi\right\rangle`	$\left\langle k^{0}; j \mid \psi\right\rangle$	of the state $\|k^0; j\rangle$ in any physical state $\|\psi\rangle$ may be arbitrary. This is simply the amplitude of the massless particle of helicity j in the state $\|k\rangle$. The amplitude
gilmore-lie-groups_F02908	286	1.000	`\left|k^{0} ; j\right\rangle`	$\left\|k^{0}; j\right\rangle$	amplitude of the massless particle of helicity j in the state $\|\psi\rangle$. The amplitude $\langle k^0; {}^{j\ 0}_{m\ 0}\|\psi\rangle$ in the same physical state $\|\psi\rangle$ is the same. The amplitudes of the
gilmore-lie-groups_F02909	286	0.993	`\left\langle k^{0} ;{ }_{j}^{j}{ }_{0}^{0} \mid \psi \right\rangle`	$\left\langle k^{0}; {}^{j\,0}_{j\,0} \mid \psi\right\rangle$	allowed in the manifestly covariant representation but not present in the Hilbert
gilmore-lie-groups_F02910	286	0.999	`\left\langle k^{0} ;{ }_{m}^{j}{ }_{0}^{0} \mid \psi \right\rangle, m \neq j`	$\left\langle k^{0}; {}^{j\ 0}_{m\,0} \mid \psi\right\rangle, m \neq j$	space that carries the unitary irreducible representation. A simple linear way to
gilmore-lie-groups_F02911	286	0.719	`\{\cdot\}`	$\{\cdot\}$	are absent in the description of a physical state ($m \neq j$) must vanish.
gilmore-lie-groups_F02912	286	0.719	`(j-j) k_{3}^{0}=0`	$(j-j)k_3^0 = 0$	are absent in the description of a physical state ($m \neq j$) must vanish.
gilmore-lie-groups_F02913	286	0.999	`(m-j) k_{3}^{0}`	$(m-j)k_3^0$	For the negative helicity states $\xi = -j$ we have by a completely similar argument
gilmore-lie-groups_F02914	286	1.000	`\left\langle k^{0} ;{ }_{m}^{j}{ }_{0}^{0} \mid \psi \right\rangle`	$\left\langle k^{0}; {}^{j\ 0}_{m\,0} \mid \psi\right\rangle$	[illegible]
gilmore-lie-groups_F02915	286	1.000	`(m-j) k_{3}^{0} \neq 0`	$(m-j)k_3^0 \neq 0$	[illegible]
gilmore-lie-groups_F02916	286	0.961	`m \neq j`	$m \neq j$	$\left\{J_3^{\prime\prime} k_3^{\prime} + j k_4^{\prime} I_{2j+1}\right\}\left\langle k^{\prime}; {}^{j}_{0\ m'} \middle\| \psi\right\rangle = 0$
gilmore-lie-groups_F02917	286	1.000	`\xi=-j`	$\xi = -j$	[illegible]
gilmore-lie-groups_F02918	286	0.556	`\left|k^{0}\right\rangle\left|\begin{array}{cc}j & j^{\prime} \\ \mu & \mu^{\prime}\end{array}\right\rangle`	$\left\|k^{0}\right\rangle\left\|\begin{array}{cc}j & j^{\prime} \\ \mu & \mu^{\prime}\end{array}\right\rangle$	

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gilmore-lie-groups_F02919	286	0.556	`\left.\left.|k\rangle\right|_{v} ^{j} \begin{array}{cc}j^{\prime} \\ v^{\prime}\end{array} \right\rangle`	$\left\|k\right\rangle\left\|_{v}^{j} \begin{array}{cc}j^{\prime} \\ v^{\prime}\end{array} \right\rangle$	
gilmore-lie-groups_F02920	287	0.847	`\left\langle k ;{ }_{\mu}^{j}{ }_{\mu^{\prime}}^{j^{\prime}} \mid \psi\right\rangle`	$\left\langle k ;{ }_{\mu}^{j}{ }_{\mu^{\prime}}^{j^{\prime}} \mid \psi\right\rangle$	The condition on the amplitude $\langle k ;{ }_{\mu}^{j}{ }_{\mu^{\prime}}^{j^{\prime}} \|\psi\rangle$ in the subspace $\|k\rangle$ is related to the
gilmore-lie-groups_F02921	287	1.000	`\left|k^{0}\right\rangle`	$\left\|k^{0}\right\rangle$	conditions (15.54) and (15.55) in the subspace $\|k^{0}\rangle$ by a similarity transformation
gilmore-lie-groups_F02922	287	1.000	`\xi=j`	$\xi=j$	(15.54). The coset representative may be taken as the product of a boost in the
gilmore-lie-groups_F02923	287	1.000	`M^{j j^{\prime}}\left(k^{0}\right)=M^{j 0}\left(k^{0}\right)`	$M^{j j^{\prime}}\left(k^{0}\right)=M^{j 0}\left(k^{0}\right)$	(15.54). The coset representative may be taken as the product of a boost in the
gilmore-lie-groups_F02924	287	0.943	`|k\rangle\left|\begin{array}{ll}1 & 0 \\ \mu & 0 \end{array}\right\rangle`	$\left\|k\right\rangle\left\|\begin{array}{ll}1 & 0 \\ \mu & 0 \end{array}\right\rangle$	$\{\mathbf{J} \cdot \mathbf{k}+1 k_{4} I_{3}\}\left\langle k ;{ }_{\mu}^{0}{}_{0}^{1}\right\|\psi\rangle=0$ (15.62)
gilmore-lie-groups_F02925	287	1.000	`\langle x \mid k\rangle\left\langle k ;{ }_{m}^{j}{ }_{0}^{0} \mid \psi\right\rangle`	$\langle x \mid k\rangle\left\langle k ;{ }_{m}^{j}{ }_{0}^{0} \mid \psi\right\rangle$	
gilmore-lie-groups_F02926	287	1.000	`\psi_{j m}(x),(j=1, m=+1,0,-1`	$\psi_{j m}(x),(j=1, m=+1,0,-1$	
gilmore-lie-groups_F02927	288	1.000	`D^{01}`	D^{01}	–
gilmore-lie-groups_F02928	289	0.999	`k^{0}=(0,0,1, i)`	$k^{0}=(0,0,1, i)$	vanishing component of the boosted field is orthogonal to the spacial part of the **k** vector: $\mathbf{k} \cdot \mathbf{v}(\mathbf{k})=0$. Backtransforming from the Fourier to the spacial representation
gilmore-lie-groups_F02929	289	0.999	`\left\langle k ;{ }_{m}^{j=1}{ }_{0}^{0} \mid \psi\right\rangle`	$\left\langle k ;{ }_{m}^{j=1}{ }_{0}^{0} \mid \psi\right\rangle$	vanishing component of the boosted field is orthogonal to the spacial part of the **k** vector: $\mathbf{k} \cdot \mathbf{v}(\mathbf{k})=0$. Backtransforming from the Fourier to the spacial representation
gilmore-lie-groups_F02930	289	1.000	`m=+1`	$m=+1$	vector: $\mathbf{k} \cdot \mathbf{v}(\mathbf{k})=0$. Backtransforming from the Fourier to the spacial representation,
gilmore-lie-groups_F02931	289	1.000	`-\left(v_{x}+i v_{y}\right)`	$-\left(v_{x}+i v_{y}\right)$	vector: $\mathbf{k} \cdot \mathbf{v}(\mathbf{k})=0$. Backtransforming from the Fourier to the spacial representation,
gilmore-lie-groups_F02932	289	1.000	`\mathbf{v}=\left(v_{x}, v_{y}, 0\right)`	$\mathbf{v}=\left(v_{x}, v_{y}, 0\right)$	
gilmore-lie-groups_F02933	289	1.000	`\mathbf{k}^{0}=(0,0,1): \mathbf{k}^{0} \cdot \mathbf{v}=0`	$\mathbf{k}^{0}=(0,0,1): \mathbf{k}^{0} \cdot \mathbf{v}=0$	
gilmore-lie-groups_F02934	289	1.000	`B_{z}`	B_{z}	
gilmore-lie-groups_F02935	289	0.976	`\mathbf{k}`	$\mathbf{k}$	
gilmore-lie-groups_F02936	289	1.000	`\mathbf{k} \cdot \mathbf{v}(\mathbf{k})=0`	$\mathbf{k} \cdot \mathbf{v}(\mathbf{k})=0$	
gilmore-lie-groups_F02937	290	0.999	`\nabla \cdot \mathbf{E}=0`	$\nabla \cdot \mathbf{E}=0$	equations $\nabla \cdot \mathbf{E}=0$ and $\nabla \cdot \mathbf{B}=0$. Show th
gilmore-lie-groups_F02938	290	0.999	`\nabla \cdot \mathbf{B}=0`	$\nabla \cdot \mathbf{B}=0$	equations $\nabla \cdot \mathbf{E}=0$ and $\nabla \cdot \mathbf{B}=0$. Show th
gilmore-lie-groups_F02939	290	1.000	`\mathbf{x}(j)`	$\mathbf{x}(j)$	electric charge e_i and magnetic charge m_i, the electric and magnetic charge densities
gilmore-lie-groups_F02940	290	1.000	`e_{j}`	e_{j}	and current densities are defined as follows.
gilmore-lie-groups_F02941	290	1.000	`m_{j}`	m_{j}	and current densities are defined as follows.

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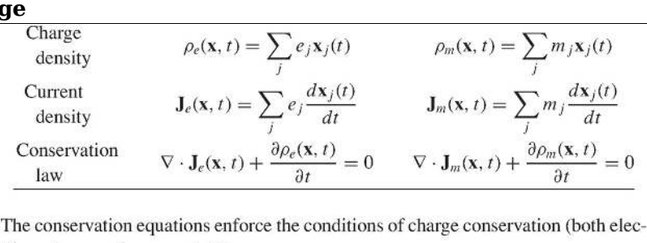
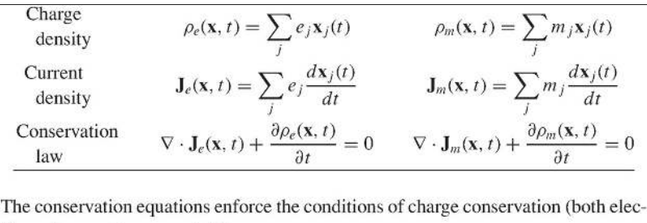
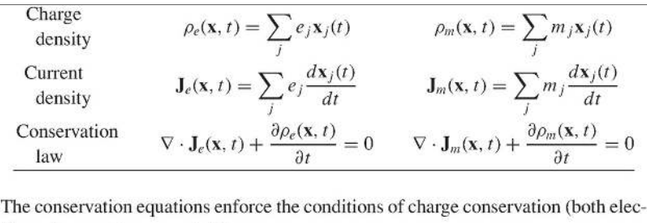
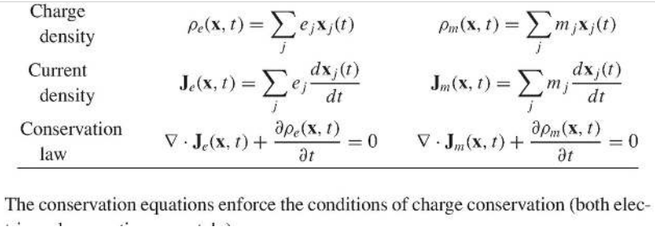
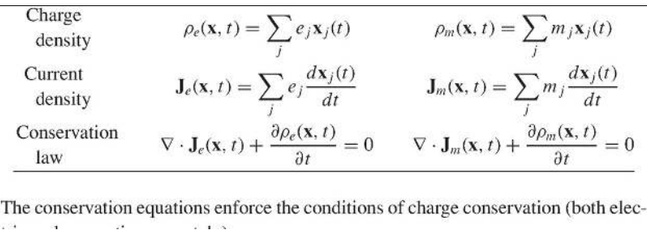
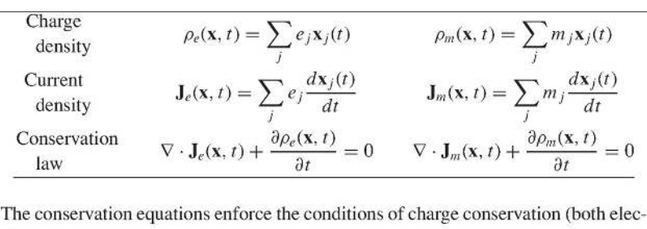
gilmore-lie-groups_F02942	290	■ 1.000	`\rho_{e}(\mathbf{x}, t)=\sum_{j} e_{j} \mathbf{x}_{j}(t)`	$\rho_e(\mathbf{x}, t) = \sum_j e_j \mathbf{x}_j(t)$	
gilmore-lie-groups_F02943	290	■ 1.000	`\rho_{m}(\mathbf{x}, t)=\sum_{j} m_{j} \mathbf{x}_{j}(t)`	$\rho_m(\mathbf{x}, t) = \sum_j m_j \mathbf{x}_j(t)$	
gilmore-lie-groups_F02944	290	■ 1.000	`\mathbf{J}_{e}(\mathbf{x}, t)=\sum_{j} e_{j} \frac{d \mathbf{x}_{j}(t)}{d t}`	$\mathbf{J}_e(\mathbf{x}, t) = \sum_j e_j \frac{d\mathbf{x}_j(t)}{dt}$	
gilmore-lie-groups_F02945	290	■ 1.000	`\mathbf{J}_{m}(\mathbf{x}, t)=\sum_{j} m_{j} \frac{d \mathbf{x}_{j}(t)}{d t}`	$\mathbf{J}_m(\mathbf{x}, t) = \sum_j m_j \frac{d\mathbf{x}_j(t)}{dt}$	
gilmore-lie-groups_F02946	290	■ 1.000	`\nabla \cdot \mathbf{J}_{e}(\mathbf{x}, t)+\frac{\partial \rho_{e}(\mathbf{x}, t)}{\partial t}=0`	$\nabla \cdot \mathbf{J}_e(\mathbf{x}, t) + \frac{\partial \rho_e(\mathbf{x}, t)}{\partial t} = 0$	
gilmore-lie-groups_F02947	290	■ 1.000	`\nabla \cdot \mathbf{J}_{m}(\mathbf{x}, t)+\frac{\partial \rho_{m}(\mathbf{x}, t)}{\partial t}=0`	$\nabla \cdot \mathbf{J}_m(\mathbf{x}, t) + \frac{\partial \rho_m(\mathbf{x}, t)}{\partial t} = 0$	

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gilmore-lie-groups_F02948	290	0.997	`T, P, T P`	T, P, TP	
gilmore-lie-groups_F02949	290	1.000	`1 / c`	$1/c$	$\nabla \times \mathbf{B} - \frac{1}{c}\frac{\partial \mathbf{E}}{\partial}$ $= +\frac{4\pi}{}\mathbf{J}_e$
gilmore-lie-groups_F02950	291	0.867	`\phi=\pi / 2`	$\phi = \pi/2$	In particular, show that for $\phi = \pi/2$ this is the dual transformation $(\mathbf{B}, \mathbf{E}) \rightarrow$
gilmore-lie-groups_F02951	291	0.867	`(\mathbf{B}, \mathbf{E}) \rightarrow`	$(\mathbf{B}, \mathbf{E}) \rightarrow$	In particular, show that for $\phi = \pi/2$ this is the dual transformation $(\mathbf{B}, \mathbf{E}) \rightarrow$
gilmore-lie-groups_F02952	291	1.000	`(*)=0`	$(*) = 0$	$(*) = 0$, for $*$ = anyvector. Show
gilmore-lie-groups_F02953	291	1.000	`*=`	$* =$	$(*) = 0$, for $*$ = anyvector. Show
gilmore-lie-groups_F02954	291	0.998	`D^{j j^{\prime}+j^{\prime} j}(\Lambda)`	$D^{jj'+j'j}(\Lambda)$	the gravitational wave equations in free space are
gilmore-lie-groups_F02955	291	0.998	`j-j^{\prime}= \pm 2`	$j - j' = \pm 2$	the gravitational wave equations in free space are
gilmore-lie-groups_F02956	291	0.998	`\left(j, j^{\prime}\right)=(2,0)`	$(j, j') = (2, 0)$	the gravitational wave equations in free space are
gilmore-lie-groups_F02957	291	0.990	`\mathbf{G}_{\mathbf{e}}`	$\mathbf{G_e}$	$\begin{bmatrix} 0 & 0 & \sqrt{4}\partial & 0 & 0 & 0 \end{bmatrix}$
gilmore-lie-groups_F02958	291	0.990	`\mathbf{G}_{\mathbf{m}}`	$\mathbf{G_m}$	$\begin{bmatrix} 0 & 0 & \sqrt{4}\partial & 0 & 0 & 0 \end{bmatrix}$
gilmore-lie-groups_F02959	291	0.866	`\mathbf{J} \cdot \nabla`	$\mathbf{J} \cdot \nabla$	$\begin{vmatrix} 0 & 0 & \sqrt{6}\partial_- & -1\partial_0 & \sqrt{4}\partial_+ \end{vmatrix}$
gilmore-lie-groups_F02960	292	1.000	`F_{i j}=F_{j i}, \sum_{i} F_{i i}=0`	$F_{ij} = F_{ji}, \sum_i F_{ii} = 0$	4. Follow the outline of Problem 2 to show the following
gilmore-lie-groups_F02961	292	1.000	`\partial^{i} F_{i j}=0`	$\partial^i F_{ij} = 0$	4. Follow the outline of Problem 2 to show the following
gilmore-lie-groups_F02962	292	0.999	`U_{i j}=\sum_{k} m_{k}\left(\mathbf{x}_{k}(t) \mathbf{x}_{k}(t)\right)_{i j}`	$U_{ij} = \sum_k m_k \left(\mathbf{x}_k(t)\mathbf{x}_k(t)\right)_{ij}$	**c.** The coupled equations are invariant under a gauge transformation of the first
gilmore-lie-groups_F02963	292	0.999	`\mathbf{G}_{\mathbf{m}}+i \mathbf{G}_{\mathbf{e}} \rightarrow e^{i \phi}\left(\mathbf{G}_{\mathbf{m}}+i \mathbf{G}_{\mathbf{e}}\right)`	$\mathbf{G_m} + i\mathbf{G_e} \rightarrow e^{i\phi}\left(\mathbf{G_m} + i\mathbf{G_e}\right)$	$(J, M) = (0, 0), (1, 0), (1, \pm 1), (2, 0), (2 \pm 1)$. What are these equations in th
gilmore-lie-groups_F02964	292	0.999	`\mathbf{J}_{\mathbf{m}}+i \mathbf{J}_{\mathbf{e}} \rightarrow e^{i \phi}\left(\mathbf{J}_{\mathbf{m}}+i \mathbf{J}_{\mathbf{e}}\right)`	$\mathbf{J_m} + i\mathbf{J_e} \rightarrow e^{i\phi}\left(\mathbf{J_m} + i\mathbf{J_e}\right)$	$(J, M) = (0, 0), (1, 0), (1, \pm 1), (2, 0), (2 \pm 1)$. What are these equations in th
gilmore-lie-groups_F02965	292	1.000	`D^{j j}(\Lambda)`	$D^{jj}(\Lambda)$	
gilmore-lie-groups_F02966	292	0.871	`(J, M)`	(J, M)	
gilmore-lie-groups_F02967	292	1.000	`(J, M)=(0,0),(1,0),(1, \pm 1),(2,0),(2 \pm 1)`	$(J, M) = (0, 0), (1, 0), (1, \pm 1), (2, 0), (2 \pm 1)$	
gilmore-lie-groups_F02968	293	1.000	`N \lambda`	$N\lambda$	shift because the two points appear to be moving apart due to the expansion of the
gilmore-lie-groups_F02969	293	1.000	`N \lambda^{\prime}`	$N\lambda'$	universe. The fourth redshift source is controversial. Mach proposed that the inertia
gilmore-lie-groups_F02970	293	1.000	`\rho(\mathbf{x}, t)=\rho(t)`	$\rho(\mathbf{x}, t) = \rho(t)$	the mass of the electron comes from two sources: interactions with electromag-
gilmore-lie-groups_F02971	293	1.000	`m_{e}(t) / M_{p}(t)`	$m_e(t)/M_p(t)$	n_2 are the principal quantum numbers of the two states involved in the transition
gilmore-lie-groups_F02972	293	0.981	`v=\frac{1}{2}\left(m c^{2} / \hbar\right) \times\left| \left(1 / n_{1}^{2}-1 / n_{2}^{2}\right)\right|`	$v = \frac{1}{2}\left(mc^2/\hbar\right) \times \left\|\left(1/n_1^2 - 1/n_2^2\right)\right\|$	of the universal expansion *and* because the electron was less massive in the past.
gilmore-lie-groups_F02973	293	1.000	`H_{\alpha}`	H_α	

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gilmore-lie-groups_F02974	294	1.000	`\Phi(x)`	$\Phi(x)$	transformation S that brings the curved metric to flat form: $S^t g_{\text{grav}} S = g_{\text{flat}}$. Interpret
gilmore-lie-groups_F02975	294	1.000	`S^{t} g_{\text {grav }} S=g_{\text {flat }}`	$S^t g_{\text{grav}}\, S = g_{\text{flat}}$	S in terms of a locally free-falling coordinate transformation.
gilmore-lie-groups_F02976	294	1.000	`V`	V	charge q at the origin of a sphere of radius a, $\rho(x) = q\delta(x)$, The **E** field is spherically
gilmore-lie-groups_F02977	294	0.867	`\mathbf{E}`	$\mathbf{E}$	symmetric, and Gauss' Law reduces to
gilmore-lie-groups_F02978	294	0.523	`a, p(x)=q \delta(x)`	$a, p(x) = q\delta(x)$	$4\pi a^2 \lvert\mathbf{E}(a)\rvert = 4\pi q$
gilmore-lie-groups_F02979	294	1.000	`|\mathbf{E}(a)|=q /|\mathbf{a}|`	$\lvert\mathbf{E}(a)\rvert = q/\lvert\mathbf{a}\rvert$	**a.** An observation point subtends an angle θ when measured from the center of the
gilmore-lie-groups_F02980	294	0.808	`\left(\oint \mathbf{E} \cdot d \mathbf{S}=\int 2 \pi \rho d A\right)`	$\left(\oint \mathbf{E} \cdot d\mathbf{S} = \int 2\pi\rho dA\right)$	sphere S^2 (c.f., Fig. 15.1). Show that its distance a from the north pole is $a = R\theta$
gilmore-lie-groups_F02981	294	1.000	`a=R \theta`	$a = R\theta$	
gilmore-lie-groups_F02982	295	1.000	`2 \pi R \sin \theta`	$2\pi R \sin\theta$	and the circumference of a circle of latitude through this point is $2\pi R \sin\theta$. Use
gilmore-lie-groups_F02983	295	1.000	`q / a`	q/a	Conclude that the field is stronger than the q/a form it would have in a plane. Show that this effective strengthening is due to the relative compression of the **E**
gilmore-lie-groups_F02984	295	1.000	`a(a=R \theta)`	$a(a = R\theta)$	If the observer thinks (s)he is in a flat space, conclude (s)he will think the effective
gilmore-lie-groups_F02985	295	1.000	`a=c t`	$a = ct$	is.
gilmore-lie-groups_F02986	295	1.000	`H^{n}=S O(n, 1) / S O(n), R^{n}=`	$H^n = SO(n,1)/SO(n), R^n =$	dr^2
gilmore-lie-groups_F02987	295	0.999	`I S O(n) / S O(n)`	$ISO(n)/SO(n)$	$ds^2 = \frac{}{1-kr^2} + r^2 \sum (\sin\theta_2 \sin\theta_3 \cdots$
gilmore-lie-groups_F02988	295	1.000	`k=(-1,0,+1)`	$k = (-1, 0, +1)$	$x_2 \quad = r \sin\theta_2 \cos\theta_3$
gilmore-lie-groups_F02989	295	1.000	`H^{n}, R^{n}, S^{n}`	H^n, R^n, S^n	$x_2 \quad = r \sin\theta_2 \cos\theta_3$
gilmore-lie-groups_F02990	295	1.000	`H^{n}, S^{n}`	H^n, S^n	$\oint \mathbf{E}\cdot d\mathbf{S} = \int \Omega\rho(x) dV$
gilmore-lie-groups_F02991	295	1.000	`\Omega`	Ω	$\lvert\mathbf{E}\rvert a^{n-1} = q$
gilmore-lie-groups_F02992	295	1.000	`S^{n-1} \subset H^{n}, R^{n}`	$S^{n-1} \subset H^n, R^n$	$\lvert\mathbf{E}\rvert a^{n-1} = q$
gilmore-lie-groups_F02993	295	1.000	`\int e^{-x^{2}} d x=\sqrt{\pi}`	$\int e^{-x^2} dx = \sqrt{\pi}$	
gilmore-lie-groups_F02994	295	1.000	`\Omega=2 \pi^{n / 2} / \Gamma(n / 2)`	$\Omega = 2\pi^{n/2}/\Gamma(n/2)$	
gilmore-lie-groups_F02995	296	1.000	`H^{n}`	H^n	on R, c, t?
gilmore-lie-groups_F02996	296	1.000	`R, c, t`	R, c, t	
gilmore-lie-groups_F02997	296	0.839	`(l, b)=\left(263^{\circ}, 48^{\circ}\right)`	$(l, b) = (263^\circ, 48^\circ)$	How do you use this information
gilmore-lie-groups_F02998	296	1.000	`T(\theta, \phi ; t)=`	$T(\theta, \phi; t) =$	modynamic measurements, argue that this special reference frame is statistically
gilmore-lie-groups_F02999	296	1.000	`\sum_{l, m} A_{m}^{l}(t) Y_{m}^{l}(\theta, \phi)`	$\sum_{l,m} A_m^l(t) Y_m^l(\theta, \phi)$	determined.
gilmore-lie-groups_F03000	296	0.998	`\Delta U \Delta(1 / T) \geq k`	$\Delta U \Delta(1/T) \geq k$	

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gilmore-lie-groups_FO3001	297	1.000	j=\frac{1}{2}, 1,2	$j=\frac{1}{2}, 1, 2$	why, or why not, the special frames defined by $j=\frac{1}{2}, 1, 2$ are the same. What
gilmore-lie-groups_FO3002	297	1.000	v(t)	$v(t)$	that it moves through the microwave background radiation with a velocity $v(t)$.
gilmore-lie-groups_FO3003	297	1.000	v(t) \simeq v\left(t_{0}\right) e^{-\left(t-t_{0}\right) / \tau}	$v(t) \simeq v\left(t_0\right) e^{-(t-t_0)/\tau}$	Show that its velocity decays to zero according to $v(t) \simeq v(t_0)e^{-(t-t_0)/\tau}$ because it is moving through a viscous medium. Estimate τ and present your answer in
gilmore-lie-groups_FO3004	297	1.000	\tau	τ	the form τ/T_p where T_p is the present age of the universe ($T_p \sim 13.7$ BY). To
gilmore-lie-groups_FO3005	297	0.990	\tau / T_{p}	τ/T_p	carry out this estimate you may assume the massive object is a black body –
gilmore-lie-groups_FO3006	297	0.990	T_{p}	T_p	carry out this estimate you may assume the massive object is a black body –
gilmore-lie-groups_FO3007	297	0.990	T_{p} \simeq 13.7 \mathrm{BY}	$T_p \simeq 13.7\mathrm{BY}$	carry out this estimate you may assume the massive object is a black body –
gilmore-lie-groups_FO3008	297	1.000	T_{B H}	T_{BH}	Use the standard relations for a neutral nonrotating black hole $R=2GM/c^2$,
gilmore-lie-groups_FO3009	297	1.000	R=2 G M / c^{2}	$R=2GM/c^2$	$T_{BH}=\hbar c^3/8\pi kGM$. You can assume that the mass M is sufficiently large that
gilmore-lie-groups_FO3010	297	1.000	T_{B H}=\hbar c^{3} / 8 \pi k G M	$T_{BH}=\hbar c^3/8\pi kGM$	the temperature T_{BH} can be neglected (set to zero). Assume that the absorption
gilmore-lie-groups_FO3011	297	1.000	\gamma \pi R^{2}	$\gamma\pi R^2$	Note that the problem of slowing down in a viscous medium was discused by Einstein in another of the papers from his "annus mirabilis," the precursor of the
gilmore-lie-groups_FO3012	297	1.000	\gamma=3^{3} / 2^{2}	$\gamma=3^3/2^2$	Note that the problem of slowing down in a viscous medium was discused by Einstein in another of the papers from his "annus mirabilis," the precursor of the
gilmore-lie-groups_FO3013	298	1.000	d y / d x=g(x)	$dy/dx=g(x)$	lations of the differential equation into other solutions. This observation was used – exploited – by Lie to develop an algorithm for determining
gilmore-lie-groups_FO3014	298	1.000	y: d y / d x=g(x)	$y: dy/dx=g(x)$	
gilmore-lie-groups_FO3015	298	1.000	d y / d x=p	$dy/dx=p$	
gilmore-lie-groups_FO3016	299	1.000	F(x, y, p)=0	$F(x,y,p)=0$	a surface equation $F(x, y, p)=0$. The special forms of the surface and constraint
gilmore-lie-groups_FO3017	299	1.000	R, S, T	R,S,T	canonical variable $R(x, y)$ is the new independent variable (like x), $S(x, y)$ is the
gilmore-lie-groups_FO3018	299	1.000	R(x, y)	$R(x,y)$	new dependent variable (like y), and $T(x, y, p)$ is the new constraint between S and
gilmore-lie-groups_FO3019	299	1.000	S(x, y)	$S(x,y)$	new dependent variable (like y), and $T(x, y, p)$ is the new constraint between S and
gilmore-lie-groups_FO3020	299	1.000	T(x, y, p)	$T(x,y,p)$	R (like dy/dx). In this new coordinate system the surface and constraint equations
gilmore-lie-groups_FO3021	299	1.000	d y / d x	dy/dx	assume the desired forms $F(R,-,T)=0$ and $dS/dR=f(R,-,T)$. The system
gilmore-lie-groups_FO3022	299	0.999	F(R,-, T)=0	$F(R,-,T)=0$	has been reduced to quadratures, and integration follows immediately.
gilmore-lie-groups_FO3023	299	0.999	d S / d R=f(R,-, T)	$dS/dR=f(R,-,T)$	has been reduced to quadratures, and integration follows immediately.
gilmore-lie-groups_FO3024	299	1.000	y-G(x)=0	$y-G(x)=0$	represented by the Taylor series displacement operator $e^{c\partial/\partial y}$, for
gilmore-lie-groups_FO3025	299	1.000	y+c-G(x)=	$y+c-G(x)=$	represented by the Taylor series displacement operator $e^{c\partial/\partial y}$, for
gilmore-lie-groups_FO3026	299	1.000	e^{c \partial / \partial y}	$e^{c\partial/\partial y}$	In short, the "trivial" additive constant is in fact a one-parameter group

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gilmore-lie-groups_F03027	300	1.000	`F(x, y, p)=p-g(x)`	$F(x,y,p)=p-g(x)$	$F(x, y, p) = p - g(x)$ for the particular case at hand. There are two relations
gilmore-lie-groups_F03028	300	1.000	`x, y, p`	x,y,p	among the three variables x, y, p. They are given by the surface equation and
gilmore-lie-groups_F03029	300	1.000	`\partial / \partial x, \partial / \partial y, \partial / \partial p`	$\partial/\partial x, \partial/\partial y, \partial/\partial p$	on the surface $F(x, y, p)$ defining the ordinary differential equation. It is also
gilmore-lie-groups_F03030	300	1.000	`F(x, y, p)`	$F(x,y,p)$	useful to express the action of the generator of infinitesimal displacements that
gilmore-lie-groups_F03031	300	0.798	`\left(d^{n} y / d x^{n}, n=1\right)`	$(d^n y/dx^n, n=1)$	If the equation that defines the first order ordinary differential equation, $F(x, y, p) = 0$, is not of the form $p = g(x)$, so that $\frac{\partial}{\partial y} F(x, y, p) \neq 0$, then we
gilmore-lie-groups_F03032	300	1.000	`p^{m}=(d y / d x)^{m}, m=1`	$p^m = (dy/dx)^m, m = 1$	$F(x, y, p) = 0$, is not of the form $p = g(x)$, so that $\frac{\partial}{\partial y} F(x, y, p) \neq 0$, then we can attempt to find the following
gilmore-lie-groups_F03033	300	1.000	`p-g(x)`	$p-g(x)$	(ii) A new "canonical" coordinate system (R, S, T). In this coordinate system $R = R(x, y)$ is the independent variable, $S = S(x, y)$ is the dependent variable, and $T = T(x, y, p)$
gilmore-lie-groups_F03034	300	1.000	`\frac{\partial}{\partial y} F(x, y, p) \neq 0`	$\frac{\partial}{\partial y} F(x,y,p) \neq 0$	(ii) A new "canonical" coordinate system (R, S, T). In this coordinate system $R = R(x, y)$ is the independent variable, $S = S(x, y)$ is the dependent variable, and $T = T(x, y, p)$
gilmore-lie-groups_F03035	300	0.999	`(R, S, T)`	(R,S,T)	
gilmore-lie-groups_F03036	300	0.999	`R=R(x, y)`	$R=R(x,y)$	
gilmore-lie-groups_F03037	300	1.000	`S=S(x, y)`	$S=S(x,y)$	
gilmore-lie-groups_F03038	300	1.000	`T=T(x, y, p)`	$T=T(x,y,p)$	
gilmore-lie-groups_F03039	301	1.000	`x \rightarrow x`	$x \rightarrow x$	so that $\xi = 0$, $\eta = 1$, and $\zeta = 0$.
gilmore-lie-groups_F03040	301	1.000	`y \rightarrow y+\epsilon`	$y \rightarrow y+\epsilon$	so that $\xi = 0$, $\eta = 1$, and $\zeta = 0$.
gilmore-lie-groups_F03041	301	1.000	`\xi=0, \eta=1`	$\xi=0, \eta=1$	
gilmore-lie-groups_F03042	301	1.000	`\zeta(x, y, p)`	$\zeta(x,y,p)$	[illegible]
gilmore-lie-groups_F03043	301	1.000	`\xi(x, y)`	$\xi(x,y)$	[illegible]
gilmore-lie-groups_F03044	301	1.000	`\eta(x, y)`	$\eta(x,y)$	[illegible]
gilmore-lie-groups_F03045	301	1.000	`\eta_{x}=\partial \eta / \partial x`	$\eta_x = \partial\eta/\partial x$	
gilmore-lie-groups_F03046	302	1.000	`\xi(x, y), \eta(x, y)`	$\xi(x,y), \eta(x,y)$	and $\zeta(x, y, p)$ that define the infinitesimal generator X. These functions are deter-
gilmore-lie-groups_F03047	302	1.000	`y: p=p(x, y)`	$y: p=p(x,y)$	ables x and y. The generators of the infinitesimal displacements, $\xi(x, y)$ and $\eta(x, y)$,
gilmore-lie-groups_F03048	302	1.000	`X F(x, y, p(x, y))=0`	$XF(x,y,p(x,y))=0$	are represented by Laurent expansions, or Taylor series expansions if convergent
gilmore-lie-groups_F03049	302	1.000	`d_{\xi}, d_{\eta}`	d_ξ, d_η	This gives a set of simultaneous *linear* equations in the expansion amplitudes
gilmore-lie-groups_F03050	302	0.999	`X F=0`	$XF=0$	ξ_{ij}, η_{ij}. In general, there are more equations than unknowns. Since the equations
gilmore-lie-groups_F03051	302	0.999	`\sum C_{i j} x^{i} y^{j}=0`	$\sum C_{ij} x^i y^j = 0$	ξ_{ij}, η_{ij}. In general, there are more equations than unknowns. Since the equations
gilmore-lie-groups_F03052	302	1.000	`C_{i j}`	C_{ij}	are homogeneous, there are no nontrivial solutions if the rank of this system is equal

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gilmore-lie-groups_F03053	302	0.999	`\xi_{i j}, \eta_{i j}`	ξ_{ij}, η_{ij}	scaling factor) is equal to the corank of this system of equations. This is not larger than one for first order equations but may exceed one for second and higher order
gilmore-lie-groups_F03054	303	1.000	`X(x, y, p) S(x, y)=1`	$X(x,y,p)S(x,y)=1$	
gilmore-lie-groups_F03055	303	1.000	`X S=+1`	$XS=+1$	
gilmore-lie-groups_F03056	303	1.000	`X S=-1`	$XS=-1$	*16.2.4.2 Invariant coordinates: independent variable*
gilmore-lie-groups_F03057	303	1.000	`X S=k \neq 0`	$XS=k\neq 0$	*16.2.4.2 Invariant coordinates: independent variable*
gilmore-lie-groups_F03058	303	1.000	`X R=0`	$XR=0$	$\left(\xi(x,y)\frac{\partial}{\partial x}+\eta(x,y)\frac{\partial}{\partial y}\right)R(x,y)=0$
gilmore-lie-groups_F03059	303	1.000	`X T=0`	$XT=0$	$\left(\xi(x,y)\frac{\partial}{\partial x}+\eta(x,y)\frac{\partial}{\partial y}\right)R(x,y)=0$
gilmore-lie-groups_F03060	304	1.000	`R: T=T(R)`	$R:T=T(R)$	$S=\int f(R,-,T(R))\,dR+c$ (16.20)
gilmore-lie-groups_F03061	304	1.000	`x=x(R, S), y=y(R, S)`	$x=x(R,S), y=y(R,S)$	
gilmore-lie-groups_F03062	305	1.000	`x p+y-x y^{2}=0`	$xp+y-xy^2=0$	The shape of the surface depends on both coordinates x and y.
gilmore-lie-groups_F03063	305	0.980	`0.1 \leq x \leq 1.1`	$0.1\leq x\leq 1.1$	
gilmore-lie-groups_F03064	305	0.980	`-2 \leq y \leq+2`	$-2\leq y\leq +2$	
gilmore-lie-groups_F03065	305	1.000	`y \rightarrow \alpha y`	$y\rightarrow \alpha y$	ant is $x\rightarrow \lambda x$, $y\rightarrow \lambda^{-1}y$, $p\rightarrow \lambda^{-2}p$. Since there is a one-parameter invariance
gilmore-lie-groups_F03066	305	1.000	`x \rightarrow \beta x`	$x\rightarrow \beta x$	ant is $x\rightarrow \lambda x$, $y\rightarrow \lambda^{-1}y$, $p\rightarrow \lambda^{-2}p$. Since there is a one-parameter invariance
gilmore-lie-groups_F03067	305	1.000	`\alpha\left(x p+y-(\alpha \beta) x y^{2}\right)=0`	$\alpha\left(xp+y-(\alpha\beta)xy^2\right)=0$	group for this differential equation, Lie's methods are guaranteed to work. In fact,
gilmore-lie-groups_F03068	305	1.000	`\alpha \beta=1`	$\alpha\beta=1$	group for this differential equation, Lie's methods are guaranteed to work. In fact,
gilmore-lie-groups_F03069	305	1.000	`x \rightarrow \lambda x, y \rightarrow \lambda^{-1} y, p \rightarrow \lambda^{-2} p`	$x\rightarrow \lambda x, y\rightarrow \lambda^{-1}y, p\rightarrow \lambda^{-2}p$	directly. The surface $p=y^2-y/x$ is shown in Fig. 16.1. The value of p clearly depends
gilmore-lie-groups_F03070	305	1.000	`X(x, y, p)`	$X(x,y,p)$	new coordinate system in which the surface is independent of the new dependent
gilmore-lie-groups_F03071	305	1.000	`p=y^{2}-y / x`	$p=y^2-y/x$	The determining equation Eq. (16.14) is
gilmore-lie-groups_F03072	306	1.000	`p: p(x, y)=`	$p:p(x,y)=$	we use the surface equation $F(x,y,p)=0$ to find an expression for p: $p(x,y)=$
gilmore-lie-groups_F03073	306	1.000	`-y / x+y^{2}`	$-y/x+y^2$	$-y/x+y^2$. This is substituted into the determining equation $XF(x,y,p)=0$ to
gilmore-lie-groups_F03074	306	1.000	`X F(x, y, p)=0`	$XF(x,y,p)=0$	$-y/x+y^2$. This is substituted into the determining equation $XF(x,y,p)=0$ to
gilmore-lie-groups_F03075	306	1.000	`\eta: \xi=\xi_{00}, \eta=\eta_{00}`	$\eta:\xi=\xi_{00},\eta=\eta_{00}$	are substituted into Eq. (16.23) we obtain three equations for the two unknowns. The
gilmore-lie-groups_F03076	306	0.999	`y / x, 1`	$y/x, 1$	ξ_{00}, η_{00} as follows:
gilmore-lie-groups_F03077	306	0.999	`x y`	xy	ξ_{00}, η_{00} as follows:
gilmore-lie-groups_F03078	306	1.000	`\xi_{00}, \eta_{00}`	ξ_{00},η_{00}	

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gilmore-lie-groups_F03079	307	1.000	`\xi_{01}=\xi_{00}=\eta_{00}=\eta_{10}=0`	$\xi_{01} = \xi_{00} = \eta_{00} = \eta_{10} = 0$	four equations we determine $\xi_{01} = \xi_{00} = \eta_{00} = \eta_{10} = 0$, and from the coefficient
gilmore-lie-groups_F03080	307	1.000	`x y^{2}`	xy^2	of xy^2 we learn $-\xi_{10} - \eta_{01} = 0$ so that, up to some overall scaling factor, we can
gilmore-lie-groups_F03081	307	1.000	`-\xi_{10}-\eta_{01}=0`	$-\xi_{10} - \eta_{01} = 0$	of xy^2 we learn $-\xi_{10} - \eta_{01} = 0$ so that, up to some overall scaling factor, we can
gilmore-lie-groups_F03082	307	1.000	`\xi(x, y)=x`	$\xi(x, y) = x$	take $\xi(x, y) = x$ and $\eta(x, y) = -y$. Since we have found one nontrivial solution
gilmore-lie-groups_F03083	307	1.000	`\eta(x, y)=-y`	$\eta(x, y) = -y$	take $\xi(x, y) = x$ and $\eta(x, y) = -y$. Since we have found one nontrivial solution
gilmore-lie-groups_F03084	307	1.000	`\zeta=-2 p`	$\zeta = -2p$	$\partial \quad \partial \quad \partial$
gilmore-lie-groups_F03085	307	1.000	`-y d S(y) / d y=1`	$-y dS(y)/dy = 1$	neglecting the negative sign: $S(x, y) = \ln(y)$.
gilmore-lie-groups_F03086	307	1.000	`-\ln (y)`	$-\ln(y)$	The invariant coordinates are determined using the method of characteristics:
gilmore-lie-groups_F03087	307	1.000	`S(x, y)=\ln (y)`	$S(x, y) = \ln(y)$	$\frac{dx}{}$ – $\frac{dy}{}$ – $\frac{dp}{}$
gilmore-lie-groups_F03088	307	1.000	`y d x=-x d y`	$ydx = -xdy$	$-dp/2p$ equal to either of the other two differentials. We set it equal to dx/x to
gilmore-lie-groups_F03089	307	1.000	`d(x y)=0`	$d(xy) = 0$	avoid having the second invariant coordinate dependent on y. The equation is
gilmore-lie-groups_F03090	307	1.000	`R(x, y)=x y`	$R(x, y) = xy$	avoid having the second invariant coordinate dependent on y. The equation is
gilmore-lie-groups_F03091	307	1.000	`-d p / 2 p`	$-dp/2p$	The forward and backward transformations between the two coordinate systems
gilmore-lie-groups_F03092	307	1.000	`d x / x`	dx/x	The forward and backward transformations between the two coordinate systems
gilmore-lie-groups_F03093	307	1.000	`d x / x=-d p / 2 p`	$dx/x = -dp/2p$	$\left(\begin{matrix} R \\ \end{matrix}\right) \quad \left(\begin{matrix} xy \\ \end{matrix}\right) \qquad \left(\begin{matrix} x \\ \end{matrix}\right) \quad \left(\begin{matrix} Re^{-} \\ \end{matrix}\right)$
gilmore-lie-groups_F03094	307	1.000	`(1 / x) d\left(x^{2} p\right)=0`	$(1/x)d\left(x^2 p\right) = 0$	$\left(\begin{matrix} R \\ \end{matrix}\right) \quad \left(\begin{matrix} xy \\ \end{matrix}\right) \qquad \left(\begin{matrix} x \\ \end{matrix}\right) \quad \left(\begin{matrix} Re^{-} \\ \end{matrix}\right)$
gilmore-lie-groups_F03095	307	1.000	`T(x, y, p)=x^{2} p`	$T(x, y, p) = x^2 p$	$\left(\begin{matrix} R \\ \end{matrix}\right) \quad \left(\begin{matrix} xy \\ \end{matrix}\right) \qquad \left(\begin{matrix} x \\ \end{matrix}\right) \quad \left(\begin{matrix} Re^{-} \\ \end{matrix}\right)$
gilmore-lie-groups_F03096	308	1.000	`T / R+1-`	$T/R + 1-$	for $-3 \leq R \leq +4$ and $-2 \leq S \leq +2$. The function is a simple ruled surface, independent of S
gilmore-lie-groups_F03097	308	0.669	`R=0`	$R = 0$	independent of S.
gilmore-lie-groups_F03098	308	0.669	`R, S`	R, S	independent of S.
gilmore-lie-groups_F03099	308	1.000	`-3 \leq R \leq+4`	$-3 \leq R \leq +4$	
gilmore-lie-groups_F03100	308	1.000	`-2 \leq S \leq+2`	$-2 \leq S \leq +2$	
gilmore-lie-groups_F03101	308	1.000	`T=T(R, S)`	$T = T(R, S)$	The new constraint equation is
gilmore-lie-groups_F03102	308	1.000	`R: T(R)=R^{2}-R`	$R : T(R) = R^2 - R$	$\frac{dS}{dR} = \frac{1}{R} - \frac{1}{R^2} \Longrightarrow S = \ln(R) + \frac{1}{R} + c$ (16.34)
gilmore-lie-groups_F03103	309	0.999	`(R, S)`	(R, S)	The inverse transformation, Eq. (16.30), from (R, S) to (x, y) is finally used to
gilmore-lie-groups_F03104	309	1.000	`x d / d x`	xd/dx	mations, since $e^{\lambda x d/dx} x = e^{\lambda} x$. As a result, the infinitesimal generator X has the

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gilmore-lie-groups_F03105	309	1.000	e^{\lambda x d / d x} x=e^{\lambda} x	$e^{\lambda x d/dx} x = e^{\lambda} x$	following effect on the coordinates (x, y, p):
gilmore-lie-groups_F03106	309	0.766	(x, y, p)	(x, y, p)	
gilmore-lie-groups_F03107	309	1.000	\ln (y)	$\ln(y)$	group parameter: $\ln(e^{-\lambda} y) = \ln(y) - \lambda$. The invariant operators come right out of
gilmore-lie-groups_F03108	309	1.000	\ln \left(e^{-\lambda} y\right)=\ln (y)-\lambda	$\ln\left(e^{-\lambda} y\right) = \ln(y) - \lambda$	the scaling transformations: xy and x^2p are unchanged by the scaling transformation. None of these operators is unique. The operator $\ln(xy^2)$ is linear and x^3yp
gilmore-lie-groups_F03109	309	1.000	x^{2} p	$x^2 p$	is invariant. We have just chosen the most convenient (simplest) solutions to the
gilmore-lie-groups_F03110	309	1.000	\ln \left(x y^{2}\right)	$\ln\left(x y^2\right)$	equations defining the new coordinates.
gilmore-lie-groups_F03111	309	1.000	x^{3} y p	$x^3 y p$	equations defining the new coordinates.
gilmore-lie-groups_F03112	309	1.000	F\left(x y, x^{2} p\right)=0	$F\left(x y, x^2 p\right) = 0$	
gilmore-lie-groups_F03113	309	1.000	x^{2} p=h(x y)	$x^2 p = h(x y)$	10.4.2 Higher degree equations
gilmore-lie-groups_F03114	309	1.000	d y / d x=x^{-2} h(x y)	$dy/dx = x^{-2} h(x y)$	10.4.2 Higher degree equations
gilmore-lie-groups_F03115	309	1.000	h(z)=-z+z^{2}	$h(z) = -z + z^2$	These methods work equally well with first order equations of higher degree.
gilmore-lie-groups_F03116	309	1.000	d y / d x+y^{2}-2 / x^{2}=0, h(z)=z^{2}-2	$dy/dx + y^2 - 2/x^2 = 0, h(z) = z^2 - 2$	These methods work equally well with first order equations of higher degree.
gilmore-lie-groups_F03117	309	1.000	y^{\prime 2}+y^{4}-x^{-4}=0	$y'^2 + y^4 - x^{-4} = 0$	
gilmore-lie-groups_F03118	309	1.000	R^{4}+T^{2}=1	$R^4 + T^2 = 1$	
gilmore-lie-groups_F03119	310	1.000	p= \pm \sqrt{x^{-4}-y^{4}}	$p = \pm\sqrt{x^{-4} - y^4}$	$p = \pm\sqrt{x^{-4} - y^4}$, corresponding to the two solution branches in the canonical
gilmore-lie-groups_F03120	310	1.000	T= \pm \sqrt{1-R^{4}}	$T = \pm\sqrt{1 - R^4}$	coordinate system $T = \pm\sqrt{1 -}$
gilmore-lie-groups_F03121	310	1.000	\zeta(x, y, p)=\eta^{(1)}(x, y, p)	$\zeta(x, y, p) = \eta^{(1)}(x, y, p)$	the canonical coordinates (R, S, T). Since the constraint equation dS/dR depends
gilmore-lie-groups_F03122	310	1.000	d S / d R	dS/dR	only on the change of variables, it also can be tabulated, and has been. The simplest
gilmore-lie-groups_F03123	310	1.000	S \rightarrow S^{\prime}=S+c, R^{\prime}=R	$S \to S' = S + c, R' = R$	$e^{+c} y$.
gilmore-lie-groups_F03124	310	1.000	\ln (y) \rightarrow \ln (y)+c=\ln \left(e^{c} y\right)=	$\ln(y) \to \ln(y) + c = \ln\left(e^c y\right) =$	$e^{+c} y$.
gilmore-lie-groups_F03125	310	0.995	\ln (\bar{y}(c))	$\ln(\bar{y}(c))$	
gilmore-lie-groups_F03126	310	0.995	x y=\bar{x}(c) \bar{y}(c)	$x y = \bar{x}(c)\bar{y}(c)$	
gilmore-lie-groups_F03127	310	0.995	\bar{x}(c)=e^{-c} x	$\bar{x}(c) = e^{-c} x$	
gilmore-lie-groups_F03128	310	0.995	\bar{y}(c)=	$\bar{y}(c) =$	
gilmore-lie-groups_F03129	310	0.999	e^{+c} y	$e^{+c} y$	
gilmore-lie-groups_F03130	310	0.998	y^{(2)}	$y^{(2)}$	∂x ∂y $\partial y^{(1)}$

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gilmore-lie-groups_F03131	311	1.000	`\xi, \eta, \zeta`	ξ, η, ζ	Table 16.1. *Infinitesimal generators ξ, η, ζ, canonical coordinates R, S, T, and*
gilmore-lie-groups_F03132	311	0.852	`1 / T`	$1/T$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^x/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

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gilmore-lie-groups_F03133	311	0.852	`1 / a`	$1/a$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03134	311	0.852	`-1 / b`	$-1/b$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03135	311	0.852	`a x+b y`	$ax + by$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03136	311	0.852	`b x-a y`	$bx - ay$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03137	311	0.852	`(b-a T) /(a+b T)`	$(b - aT)/(a + bT)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03138	311	0.852	`-p`	$-p$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03139	311	0.852	`\ln x`	$\ln x$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03140	311	0.852	`x p`	xp	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03141	311	0.852	`\ln y`	$\ln y$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03142	311	0.852	`p / y`	p/y	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03143	311	0.852	x / a	x/a	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\partial} + \frac{dy}{\partial} + \frac{dy^{(1)}}{\partial} + \dots + y^{(n+1)}\frac{\partial}{\partial}$ (16.40)
gilmore-lie-groups_F03144	311	0.852	y / b	y/b	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\partial} + \frac{dy}{\partial} + \frac{dy^{(1)}}{\partial} + \dots + y^{(n+1)}\frac{\partial}{\partial}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03145	311	0.852	`(1 / b-1 / a) p`	$(1/b - 1/a)p$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03146	311	0.852	`y^{b} / x^{a}`	y^b/x^a	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03147	311	0.852	`b \ln y`	$b \ln y$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03148	311	0.852	`p / x^{(a / b-1)}`	$p/x^{(a/b-1)}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03149	311	0.852	`(b T / R) /\left(b T-a R^{(1 / b)}\right)`	$(bT/R)/\left(bT - aR^{(1/b)}\right)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03150	311	0.852	`y / x`	y/x	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03151	311	0.852	`(T / R) /(T-R)`	$(T/R)/(T-R)$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03152	311	0.852	`-2 p`	$-2p$	

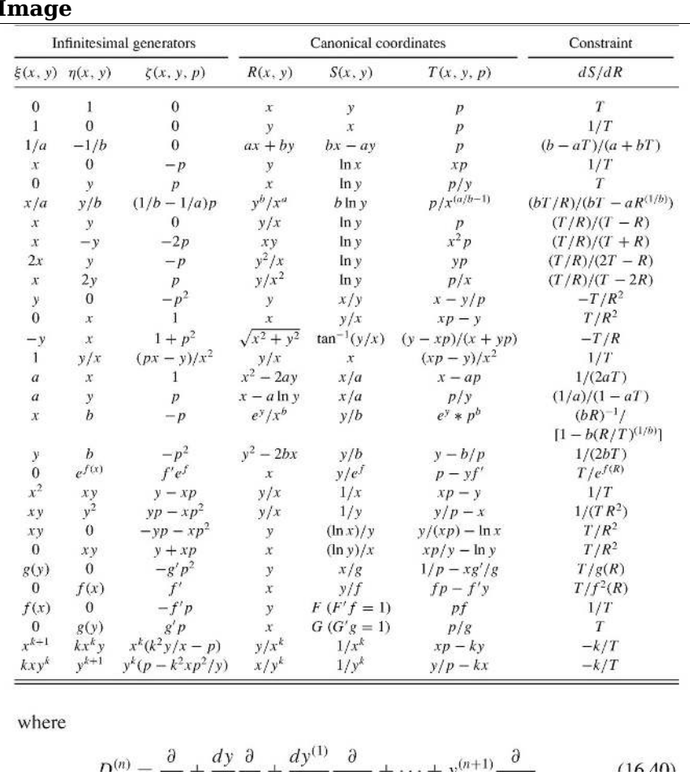
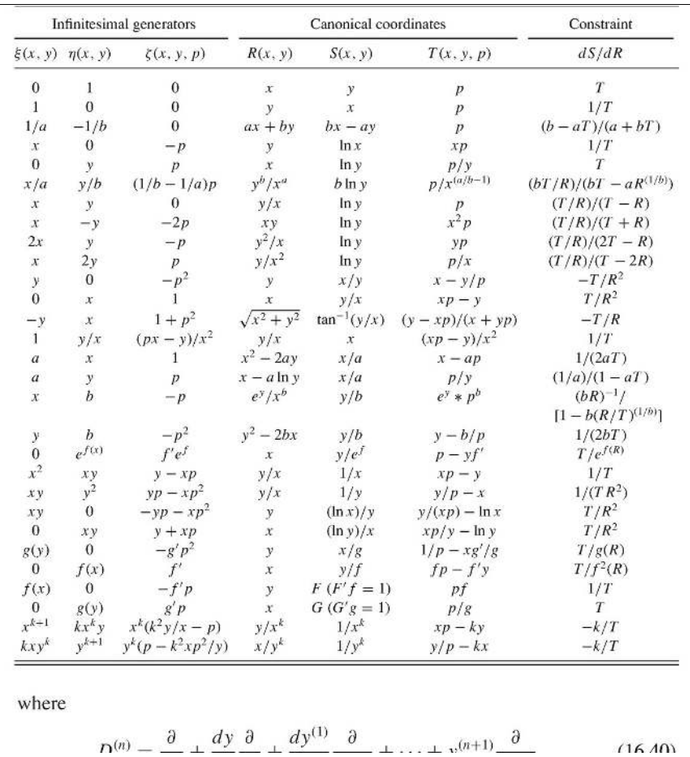
Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03153	311	0.852	`(T / R) /(T+R)`	$(T/R)/(T+R)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03154	311	0.852	`2 x`	$2x$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03155	311	0.852	`y^{2} / x`	y^2/x	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03156	311	0.852	`y p`	yp	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03157	311	0.852	`(T / R) /(2 T-R)`	$(T/R)/(2T-R)$	
gilmore-lie-groups_F03158	311	0.852	`2 y`	$2y$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

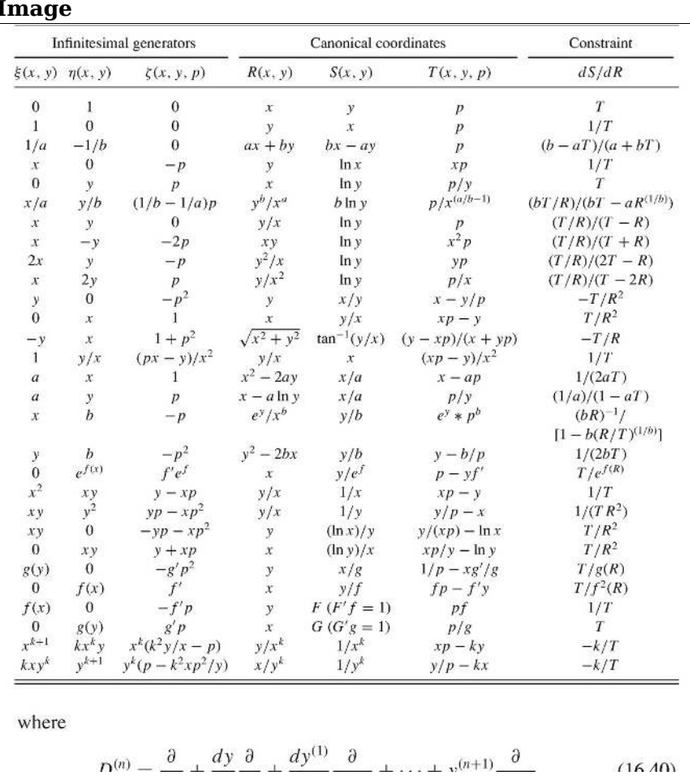
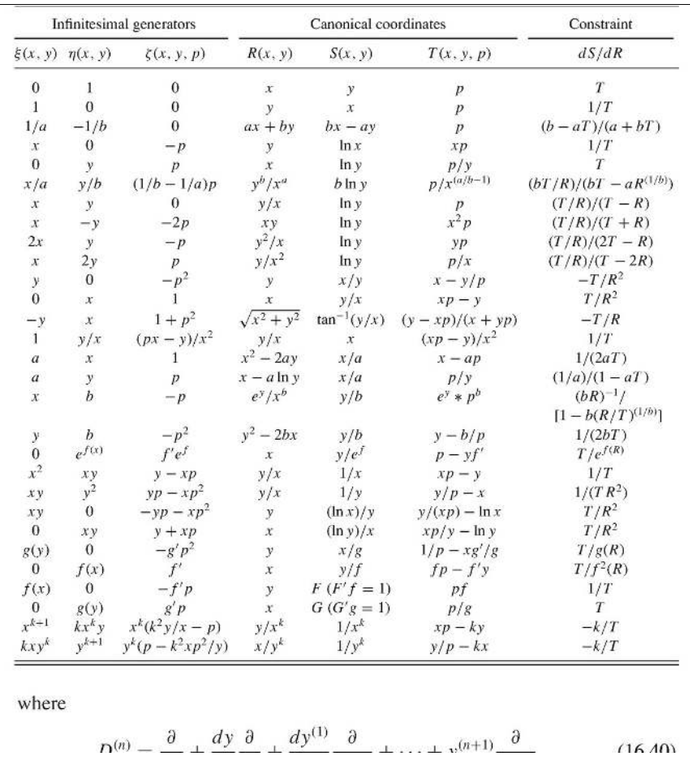
$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03159	311	0.852	`y / x^{2}`	y/x^2	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03160	311	0.852	`p / x`	p/x	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03161	311	0.852	`(T / R) /(T-2 R)`	$(T/R)/(T-2R)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03162	311	0.852	`-p^{2}`	$-p^2$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03163	311	0.852	`x-y / p`	$x - y/p$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03164	311	0.852	`-T / R^{2}`	$-T/R^2$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03165	311	0.852	`x p-y`	$xp - y$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03166	311	0.852	`T / R^{2}`	T/R^2	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03167	311	0.852	`1+p^{2}`	$1+p^{2}$	
gilmore-lie-groups_F03168	311	0.852	`\sqrt{x^{2}+y^{2}}`	$\sqrt{x^{2}+y^{2}}$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03169	311	0.852	`\tan ^{-1}(y / x)`	$\tan^{-1}(y/x)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad}$ (16.40)
gilmore-lie-groups_F03170	311	0.852	`(y-x p) /(x+y p)`	$(y-xp)/(x+yp)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03171	311	0.852	`-T / R`	$-T/R$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03172	311	0.852	`(p x-y) / x^{2}`	$(px-y)/x^2$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03173	311	0.852	`(x p-y) / x^{2}`	$(xp-y)/x^2$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03174	311	0.852	`x^{2}-2 a y`	x^2-2ay	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03175	311	0.852	x-a p	$x - ap$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03176	311	0.852	1 /(2 a T)	$1/(2aT)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03177	311	0.852	`x-a \ln y`	$x - a \ln y$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03178	311	0.852	`(1 / a) /(1-a T)`	$(1/a)/(1-aT)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03179	311	0.852	`e^{y} / x^{b}`	e^{y}/x^{b}	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03180	311	0.852	`e^{y} * p^{b}`	$e^{y} * p^{b}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03181	311	0.852	`(b R)^{-1} /`	$(bR)^{-1}/$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03182	311	0.852	`\left[1-b(R / T)^{(1 / b)}\right]`	$\left[1-b(R/T)^{(1/b)}\right]$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

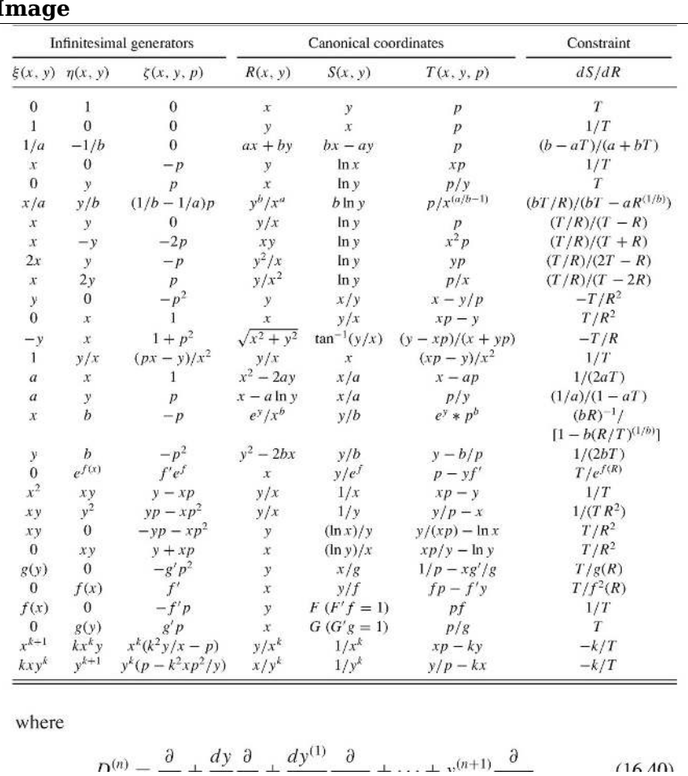
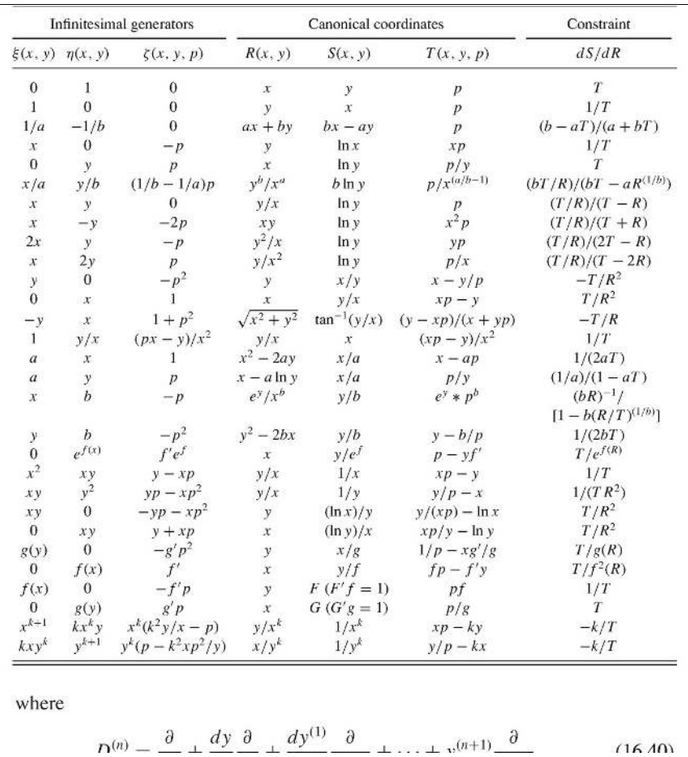
Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03183	311	0.852	`y^{2}-2 b x`	$y^2 - 2bx$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03184	311	0.852	`y-b / p`	$y - b/p$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03185	311	0.852	`1 /(2 b T)`	$1/(2bT)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03186	311	0.852	`e^{f(x)}`	$e^{f(x)}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03187	311	0.852	`f^{\prime} e^{f}`	$f^{\prime} e^{f}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f^{\prime}e^f$ x y/e^f $p-yf^{\prime}$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g^{\prime}p^2$ y x/g $1/p-xg^{\prime}/g$ $T/g(R)$ 0 $f(x)$ $f^{\prime}$ x y/f $fp-f^{\prime}y$ $T/f^2(R)$ $f(x)$ 0 $-f^{\prime}p$ y $F\ (F^{\prime}f=1)$ pf $1/T$ 0 $g(y)$ $g^{\prime}p$ x $G\ (G^{\prime}g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03188	311	0.852	`y / e^{f}`	y/e^{f}	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f^{\prime}e^f$ x y/e^f $p-yf^{\prime}$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g^{\prime}p^2$ y x/g $1/p-xg^{\prime}/g$ $T/g(R)$ 0 $f(x)$ $f^{\prime}$ x y/f $fp-f^{\prime}y$ $T/f^2(R)$ $f(x)$ 0 $-f^{\prime}p$ y $F\ (F^{\prime}f=1)$ pf $1/T$ 0 $g(y)$ $g^{\prime}p$ x $G\ (G^{\prime}g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03189	311	0.852	`p-y f^{\prime}`	$p - yf'$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03190	311	0.852	`T / e^{f(R)}`	$T/e^{f(R)}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03191	311	0.852	x^{2}	x^2	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\quad}+\frac{dy}{\quad}\frac{\partial}{\quad}+\frac{dy^{(1)}}{\quad}\frac{\partial}{\quad}+\dots+y^{(n+1)}\frac{\partial}{\quad}$ (16.40)
gilmore-lie-groups_F03192	311	0.852	y-x p	$y-xp$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\quad}+\frac{dy}{\quad}\frac{\partial}{\quad}+\frac{dy^{(1)}}{\quad}\frac{\partial}{\quad}+\dots+y^{(n+1)}\frac{\partial}{\quad}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03193	311	0.852	`1 / x`	$1/x$	
gilmore-lie-groups_F03194	311	0.852	`y^{2}`	y^2	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

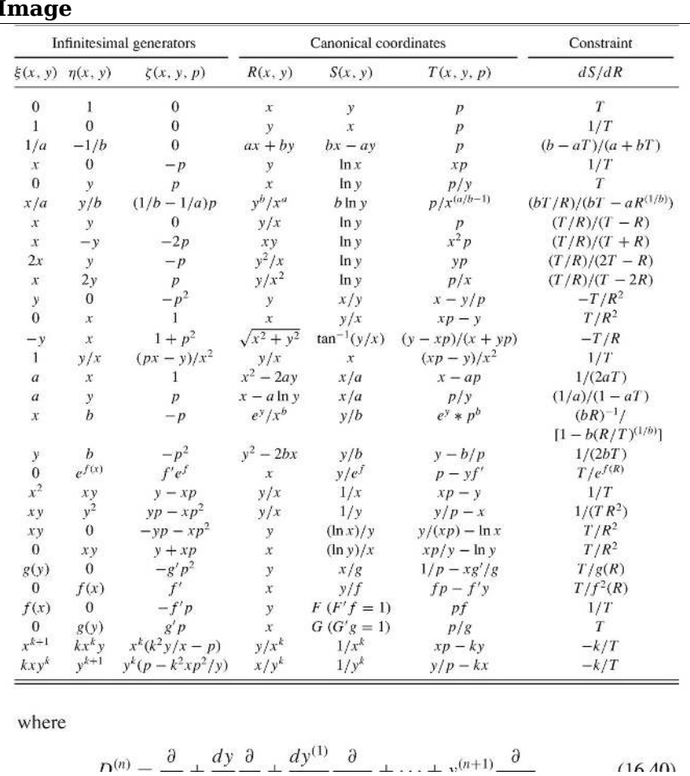
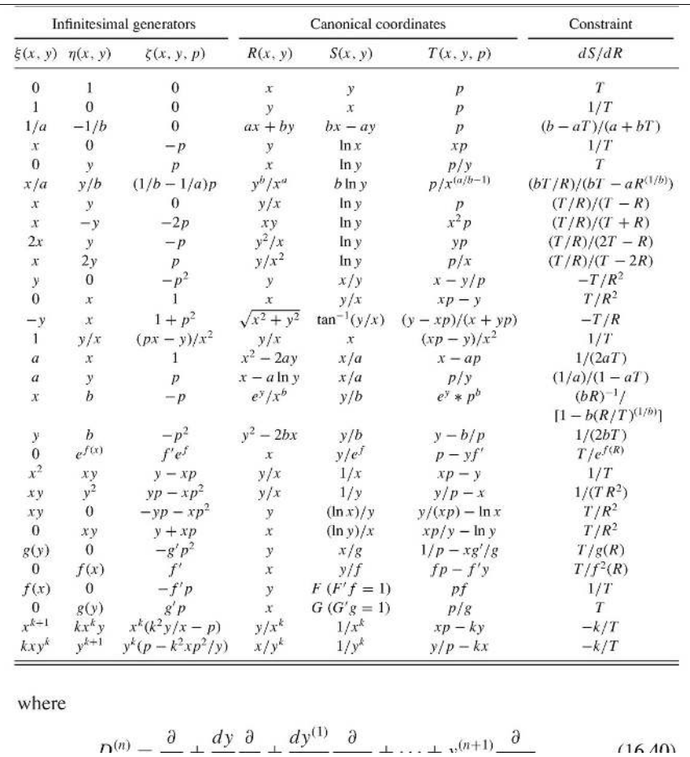
where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03195	311	0.852	`y p-x p^{2}`	$yp - xp^2$	
gilmore-lie-groups_F03196	311	0.852	`1 / y`	$1/y$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	$F\ (F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	$G\ (G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

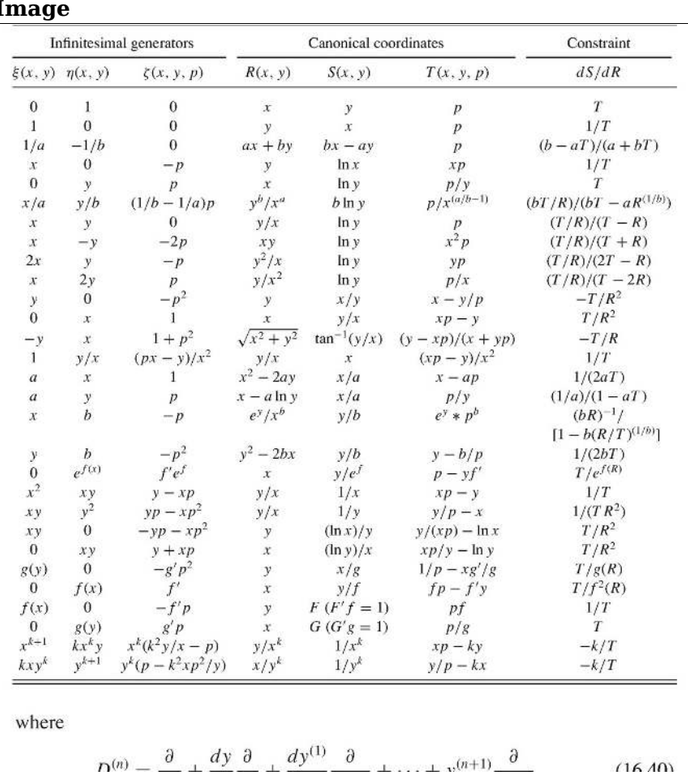
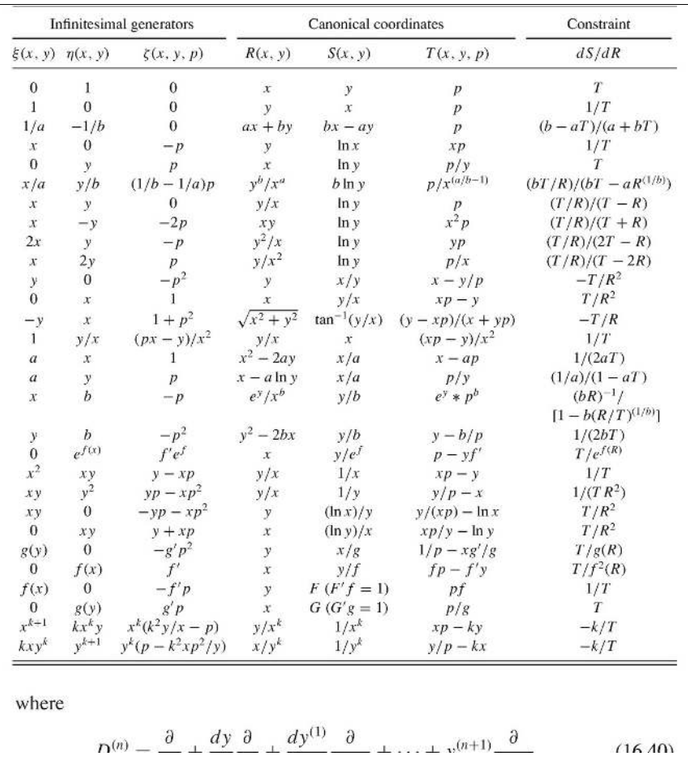
$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	$F\ (F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	$G\ (G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03197	311	0.852	`y / p-x`	$y/p-x$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\ }+\frac{dy}{\ }\frac{\partial}{\ }+\frac{dy^{(1)}}{\ }\frac{\partial}{\ }+\dots+y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03198	311	0.852	`1 /\left(T R^{2}\right)`	$1/\left(TR^2\right)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\ }+\frac{dy}{\ }\frac{\partial}{\ }+\frac{dy^{(1)}}{\ }\frac{\partial}{\ }+\dots+y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03199	311	0.852	`-y p-x p^{2}`	$-yp - xp^2$	
gilmore-lie-groups_F03200	311	0.852	`(\ln x) / y`	$(\ln x)/y$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	F $(F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	G $(G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \dots + y^{(n+1)}\frac{\partial}{} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_FO3201	311	0.852	`y /(x p)-\ln x`	$y/(xp) - \ln x$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_FO3202	311	0.852	`y+x p`	$y + xp$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03203	311	0.852	`(\ln y) / x`	$(\ln y)/x$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad}$ (16.40)
gilmore-lie-groups_F03204	311	0.852	`x p / y-\ln y`	$xp/y-\ln y$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad}$ (16.40)

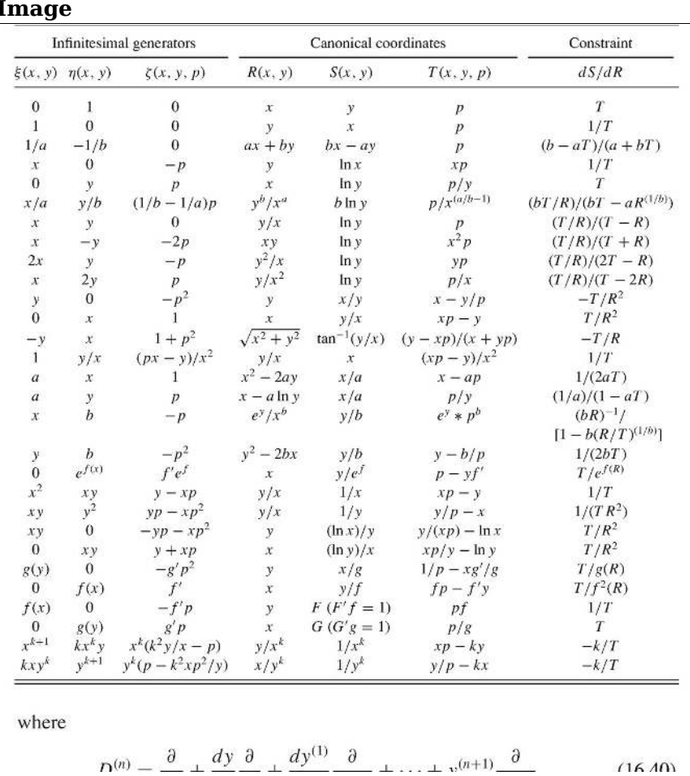
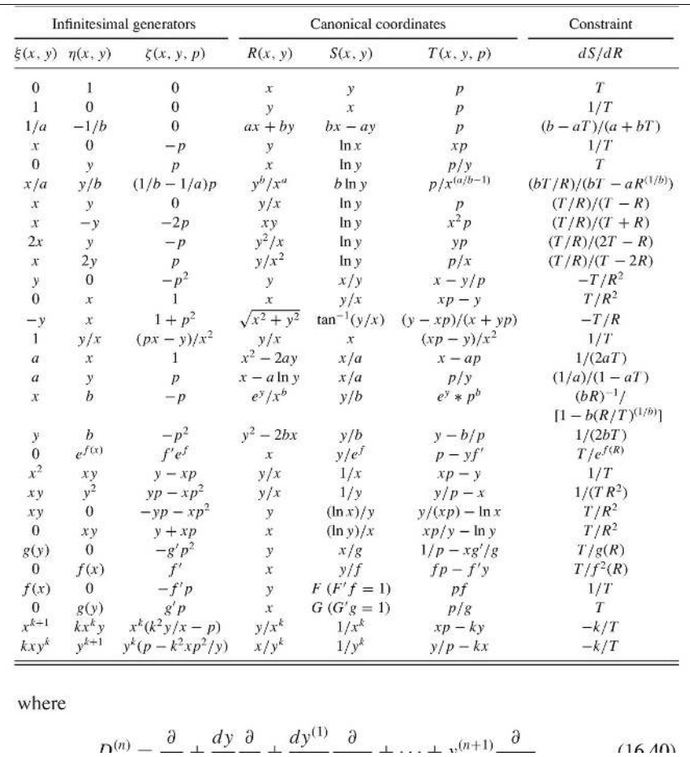
Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03205	311	0.852	`g(y)`	$g(y)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03206	311	0.852	`-g^{\prime} p^{2}`	$-g'p^2$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03207	311	0.852	`x / g`	x/g	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\quad}+\frac{dy}{\quad}\frac{\partial}{\quad}+\frac{dy^{(1)}}{\quad}\frac{\partial}{\quad}+\dots+y^{(n+1)}\frac{\partial}{\quad}$ (16.40)
gilmore-lie-groups_F03208	311	0.852	`1 / p-x g^{\prime} / g`	$1/p-xg'/g$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\quad}+\frac{dy}{\quad}\frac{\partial}{\quad}+\frac{dy^{(1)}}{\quad}\frac{\partial}{\quad}+\dots+y^{(n+1)}\frac{\partial}{\quad}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03209	311	0.852	`T / g(R)`	$T/g(R)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03210	311	0.852	`f(x)`	$f(x)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03211	311	0.852	`f^{\prime}`	f'	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\ }+\frac{dy}{\ }\frac{\partial}{\ }+\frac{dy^{(1)}}{\ }\frac{\partial}{\ }+\dots+y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03212	311	0.852	`y / f`	y/f	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\ }+\frac{dy}{\ }\frac{\partial}{\ }+\frac{dy^{(1)}}{\ }\frac{\partial}{\ }+\dots+y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03213	311	0.852	`f p-f^{\prime} y`	$fp - f'y$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03214	311	0.852	`T / f^{2}(R)`	$T/f^2(R)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b $e^y * p^b$ $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03215	311	0.852	`-f^{\prime} p`	$-f'p$	
gilmore-lie-groups_F03216	311	0.852	`F\left(F^{\prime} f=1\right)`	$F\left(F'f=1\right)$	

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	$F\ (F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	$G\ (G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad} \qquad (16.40)$$

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	e^y*p^b	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	$F\ (F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	$G\ (G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k+1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

where

$$D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad} \qquad (16.40)$$

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03217	311	0.852	`p f`	pf	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03218	311	0.852	`g^{\prime} p`	$g'p$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03219	311	0.852	`G\left(G^{\prime} g=1\right)`	$G\left(G^{\prime} g=1\right)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{}+\frac{dy}{}\frac{\partial}{}+\frac{dy^{(1)}}{}\frac{\partial}{}+\dots+y^{(n+1)}\frac{\partial}{}$ (16.40)
gilmore-lie-groups_F03220	311	0.852	`p / g`	p/g	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{}+\frac{dy}{}\frac{\partial}{}+\frac{dy^{(1)}}{}\frac{\partial}{}+\dots+y^{(n+1)}\frac{\partial}{}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03221	311	0.852	x^{k+1}	x^{k+1}	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03222	311	0.852	k x^{k} y	kx^ky	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

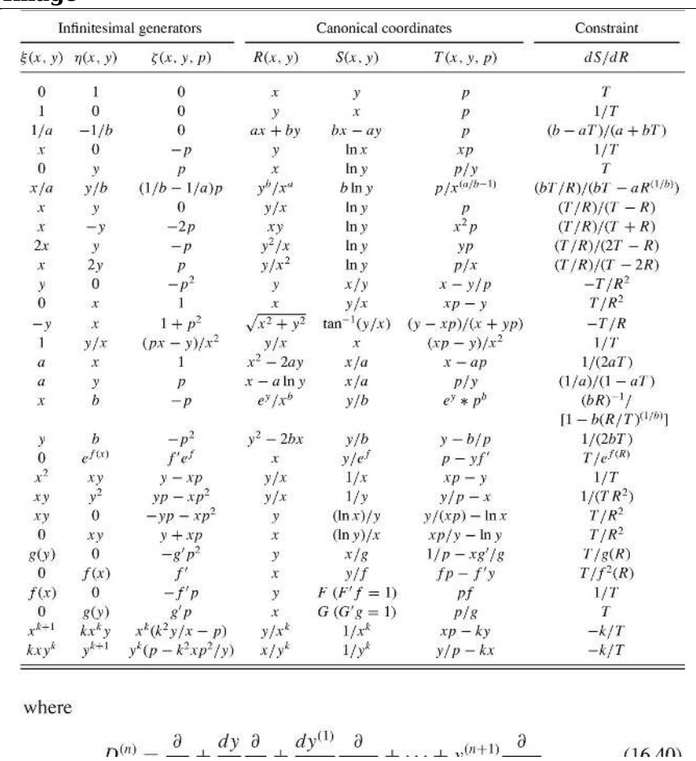
Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03223	311	0.852	`x^{k}\left(k^{2} y / x-p\right)`	$x^{k}\left(k^{2} y / x-p\right)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{}+\frac{dy}{}\frac{\partial}{}+\frac{dy^{(1)}}{}\frac{\partial}{}+\dots+y^{(n+1)}\frac{\partial}{}$ (16.40)
gilmore-lie-groups_F03224	311	0.852	`y / x^{k}`	y/x^{k}	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{}+\frac{dy}{}\frac{\partial}{}+\frac{dy^{(1)}}{}\frac{\partial}{}+\dots+y^{(n+1)}\frac{\partial}{}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03225	311	0.852	`1 / x^{k}`	$1/x^{k}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03226	311	0.852	`x p-k y`	$xp-ky$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k-1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03227	311	0.852	`-k / T`	$-k/T$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03228	311	0.852	`k x y^{k}`	kxy^k	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\ } + \frac{dy}{\ }\frac{\partial}{\ } + \frac{dy^{(1)}}{\ }\frac{\partial}{\ } + \dots + y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03229	311	0.852	`y^{k+1}`	y^{k+1}	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad}$ (16.40)
gilmore-lie-groups_F03230	311	0.852	`y^{k}\left(p-k^{2} x p^{2} / y\right)`	$y^k\left(p-k^2xp^2/y\right)$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y F $(F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x G $(G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)} = \frac{\partial}{\quad} + \frac{dy}{\quad}\frac{\partial}{\quad} + \frac{dy^{(1)}}{\quad}\frac{\partial}{\quad} + \dots + y^{(n+1)}\frac{\partial}{\quad}$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03231	311	0.852	`x / y^{k}`	x/y^{k}	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\ }+\frac{dy}{\ }\frac{\partial}{\ }+\frac{dy^{(1)}}{\ }\frac{\partial}{\ }+\dots+y^{(n+1)}\frac{\partial}{\ }$ (16.40)
gilmore-lie-groups_F03232	311	0.852	`1 / y^{k}`	$1/y^{k}$	Infinitesimal generators / Canonical coordinates / Constraint $\xi(x,y)$ $\eta(x,y)$ $\zeta(x,y,p)$ $R(x,y)$ $S(x,y)$ $T(x,y,p)$ dS/dR 0 1 0 x y p T 1 0 0 y x p $1/T$ $1/a$ $-1/b$ 0 $ax+by$ $bx-ay$ p $(b-aT)/(a+bT)$ x 0 $-p$ y $\ln x$ xp $1/T$ 0 y p x $\ln y$ p/y T x/a y/b $(1/b-1/a)p$ y^b/x^a $b\ln y$ $p/x^{(a/b-1)}$ $(bT/R)/(bT-aR^{(1/b)})$ x y 0 y/x $\ln y$ p $(T/R)/(T-R)$ x $-y$ $-2p$ xy $\ln y$ x^2p $(T/R)/(T+R)$ $2x$ y $-p$ y^2/x $\ln y$ yp $(T/R)/(2T-R)$ x $2y$ p y/x^2 $\ln y$ p/x $(T/R)/(T-2R)$ y 0 $-p^2$ y x/y $x-y/p$ $-T/R^2$ 0 x 1 x y/x $xp-y$ T/R^2 $-y$ x $1+p^2$ $\sqrt{x^2+y^2}$ $\tan^{-1}(y/x)$ $(y-xp)/(x+yp)$ $-T/R$ 1 y/x $(px-y)/x^2$ y/x x $(xp-y)/x^2$ $1/T$ a x 1 x^2-2ay x/a $x-ap$ $1/(2aT)$ a y p $x-a\ln y$ x/a p/y $(1/a)/(1-aT)$ x b $-p$ e^y/x^b y/b e^y*p^b $(bR)^{-1}/[1-b(R/T)^{(1/b)}]$ y b $-p^2$ y^2-2bx y/b $y-b/p$ $1/(2bT)$ 0 $e^{f(x)}$ $f'e^f$ x y/e^f $p-yf'$ $T/e^{f(R)}$ x^2 xy $y-xp$ y/x $1/x$ $xp-y$ $1/T$ xy y^2 $yp-xp^2$ y/x $1/y$ $y/p-x$ $1/(TR^2)$ xy 0 $-yp-xp^2$ y $(\ln x)/y$ $y/(xp)-\ln x$ T/R^2 0 xy $y+xp$ x $(\ln y)/x$ $xp/y-\ln y$ T/R^2 $g(y)$ 0 $-g'p^2$ y x/g $1/p-xg'/g$ $T/g(R)$ 0 $f(x)$ f' x y/f $fp-f'y$ $T/f^2(R)$ $f(x)$ 0 $-f'p$ y $F\ (F'f=1)$ pf $1/T$ 0 $g(y)$ $g'p$ x $G\ (G'g=1)$ p/g T x^{k-1} kx^ky $x^k(k^2y/x-p)$ y/x^k $1/x^k$ $xp-ky$ $-k/T$ kxy^k y^{k+1} $y^k(p-k^2xp^2/y)$ x/y^k $1/y^k$ $y/p-kx$ $-k/T$ where $D^{(n)}=\frac{\partial}{\ }+\frac{dy}{\ }\frac{\partial}{\ }+\frac{dy^{(1)}}{\ }\frac{\partial}{\ }+\dots+y^{(n+1)}\frac{\partial}{\ }$ (16.40)

Identifier	Page	Conf.	LaTeX source	Rendered	Image
gilmore-lie-groups_F03233	311	0.852	`y / p-k x`	$y/p-kx$	 where $D^{(n)} = \frac{\partial}{} + \frac{dy}{}\frac{\partial}{} + \frac{dy^{(1)}}{}\frac{\partial}{} + \ldots + y^{(n+1)}\frac{\partial}{}$ (16.40)
gilmore-lie-groups_F03234	312	1.000	`F\left(x, y, y^{\prime}, y^{\prime \prime}\right)=0`	$F\left(x, y, y^{\prime}, y^{\prime \prime}\right)=0$	ing group (16.36). Then the dependent coordinate is $S=\ln y$ and the surface equa-
gilmore-lie-groups_F03235	312	1.000	`S=\ln y`	$S=\ln y$	tion can be expressed in terms of three invariant coordinates as $F(R,-,T,U)=0$.
gilmore-lie-groups_F03236	312	1.000	`F(R,-, T, U)=0`	$F(R,-,T,U)=0$	Here as before R depends only on x and y, $T=T(x,y,y')$, and $U=U(x,y,y',y'')$
gilmore-lie-groups_F03237	312	1.000	`y, T=T\left(x, y, y^{\prime}\right)`	$y, T=T\left(x, y, y^{\prime}\right)$	is another invariant coordinate. How does one construct such an invariant coordi-
gilmore-lie-groups_F03238	312	1.000	`U=U\left(x, y, y^{\prime}, y^{\prime \prime}\right)`	$U=U\left(x, y, y^{\prime}, y^{\prime \prime}\right)$	is another invariant coordinate. How does one construct such an invariant coordi-
gilmore-lie-groups_F03239	312	1.000	`d T / d R`	dT/dR	
gilmore-lie-groups_F03240	312	1.000	`y^{\prime \prime}`	y''	This is a first order equation in T. Certain forms of the fur
gilmore-lie-groups_F03241	313	1.000	`F\left(x, y, \ldots, y^{(n)}\right)=0`	$F\left(x, y, \ldots, y^{(n)}\right)=0$	equation $F(x,y,\ldots,y^{(n)})=0$. As usual, we seek an infinitesimal generator
gilmore-lie-groups_F03242	313	1.000	`T\left(x, y, y^{(1)}\right)`	$T\left(x, y, y^{(1)}\right)$	the existence of a Lie symmetry can be used to reduce an nth order equation to an
gilmore-lie-groups_F03243	313	1.000	`d T^{(j)} / d R^{(j)}, j=0`	$dT^{(j)}/dR^{(j)}, j=0$	$(n-1)$st order equation.
gilmore-lie-groups_F03244	313	1.000	`j=1,2, \ldots, n-1`	$j=1,2,\ldots,n-1$	
gilmore-lie-groups_F03245	313	1.000	`y^{(j+1)}`	$y^{(j+1)}$	
gilmore-lie-groups_F03246	314	1.000	`x^{i} \rightarrow \lambda x^{i}, u \rightarrow \alpha u`	$x^{i} \rightarrow \lambda x^{i}, u \rightarrow \alpha u$	scaling transformations $x^i \to \lambda x^i$, $u \to \alpha u$. Under the scaling transformation

Infinitesimal generators			Canonical coordinates			Constraint
$\xi(x,y)$	$\eta(x,y)$	$\zeta(x,y,p)$	$R(x,y)$	$S(x,y)$	$T(x,y,p)$	dS/dR
0	1	0	x	y	p	T
1	0	0	y	x	p	$1/T$
$1/a$	$-1/b$	0	$ax+by$	$bx-ay$	p	$(b-aT)/(a+bT)$
x	0	$-p$	y	$\ln x$	xp	$1/T$
0	y	p	x	$\ln y$	p/y	T
x/a	y/b	$(1/b-1/a)p$	y^b/x^a	$b\ln y$	$p/x^{(a/b-1)}$	$(bT/R)/(bT-aR^{(1/b)})$
x	y	0	y/x	$\ln y$	p	$(T/R)/(T-R)$
x	$-y$	$-2p$	xy	$\ln y$	x^2p	$(T/R)/(T+R)$
$2x$	y	$-p$	y^2/x	$\ln y$	yp	$(T/R)/(2T-R)$
x	$2y$	p	y/x^2	$\ln y$	p/x	$(T/R)/(T-2R)$
y	0	$-p^2$	y	x/y	$x-y/p$	$-T/R^2$
0	x	1	x	y/x	$xp-y$	T/R^2
$-y$	x	$1+p^2$	$\sqrt{x^2+y^2}$	$\tan^{-1}(y/x)$	$(y-xp)/(x+yp)$	$-T/R$
1	y/x	$(px-y)/x^2$	y/x	x	$(xp-y)/x^2$	$1/T$
a	x	1	x^2-2ay	x/a	$x-ap$	$1/(2aT)$
a	y	p	$x-a\ln y$	x/a	p/y	$(1/a)/(1-aT)$
x	b	$-p$	e^y/x^b	y/b	$e^y * p^b$	$(bR)^{-1}/[1-b(R/T)^{(1/b)}]$
y	b	$-p^2$	y^2-2bx	y/b	$y-b/p$	$1/(2bT)$
0	$e^{f(x)}$	$f'e^f$	x	y/e^f	$p-yf'$	$T/e^{f(R)}$
x^2	xy	$y-xp$	y/x	$1/x$	$xp-y$	$1/T$
xy	y^2	$yp-xp^2$	y/x	$1/y$	$y/p-x$	$1/(TR^2)$
xy	0	$-yp-xp^2$	y	$(\ln x)/y$	$y/(xp)-\ln x$	T/R^2
0	xy	$y+xp$	x	$(\ln y)/x$	$xp/y-\ln y$	T/R^2
$g(y)$	0	$-g'p^2$	y	x/g	$1/p-xg'/g$	$T/g(R)$
0	$f(x)$	f'	x	y/f	$fp-f'y$	$T/f^2(R)$
$f(x)$	0	$-f'p$	y	$F\ (F'f=1)$	pf	$1/T$
0	$g(y)$	$g'p$	x	$G\ (G'g=1)$	p/g	T
x^{k-1}	kx^ky	$x^k(k^2y/x-p)$	y/x^k	$1/x^k$	$xp-ky$	$-k/T$
kxy^k	y^{k-1}	$y^k(p-k^2xp^2/y)$	x/y^k	$1/y^k$	$y/p-kx$	$-k/T$

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gilmore-lie-groups_F03247	314	1.000	`\delta(x) \rightarrow \delta(\lambda x)=\lambda^{-n} \delta(x)`	$\delta(x) \rightarrow \delta(\lambda x)=\lambda^{-n} \delta(x)$	$\delta(x) \rightarrow \delta(\lambda x) = \lambda^{-n}\delta(x)$, so
gilmore-lie-groups_F03248	314	1.000	`\alpha=\lambda^{2-n}`	$\alpha=\lambda^{2-n}$	metries for this equation therefore consist of generators of rotations and scale
gilmore-lie-groups_F03249	314	1.000	`R=R(x, u)`	$R=R(x, u)$	combination of the generators in Eq. (16.52). A solution is $R = u\|x\|^{2-n}$. As a result, $u \sim \|x\|^{2-n} = k\|x\|^{2-n}$. The constant of proportionality can be computed using the
gilmore-lie-groups_F03250	314	1.000	`R \sim u|x|^{n-2}`	$R \sim u\|x\|^{n-2}$	divergence theorem. Both sides of Eq. (16.50) are integrated over the interior of a
gilmore-lie-groups_F03251	314	1.000	`u \sim|x|^{2-n}=k|x|^{2-n}`	$u \sim \|x\|^{2-n}=k\|x\|^{2-n}$	unit sphere in R^n. The volume integral on the right is $+1$. The volume integral on
gilmore-lie-groups_F03252	314	1.000	`V\left(S^{n-1}\right)=2 \pi^{n / 2} / \Gamma\left( \frac{n}{2}\right)`	$V\left(S^{n-1}\right)=2 \pi^{n / 2} / \Gamma\left(\frac{n}{2}\right)$	is
gilmore-lie-groups_F03253	314	1.000	`R^{n}(n \neq 2)`	$R^{n}(n \neq 2)$	$u(x) = \frac{k}{\|x\|^{n-2}}$ $k = \frac{1}{(n-2)V(S^n)}$ (16.54)
gilmore-lie-groups_F03254	314	1.000	`u(x, t)`	$u(x, t)$	is treated similarly (Olver, 1993). It is invariant un X_i are Lie symmetries. Under the scaling transfo
gilmore-lie-groups_F03255	314	1.000	`u \rightarrow \alpha u, t \rightarrow \beta t`	$u \rightarrow \alpha u, t \rightarrow \beta t$	Invariance under the scaling transformations places the following two constraints on
gilmore-lie-groups_F03256	314	1.000	`x^{i} \rightarrow \lambda x^{i}`	$x^{i} \rightarrow \lambda x^{i}$	invariance under the scaling transformations the three scaling variables (since there is only
gilmore-lie-groups_F03257	314	1.000	`\alpha \lambda^{n}=1`	$\alpha \lambda^{n}=1$	
gilmore-lie-groups_F03258	314	1.000	`\beta / \lambda^{2}=1`	$\beta / \lambda^{2}=1$	
gilmore-lie-groups_F03259	315	1.000	`n+1`	$n+1$	From these relations it is possible to construct $n+1$ additional Lie symmetries, so
gilmore-lie-groups_F03260	315	1.000	`x^{i}, t`	x^{i}, t	which we obtain as before
gilmore-lie-groups_F03261	315	1.000	`R=u t^{n / 2} e^{|x|^{2} / 4 t}`	$R=u t^{n / 2} e^{\|x\|^{2} / 4 t}$	which we obtain as before
gilmore-lie-groups_F03262	315	1.000	`F(R,-, T)=`	$F(R,-, T)=$	$\int f(R,-, T(R))dR?$
gilmore-lie-groups_F03263	315	0.980	`\int f(R,-, T(R)) d R`	$\int f(R,-, T(R)) d R$	
gilmore-lie-groups_F03264	316	1.000	`\xi, \eta`	ξ, η	1850 Galois solve algebraic equations 1874 Lie solve differential equations 1969 Risch integrate in closed form ? – solve determining equations for ξ, η ? – solve determining equations for R, S, T ? – solve $F(R,-, T)=0$ for R. It is clear that additional algorithms are possible and desirable.
gilmore-lie-groups_F03265	316	1.000	`\zeta(x, y, p)=\eta^{(1)}\left(x, y, y^{(1)}\right)`	$\zeta(x, y, p)=\eta^{(1)}\left(x, y, y^{(1)}\right)$	differential equation.
gilmore-lie-groups_F03266	316	1.000	`X=\xi \partial / \partial x+\eta \partial / \partial y+ \zeta \partial / \partial p`	$X=\xi \partial / \partial x+\eta \partial / \partial y+ \zeta \partial / \partial p$	$\eta(x, y)$.
gilmore-lie-groups_F03267	316	1.000	`F=0`	$F=0$	equation is independent of the new dependent variable $T = T(x, y)$ so
gilmore-lie-groups_F03268	316	1.000	`X R=0, X S=1, X T=0`	$X R=0, X S=1, X T=0$	
gilmore-lie-groups_F03269	316	1.000	`F \rightarrow F(R,-, T)=0`	$F \rightarrow F(R,-, T)=0$	

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gilmore-lie-groups_F03270	317	1.000	`S: S=\int f(R,-, T(R))+c`	$S : S = \int f(R, -, T(R)) + c$	(viii) Solve the constraint equation for S: $S = \int f(R, -, T(R)) + c$. (ix) Backsubstitute the original coordinates for the new coordinates,
gilmore-lie-groups_F03271	317	1.000	`x=x(R, S)`	$x = x(R, S)$	(ix) Backsubstitute the original coordinates for the new coordinates, $x = x(R, S)$ and
gilmore-lie-groups_F03272	317	1.000	`y=y(R, S)`	$y = y(R, S)$	
gilmore-lie-groups_F03273	317	1.000	`n=0,1`	$n = 0, 1$	Construct the invariance group for each of the transformations presented in Table
gilmore-lie-groups_F03274	317	1.000	`V(\mathbf{x})`	$V(\mathbf{x})$	
gilmore-lie-groups_F03275	317	1.000	`m \rightarrow \alpha m), \mathbf{x} \rightarrow \beta \mathbf{x}, t \rightarrow \gamma t`	$m \rightarrow \alpha m), \mathbf{x} \rightarrow \beta \mathbf{x}, t \rightarrow \gamma t$	
gilmore-lie-groups_F03276	317	1.000	`k: V(\beta \mathbf{x}) \rightarrow \beta^{k} V( \mathbf{x})`	$k : V(\beta \mathbf{x}) \rightarrow \beta^{k} V(\mathbf{x})$	
gilmore-lie-groups_F03277	317	1.000	`\alpha^{1} \beta^{2-k}`	$\alpha^{1} \beta^{2-k}$	
gilmore-lie-groups_F03278	317	1.000	`\gamma^{-2}=1`	$\gamma^{-2} = 1$	
gilmore-lie-groups_F03279	317	1.000	`\alpha=1`	$\alpha = 1$	
gilmore-lie-groups_F03280	317	1.000	`\gamma^{2}=\beta^{2-k}`	$\gamma^{2} = \beta^{2-k}$	
gilmore-lie-groups_F03281	317	1.000	`k=-1, k=0, k,=+1, k=+2`	$k = -1, k = 0, k, = +1, k = +2$	
gilmore-lie-groups_F03282	318	1.000	`\gamma^{2}=\beta^{3}`	$\gamma^{2} = \beta^{3}$	k Potential type Transformation -1 Coulomb $\gamma^2 = \beta^3$ 0 no force $\gamma^2 = \beta^2$ $+1$ local gravitational potential $\gamma^2 = \beta^1$ $+2$ harmonic oscillator $\gamma^2 = \beta^0$
gilmore-lie-groups_F03283	318	1.000	`\gamma^{2}=\beta^{2}`	$\gamma^{2} = \beta^{2}$	k Potential type Transformation -1 Coulomb $\gamma^2 = \beta^3$ 0 no force $\gamma^2 = \beta^2$ $+1$ local gravitational potential $\gamma^2 = \beta^1$ $+2$ harmonic oscillator $\gamma^2 = \beta^0$
gilmore-lie-groups_F03284	318	1.000	`\gamma^{2}=\beta^{1}`	$\gamma^{2} = \beta^{1}$	k Potential type Transformation -1 Coulomb $\gamma^2 = \beta^3$ 0 no force $\gamma^2 = \beta^2$ $+1$ local gravitational potential $\gamma^2 = \beta^1$ $+2$ harmonic oscillator $\gamma^2 = \beta^0$
gilmore-lie-groups_F03285	318	1.000	`\gamma^{2}=\beta^{0}`	$\gamma^{2} = \beta^{0}$	k Potential type Transformation -1 Coulomb $\gamma^2 = \beta^3$ 0 no force $\gamma^2 = \beta^2$ $+1$ local gravitational potential $\gamma^2 = \beta^1$ $+2$ harmonic oscillator $\gamma^2 = \beta^0$
gilmore-lie-groups_F03286	318	0.785	`\gamma^{2}`	γ^{2}	and T' are the semiaxis and period of planet P' and R and T are the semiaxis and
gilmore-lie-groups_F03287	318	0.785	`\beta^{3}`	β^{3}	and T' are the semiaxis and period of planet P' and R and T are the semiaxis and
gilmore-lie-groups_F03288	318	0.785	`R^{\prime}`	$R^{\prime}$	and T' are the semiaxis and period of planet P' and R and T are the semiaxis and

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gilmore-lie-groups_F03289	318	1.000	`T^{\prime}`	T'	period of planet P, and the two planets P and P' have geometrically similar orbits,
gilmore-lie-groups_F03290	318	1.000	`P^{\prime}`	P'	period of planet P, and the two planets P and P' have geometrically similar orbits,
gilmore-lie-groups_F03291	318	1.000	`\beta^{3} \rightarrow\left(R^{\prime} / R\right)^{3}= \left(T^{\prime} / T\right)^{2} \leftarrow \gamma^{2}`	$\beta^3 \rightarrow (R'/R)^3 = (T'/T)^2 \leftarrow \gamma^2$	Newton's second law in the absence of forces in an inertial frame: the distance traveled (β) is proportional to the time elapsed (γ). The third line is a statement that
gilmore-lie-groups_F03292	318	0.860	`(\beta)`	(β)	like the square of the time elapsed. The fourth line is a statement of Hooke's law:
gilmore-lie-groups_F03293	318	0.860	`(\gamma)`	(γ)	like the square of the time elapsed. The fourth line is a statement of Hooke's law:
gilmore-lie-groups_F03294	318	1.000	`V=m g z`	$V = mgz$	in harmonic motion the period (γ) is independent of the size of the orbit.
gilmore-lie-groups_F03295	318	1.000	`\gamma=1`	$\gamma = 1$	**d.** Fix $\beta = 1$ and show that the period scales like $\sqrt{M}$ for all homogeneous potentials.
gilmore-lie-groups_F03296	318	1.000	`\beta=1`	$\beta = 1$	independent of its mass in lowest order.
gilmore-lie-groups_F03297	318	1.000	`\sqrt{M}`	$\sqrt{M}$	independent of its mass in lowest order.
gilmore-lie-groups_F03298	318	0.994	`\alpha \beta^{2} \gamma^{-2}=\beta^{k}`	$\alpha\beta^2\gamma^{-2} = \beta^k$	example, the Euler–Lagrange equations are derived from the variation of an action:
gilmore-lie-groups_F03299	318	1.000	`\delta \int \mathcal{L}(\mathbf{x}, \dot{\mathbf{x}}) d \mathbf{x}=0`	$\delta \int \mathcal{L}(\mathbf{x}, \dot{\mathbf{x}}) d\mathbf{x} = 0$	$\partial^2 u \quad \partial u$
gilmore-lie-groups_F03300	318	1.000	`v_{i}`	v_i	
gilmore-lie-groups_F03301	318	1.000	`e^{\epsilon v_{i}} f(x, t)`	$e^{\epsilon v_i} f(x,t)$	
gilmore-lie-groups_F03302	319	1.000	`e^{\epsilon v_{i}} f(x, t)=`	$e^{\epsilon v_i} f(x,t) =$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon, t)$ v_2 ∂_t $f(x, t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x + \epsilon^2 t} f(x - 2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ xo-dimensional wave equation is
gilmore-lie-groups_F03303	319	1.000	`\partial_{x}`	∂_x	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon, t)$ v_2 ∂_t $f(x, t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x + \epsilon^2 t} f(x - 2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ xo-dimensional wave equation is
gilmore-lie-groups_F03304	319	1.000	`f(x-\epsilon, t)`	$f(x-\epsilon, t)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon, t)$ v_2 ∂_t $f(x, t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x + \epsilon^2 t} f(x - 2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ xo-dimensional wave equation is

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gilmore-lie-groups_FO3305	319	■1.000	`\partial_{t}`	∂_t	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_FO3306	319	■1.000	`f(x, t-\epsilon)`	$f(x,t-\epsilon)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_FO3307	319	■1.000	`u \partial_{u}`	$u\partial_u$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_FO3308	319	■1.000	`e^{\epsilon} f(x, t)`	$e^{\epsilon} f(x,t)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_FO3309	319	■1.000	`v_{4}`	v_4	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_FO3310	319	■1.000	`x \partial_{x}+2 t \partial_{t}`	$x\partial_x + 2t\partial_t$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is

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gilmore-lie-groups_F03311	319	■1.000	`f\left(e^{-\epsilon} x, e^{-2 \epsilon} t\right)`	$f\left(e^{-\epsilon} x, e^{-2 \epsilon} t\right)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03312	319	■1.000	`v_{5}`	v_5	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03313	319	■1.000	`2 t \partial_{x}-x u \partial_{u}`	$2t\partial_x - xu\partial_u$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03314	319	■1.000	`e^{-\epsilon x+\epsilon^{2} t} f(x-2 \epsilon t, t)`	$e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03315	319	■1.000	`v_{6}`	v_6	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03316	319	■1.000	`4 x t \partial_{x}+4 t^{2} \partial_{t}-\left(x^{2}+2 t \right) u \partial_{u}`	$4xt\partial_x + 4t^2\partial_t - \left(x^2+2t\right) u\partial_u$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon,t)$ v_2 ∂_t $f(x,t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x+\epsilon^2 t} f(x-2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is

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gilmore-lie-groups_F03317	319	■1.000	`\lambda e^{-\epsilon \lambda^{2} x^{2}} f\left( \lambda^{2} x, \lambda^{2} t\right)`	$\lambda e^{-\epsilon\lambda^2 x^2} f\left(\lambda^2 x, \lambda^2 t\right)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon, t)$ v_2 ∂_t $f(x, t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x + \epsilon^2 t} f(x - 2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03318	319	■1.000	`\lambda^{2}=1 /(1+4 \epsilon t)`	$\lambda^2 = 1/(1+4\epsilon t)$	v_i Infinitesial $e^{\epsilon v_i} f(x,t) =$ v_1 ∂_x $f(x-\epsilon, t)$ v_2 ∂_t $f(x, t-\epsilon)$ v_3 $u\partial_u$ $e^{\epsilon} f(x,t)$ v_4 $x\partial_x + 2t\partial_t$ $f(e^{-\epsilon}x, e^{-2\epsilon}t)$ v_5 $2t\partial_x - xu\partial_u$ $e^{-\epsilon x + \epsilon^2 t} f(x - 2\epsilon t, t)$ v_6 $4xt\partial_x + 4t^2\partial_t - (x^2+2t)u\partial_u$ $\lambda e^{-\epsilon\lambda^2 x^2} f(\lambda^2 x, \lambda^2 t)$ where $\lambda^2 = 1/(1+4\epsilon t)$ wo-dimensional wave equation is
gilmore-lie-groups_F03319	319	■1.000	`D_{2}=u \partial_{u}`	$D_2 = u\partial_u$	$SO(2+1, 1+1) = SO(3,2)$.
gilmore-lie-groups_F03320	319	■1.000	`S O(2+1,1+1)=S O(3,2)`	$SO(2+1,1+1) = SO(3,2)$	generators. Show that 15 satisfy
gilmore-lie-groups_F03321	319	■1.000	`S O(3+1,1+1)=S O(4,2)`	$SO(3+1,1+1) = SO(4,2)$	Show that (Stewart, 1980)
gilmore-lie-groups_F03322	319	■1.000	`u_{x x}-u_{t}=0`	$u_{xx} - u_t = 0$	$= a_1 + a_2 x + a_3 t + a_4 xt$
gilmore-lie-groups_F03323	319	■1.000	`X=\xi^{i} \frac{\partial}{\partial x^{i}}+\eta \frac{\partial}{\partial u}+\cdots=\xi^{1} \frac{\partial}{\partial x}+\xi^{2} \frac{\partial}{\partial t}+\eta \frac{\partial}{\partial u}+\cdots`	$X = \xi^i \frac{\partial}{\partial x^i} + \eta\frac{\partial}{\partial u} + \cdots = \xi^1\frac{\partial}{\partial x} + \xi^2\frac{\partial}{\partial t} + \eta\frac{\partial}{\partial u} + \cdots$	$\xi^2 = 2a_2 t + a_4 t^2 + a_5$
gilmore-lie-groups_F03324	320	■1.000	`h(x, t)`	$h(x,t)$	Here $h(x,t)$ is any function that satisfies the homogeneous heat equation. Construct
gilmore-lie-groups_F03325	320	■0.986	`\left(t \rightarrow t^{\prime}=T(t, x, \epsilon)=t+ \right.`	$(t \to t' = T(t,x,\epsilon) = t+$	
gilmore-lie-groups_F03326	320	■1.000	`\left.\epsilon \xi(t, x), x_{i} \rightarrow x_{i}^{ \prime}=X_{i}(t, x, \epsilon)=x_{i}+\epsilon \eta_{i}(t, x)\right)`	$\epsilon\xi(t,x), x_i \to x_i' = X_i(t,x,\epsilon) = x_i + \epsilon\eta_i(t,x))$	$I = \int L(t', x', x')dt' = \int L(t', x', x')\frac{dt'}{dt}dt$
gilmore-lie-groups_F03327	320	■1.000	`d t^{\prime} / d t=\partial T / \partial t+\left(\partial T / \partial x_{i}\right) d x_{i} / d t`	$dt'/dt = \partial T/\partial t + (\partial T/\partial x_i)\, dx_i/dt$	$\int \left(\xi\frac{\partial L}{\partial t} + \eta_i \frac{\partial L}{\partial x_i} + \eta_i^{(1)}\frac{\partial L}{\partial x_i} + \frac{d\xi}{dt}L\right)dt = 0$
gilmore-lie-groups_F03328	320	■1.000	`\epsilon=0`	$\epsilon = 0$	
gilmore-lie-groups_F03329	321	■1.000	`L[u]=`	$L[u] =$	the dynamics of a system is derivable from an action integral of the form $L[u] =$
gilmore-lie-groups_F03330	321	■1.000	`\int \mathcal{L}(x, u) d x, x \in R^{p}, u \in R^{q}`	$\int \mathcal{L}(x,u)dx, x \in R^p, u \in R^q$	$\int \mathcal{L}(x,u)dx, x \in R^p, u \in R^q$, and suppose the infinitesimal generators that leave the dynamics invariant have the form
gilmore-lie-groups_F03331	321	■1.000	`d \rho(g)`	$d\rho(g)$	structed by reduction of tensor products (Wigner–Stone theorem), and $\phi(g), \psi(g)$
gilmore-lie-groups_F03332	321	■0.995	`\operatorname{Vol}(G)=\int d \rho(g), \Gamma_{\mu \nu}^{ \lambda}(g)`	$\mathrm{Vol}(G) = \int d\rho(g), \Gamma^{\lambda}_{\mu\nu}(g)$	are functions defined on the group manifold. The orthogonality and completeness
gilmore-lie-groups_F03333	321	■1.000	`\phi(g), \psi(g)`	$\phi(g), \psi(g)$	relations are
gilmore-lie-groups_F03334	322	■1.000	`\psi(g)=\langle g \mid \psi\rangle`	$\psi(g) = \langle g \mid \psi\rangle$	**c.** Carry out a Fourier decomposition on the functions $\psi(g) = \langle g\|\psi\rangle$ and $\langle \overset{\lambda}{\mu\nu} \|\psi\rangle =$

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gilmore-lie-groups_F03335	322	1.000	`\left\langle{ }_{\mu \nu}^{\lambda} \mid \psi\right \rangle=`	$\left\langle {}_{\mu\nu}^{\lambda} \mid \psi \right\rangle =$	**c.** Carry out a Fourier decomposition on the functions $\psi(g) = \langle g\|\psi\rangle$ and $\langle {}_{\mu\nu}^{\lambda}\|\psi\rangle =$
gilmore-lie-groups_F03336	322	1.000	`\int d \rho(g)\left\langle{ }_{\mu \nu}^{\lambda} \mid g \right\rangle\langle g \mid \psi\rangle`	$\int d\rho(g) \left\langle {}_{\mu\nu}^{\lambda} \mid g \right\rangle \langle g \mid \psi \rangle$	$\int d\rho(g)\langle {}_{\mu\nu}^{\lambda}\|g\rangle\langle g\|\psi\rangle$ (and similarly for $\phi(g) = \langle g\|\phi\rangle$) using the Dirac represen-
gilmore-lie-groups_F03337	322	1.000	`\phi(g)=\langle g \mid \phi\rangle`	$\phi(g) = \langle g \mid \phi \rangle$	$\int d\rho(g)\langle {}_{\mu\nu}^{\lambda}\|g\rangle\langle g\|\psi\rangle$ (and similarly for $\phi(g) = \langle g\|\phi\rangle$) using the Dirac represen-
gilmore-lie-groups_F03338	322	1.000	`\int \phi^{*}(g) \psi(g) d \rho(g)`	$\int \phi^{*}(g)\psi(g)d\rho(g)$	tation. Write down the Parseval equality for the inner product $\int \phi^{*}(g)\psi(g)d\rho(g)$
gilmore-lie-groups_F03339	323	1.000	`\mathrm{He}^{+}`	He^{+}	H. A. BETHE AND E. E. SALPETER (1957), *Quantum Mechanics of One- and Two-Electron*
gilmore-lie-groups_F03340	324	0.868	`A_{n} ; D_{n}, B_{n}, C_{n}, J`	$A_n; D_n, B_n, C_n, J$	1853–1854.
gilmore-lie-groups_F03341	325	0.866	`\mathrm{mx} /{ }^{\sim}`	$\mathrm{mx}/^{\sim}$	*Physics, Memoirs of the American Mathema*
gilmore-lie-groups_F03342	327	0.995	`A(p q), 39,48`	$A(pq), 39, 48$	A_2, 151, 160
gilmore-lie-groups_F03343	327	0.978	`A_{1}, 161`	$A_1, 161$	A_3, 46
gilmore-lie-groups_F03344	327	0.991	`A_{2}`	A_2	B_n, 161
gilmore-lie-groups_F03345	327	0.865	`A_{3}, 46,161,162`	$A_3, 46, 161, 162$	B_2, 151, 160, 16
gilmore-lie-groups_F03346	327	0.946	`A_{n}, 46,49,161,166`	$A_n, 46, 49, 161, 166$	B_3, 162
gilmore-lie-groups_F03347	327	0.992	`B_{1}, 161`	$B_1, 161$	B_n, 16
gilmore-lie-groups_F03348	327	0.749	`B_{2}, 151,160,161,164`	$B_2, 151, 160, 161, 164$	C_1, 161
gilmore-lie-groups_F03349	327	0.761	`B_{3}, 162`	$B_3, 162$	C_2, 15
gilmore-lie-groups_F03350	327	0.729	`\boldsymbol{B}_{n}, 161,166,168`	$\boldsymbol{B}_n, 161, 166, 168$	C_3, 162
gilmore-lie-groups_F03351	327	1.000	`C_{1}, 161`	$C_1, 161$	C_n, 16
gilmore-lie-groups_F03352	327	0.523	`C_{2}, 151,160,161,164`	$C_2, 151, 160, 161, 164$	D_2, 151, 160, 162
gilmore-lie-groups_F03353	327	0.712	`C_{3}, 162`	$C_3, 162$	D_n, 16
gilmore-lie-groups_F03354	327	0.997	`C_{n}, 161,166,168`	$C_n, 161, 166, 168$	$E(2)$, 91, 207
gilmore-lie-groups_F03355	327	0.840	`D_{2}, 151,160,162`	$D_2, 151, 160, 162$	$E(3)$, 42
gilmore-lie-groups_F03356	327	0.435	`G L(1 ; \mathbb{Q}), 40,47`	$GL(1;\mathbb{Q}), 40, 47$	$GL(n;\mathbb{C})$, 47
gilmore-lie-groups_F03357	327	0.979	`G L(2 ; \mathbb{C}), 47`	$GL(2;\mathbb{C}), 47$	$GL(n;\mathbb{F})$, 3
gilmore-lie-groups_F03358	327	0.788	`G L(2 ; \mathbb{R})`	$GL(2;\mathbb{R})$	$GL(n;\mathbb{Q})$, 4
gilmore-lie-groups_F03359	327	0.731	`G L(2 ; \mathbb{Z}), 45,49`	$GL(2;\mathbb{Z}), 45, 49$	$GL(n;\mathbb{R})$, 47, 1
gilmore-lie-groups_F03360	327	0.903	`G L(3 ; \mathbb{Z}), 45`	$GL(3;\mathbb{Z}), 45$	G_2, 151, 16
gilmore-lie-groups_F03361	327	0.471	`G L(n ; \mathbb{F}), 34,36,74`	$GL(n;\mathbb{F}), 34, 36, 74$	H_n^2, 103, 189
gilmore-lie-groups_F03362	327	0.698	`G L(n ; \mathbb{Q})`	$GL(n;\mathbb{Q})$	H_n^2, 102, 18

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gilmore-lie-groups_F03363	327	0.973	`G_{2}, 151,160,162,165`	$G_2, 151, 160, 162, 165$	$ISO(2)$, little group, 2
gilmore-lie-groups_F03364	327	0.933	`\operatorname{HT}(p, q), 37,48`	$\mathrm{HT}(p, q), 37, 48$	$ISO(3)$, 208, 20
gilmore-lie-groups_F03365	327	0.634	`\operatorname{Nil}(n), 38,48`	$\mathrm{Nil}(n), 38, 48$	
gilmore-lie-groups_F03366	327	0.788	`O(31), 261`	$O(31), 261$	; $\mathbb{Z}$), 46
gilmore-lie-groups_F03367	327	0.988	`O(3), 40,78`	$O(3), 40, 78$	), 40, 43, 145
gilmore-lie-groups_F03368	327	1.000	`O(3 ; \mathbb{Z}), 46`	$O(3; \mathbb{Z}), 46$	$\mathbb{Z}$), 45, 49
gilmore-lie-groups_F03369	327	0.991	`O(n), 40,43,145`	$O(n), 40, 43, 145$	n), 43
gilmore-lie-groups_F03370	327	1.000	`O(n ; \mathbb{G}), 41`	$O(n; \mathbb{G}), 41$	($2n$), 43
gilmore-lie-groups_F03371	327	1.000	`O(n ; \mathbb{Z}), 45,49`	$O(n; \mathbb{Z}), 45, 49$	45
gilmore-lie-groups_F03372	327	0.737	`O(p, q)`	$O(p, q)$	2; $\mathbb{C}$), 43
gilmore-lie-groups_F03373	327	0.939	`P_{n}, 45`	$P_n, 45$	189
gilmore-lie-groups_F03374	327	0.901	`S L(2 ; \mathbb{C}), 43`	$SL(2; \mathbb{C}), 43$	n; $\mathbb{R}$), 30
gilmore-lie-groups_F03375	327	0.985	`S L(2 ; \mathbb{R}), 26,28,29,30,41,43,56,58,62,100,102`	$SL(2; \mathbb{R}), 26, 28, 29, 30, 41, 43, 56, 58, 62, 100, 102$	n, $\mathbb{C}$), 43, 47 n; $\mathbb{Q}$), 43
gilmore-lie-groups_F03376	327	0.956	`S L(n ; \mathbb{R}), 30`	$SL(n; \mathbb{R}), 30$	n; $\mathbb{Z}$), 45
gilmore-lie-groups_F03377	327	0.600	`S L(n ; \mathbb{C}), 43,47`	$SL(n; \mathbb{C}), 43, 47$	2, 1), 105
gilmore-lie-groups_F03378	327	0.519	`\operatorname{SL}(n ; \mathbb{Q})`	$\mathrm{SL}(n; \mathbb{Q})$	2, 1), little gro
gilmore-lie-groups_F03379	327	0.747	`\operatorname{SL}(n ; \mathbb{R})`	$\mathrm{SL}(n; \mathbb{R})$	2, 1)/$SO(2)$, 106
gilmore-lie-groups_F03380	327	0.880	`S L(n ; \mathbb{Z}), 45`	$SL(n; \mathbb{Z}), 45$	2), 48, 164
gilmore-lie-groups_F03381	327	0.703	`S O(2,1), 105`	$SO(2, 1), 105$	$2n$), 164
gilmore-lie-groups_F03382	327	0.943	`S O(2,1) / S O(2), 106`	$SO(2, 1)/SO(2), 106$	3, 1), little group, 267, 2
gilmore-lie-groups_F03383	327	0.820	`\operatorname{SO}(2), 48,164`	$\mathrm{SO}(2), 48, 164$	3, 2), 210
gilmore-lie-groups_F03384	327	0.621	`S O(2 n), 164`	$SO(2n), 164$	3), 49, 90, 106
gilmore-lie-groups_F03385	327	1.000	`S O(2 n+1), 164`	$SO(2n + 1), 164$	3), little group, 267
gilmore-lie-groups_F03386	327	0.607	`S O(3,1), 263`	$SO(3, 1), 263$	3)/$SO(2)$, 107
gilmore-lie-groups_F03387	327	0.979	`\operatorname{SO}(3), 49,90,106`	$\mathrm{SO}(3), 49, 90, 106$	n), 43, 145
gilmore-lie-groups_F03388	327	0.875	`S O(3) / S O(2), 107`	$SO(3)/SO(2), 107$	1, 1), 38, 43, 48, 105
gilmore-lie-groups_F03389	327	0.498	`\operatorname{SO}(4,1), 210`	$\mathrm{SO}(4, 1), 210$	1, 1)/$U(1)$, 106
gilmore-lie-groups_F03390	327	0.463	`\operatorname{SO}(n)`	$\mathrm{SO}(n)$	2)/$U(1)$, 107
gilmore-lie-groups_F03391	327	0.637	`\operatorname{SU}(1 ; \mathbb{Q}), 40,48`	$\mathrm{SU}(1; \mathbb{Q}), 40, 48$	p, q), 43, 164

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gilmore-lie-groups_F03392	327	0.998	`\operatorname{SU}(1,1), 38,43,48,105`	$\operatorname{SU}(1,1), 38, 43, 48, 105$	
gilmore-lie-groups_F03393	327	1.000	`S U(1,1) / U(1), 106`	$SU(1,1)/U(1), 106$	
gilmore-lie-groups_F03394	327	0.606	`\operatorname{SU}(2), 48,106`	$\operatorname{SU}(2), 48, 106$	
gilmore-lie-groups_F03395	327	0.999	`S U(2) / U(1), 107`	$SU(2)/U(1), 107$	
gilmore-lie-groups_F03396	327	0.983	`\operatorname{SU}(n), 43,90,164`	$\operatorname{SU}(n), 43, 90, 164$	
gilmore-lie-groups_F03397	327	0.962	`\operatorname{SU}(p, q), 43,164`	$\operatorname{SU}(p, q), 43, 164$	
gilmore-lie-groups_F03398	327	0.994	`S_{3}, 5,46`	$S_3, 5, 46$	
gilmore-lie-groups_F03399	328	0.886	`S_{n}, 45,49`	$S_n, 45, 49$	
gilmore-lie-groups_F03400	328	0.925	`\operatorname{Sol}(n), 38,48`	$\operatorname{Sol}(n), 38, 48$	
gilmore-lie-groups_F03401	328	0.986	`\operatorname{Sp}(1), 40`	$\operatorname{Sp}(1), 40$	
gilmore-lie-groups_F03402	328	0.995	`\operatorname{Sp}(2 ; \mathbb{R}), 41`	$\operatorname{Sp}(2; \mathbb{R}), 41$	
gilmore-lie-groups_F03403	328	0.883	`\operatorname{Sp}(2 n ; \mathbb{R}), 41`	$\operatorname{Sp}(2n; \mathbb{R}), 41$	
gilmore-lie-groups_F03404	328	0.739	`\operatorname{Sp}(n), 40,164`	$\operatorname{Sp}(n), 40, 164$	
gilmore-lie-groups_F03405	328	0.999	`\operatorname{Sp}(n ; \mathbb{C}), 41`	$\operatorname{Sp}(n; \mathbb{C}), 41$	
gilmore-lie-groups_F03406	328	0.944	`\operatorname{Sp}(n ; \mathbb{G}), 41`	$\operatorname{Sp}(n; \mathbb{G}), 41$	
gilmore-lie-groups_F03407	328	0.621	`\operatorname{Sp}(n ; \mathbb{R}, 41`	$\operatorname{Sp}(n; \mathbb{R}, 41$	
gilmore-lie-groups_F03408	328	0.903	`\operatorname{Sp}(p, q), 164`	$\operatorname{Sp}(p, q), 164$	
gilmore-lie-groups_F03409	328	0.970	`U(1,1), 43`	$U(1,1), 43$	
gilmore-lie-groups_F03410	328	0.619	`U(2), 40,78`	$U(2), 40, 78$	
gilmore-lie-groups_F03411	328	1.000	`U(2 ; \mathbb{Q}), 164`	$U(2; \mathbb{Q}), 164$	
gilmore-lie-groups_F03412	328	0.804	`U(n), 40,43,90`	$U(n), 40, 43, 90$	
gilmore-lie-groups_F03413	328	1.000	`U(n ; \mathbb{G}), 41`	$U(n; \mathbb{G}), 41$	
gilmore-lie-groups_F03414	328	1.000	`U(p, q), 43`	$U(p, q), 43$	
gilmore-lie-groups_F03415	328	0.713	`U \operatorname{Sp}(2 n), 44`	$U \operatorname{Sp}(2n), 44$	
gilmore-lie-groups_F03416	328	0.397	`\operatorname{UT}(p, q), 48`	$\operatorname{UT}(p, q), 48$	
gilmore-lie-groups_F03417	328	1.000	`\mathbb{Z}`	$\mathbb{Z}$	
gilmore-lie-groups_F03418	328	0.999	`S_{2}, 10`	$S_2, 10$	
gilmore-lie-groups_F03419	328	0.743	`S_{3}, 12`	$S_3, 12$	
gilmore-lie-groups_F03420	328	0.712	`C_{2}, 153`	$C_2, 153$	

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gilmore-lie-groups_F03421	329	1.000	`\overline{S O(2,1) / S O(2)}, 108`	$\overline{SO(2,1)/SO(2)}, 108$	creation operators, 84, 8
gilmore-lie-groups_F03422	329	0.560	`\overline{S U(1,1) / U(1)}, 108`	$\overline{SU(1,1)/U(1)}, 108$	bosons, 88
gilmore-lie-groups_F03423	330	1.000	`\mathfrak{a}(p, q), 77,129`	$\mathfrak{a}(p,q), 77, 129$	$\mathfrak{ou}(2n)$, 179
gilmore-lie-groups_F03424	330	0.874	`\mathfrak{g} \mathfrak{l}(n ; \mathbb{F}), 74,83`	$\mathfrak{gl}(n;\mathbb{F}), 74, 83$	$\mathfrak{o}(n;G)$, 79
gilmore-lie-groups_F03425	330	0.808	`\mathfrak{h t}(p, q), 75`	$\mathfrak{ht}(p,q), 75$	$\mathfrak{o}(p,q)$, 7
gilmore-lie-groups_F03426	330	0.891	`\operatorname{nil}(n), 77,130`	$\mathrm{nil}(n), 77, 130$	$\mathfrak{sl}(2;\mathbb{R})$, 100,
gilmore-lie-groups_F03427	330	1.000	`\mathfrak{o u}(2 n), 179`	$\mathfrak{ou}(2n), 179$	$\mathfrak{sl}(n)$, 80
gilmore-lie-groups_F03428	330	1.000	`\mathfrak{o}(n ; G), 79`	$\mathfrak{o}(n;G), 79$	$\mathfrak{sl}(n;\mathbb{C})$,
gilmore-lie-groups_F03429	330	0.997	`\mathfrak{o}(p, q), 78`	$\mathfrak{o}(p,q), 78$	$\mathfrak{sl}(n;\mathbb{R})$,
gilmore-lie-groups_F03430	330	0.630	`\mathfrak{s} \mathfrak{l}(2 ; \mathbb{R}), 100,102,154,173`	$\mathfrak{sl}(2;\mathbb{R}), 100, 102, 154, 173$	$\mathfrak{sal}(n)$, 77, 130
gilmore-lie-groups_F03431	330	0.811	`\mathfrak{s l}(n), 80`	$\mathfrak{sl}(n), 80$	$\mathfrak{so}(2,1$
gilmore-lie-groups_F03432	330	0.637	`\mathfrak{s} \mathfrak{l}(n ; \mathbb{C}), 80,85,86`	$\mathfrak{sl}(n;\mathbb{C}), 80, 85, 86$	$\mathfrak{so}(2n)$, 180
gilmore-lie-groups_F03433	330	0.940	`\mathfrak{s l}(n ; \mathbb{Q}), 80,86`	$\mathfrak{sl}(n;\mathbb{Q}), 80, 86$	$\mathfrak{so}(3,1)$, 79
gilmore-lie-groups_F03434	330	0.743	`\mathfrak{s} \mathfrak{l}(n ; \mathbb{R}), 80,85,178,180`	$\mathfrak{sl}(n;\mathbb{R}), 80, 85, 178, 180$	$\mathfrak{so}(3,2)$, 86
gilmore-lie-groups_F03435	330	0.808	`\mathfrak{s} \mathfrak{o} \mathfrak{l}(n), 77,130`	$\mathfrak{sol}(n), 77, 130$	$\mathfrak{so}(3)$, 86, 90,
gilmore-lie-groups_F03436	330	0.932	`\mathfrak{s} \mathfrak{o}(2,1), 78`	$\mathfrak{so}(2,1), 78$	$\mathfrak{so}(4,1)$,
gilmore-lie-groups_F03437	330	0.608	`\mathfrak{s o}(2 n), 180`	$\mathfrak{so}(2n), 180$	$\mathfrak{so}(4)$, 15,
gilmore-lie-groups_F03438	330	0.802	`\mathfrak{s} \mathfrak{o}(3,1), 79`	$\mathfrak{so}(3,1), 79$	$\mathfrak{so}(n)$, 13
gilmore-lie-groups_F03439	330	0.887	`\mathfrak{s} \mathfrak{o}(3,2), 86`	$\mathfrak{so}(3,2), 86$	$\mathfrak{so}(p,q)$,
gilmore-lie-groups_F03440	330	1.000	`\mathfrak{s} \mathfrak{o}(3), 86,90,154`	$\mathfrak{so}(3), 86, 90, 154$	$\mathfrak{so}^*(2n)$, 180
gilmore-lie-groups_F03441	330	0.666	`\mathfrak{s} \mathfrak{o}(4,1), 86`	$\mathfrak{so}(4,1), 86$	$\mathfrak{sp}(2n;\mathbb{R})$
gilmore-lie-groups_F03442	330	0.930	`\mathfrak{s o}(4), 132`	$\mathfrak{so}(4), 132$	$\mathfrak{sp}(G;\mathbb{C}$
gilmore-lie-groups_F03443	330	0.562	`\mathfrak{s} \mathfrak{o}(5), 86,146`	$\mathfrak{so}(5), 86, 146$	$\mathfrak{sp}(G;\mathbb{R})$, 7
gilmore-lie-groups_F03444	330	0.651	`\mathfrak{s o}(n), 132,145,178`	$\mathfrak{so}(n), 132, 145, 178$	$\mathfrak{sp}(n)$, 132, 178
gilmore-lie-groups_F03445	330	0.986	`\mathfrak{s} \mathfrak{o}(p, q), 84,178`	$\mathfrak{so}(p,q), 84, 178$	$\mathfrak{sp}(n;\mathbb{C})$, 19
gilmore-lie-groups_F03446	330	0.972	`\mathfrak{s} \mathfrak{o}^{*}(2 n), 180`	$\mathfrak{so}^*(2n), 180$	$\mathfrak{sp}(p,q)$, 7
gilmore-lie-groups_F03447	330	0.986	`\mathfrak{s} \mathfrak{p}(2 n ; \mathbb{R}), 178,179,180`	$\mathfrak{sp}(2n;\mathbb{R}), 178, 179, 180$	
gilmore-lie-groups_F03448	330	0.994	`\mathfrak{s p}(G ; \mathbb{C}), 79`	$\mathfrak{sp}(G;\mathbb{C}), 79$	
gilmore-lie-groups_F03449	330	0.788	`\mathfrak{s} \mathfrak{p}(G ; \mathbb{R}), 79`	$\mathfrak{sp}(G;\mathbb{R}), 79$	

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gilmore-lie-groups_F03450	330	0.986	`\mathfrak{s p}(n), 132,178`	$\mathfrak{sp}(n), 132, 178$	
gilmore-lie-groups_F03451	330	0.791	`\mathfrak{s p}(n ; G), 79`	$\mathfrak{sp}(n; G), 79$	
gilmore-lie-groups_F03452	330	0.767	`\mathfrak{s p}(p, q), 78,178`	$\mathfrak{sp}(p, q), 78, 178$	
gilmore-lie-groups_F03453	331	0.990	`\mathfrak{s} \mathfrak{u}(1,1), 140,141,143,173`	$\mathfrak{su}(1, 1), 140, 141, 143, 173$	$\mathfrak{su}(1, 1)$, 140, 141, 143, 173
gilmore-lie-groups_F03454	331	0.623	`\mathfrak{s u}(2), 111,140,141,143,173`	$\mathfrak{su}(2), 111, 140, 141, 143, 173$	$\mathfrak{su}(2)$, 111, 140, 141, 143, 173
gilmore-lie-groups_F03455	331	0.943	`\mathfrak{s} \mathfrak{u}(2 n), 180`	$\mathfrak{su}(2n), 180$	$\mathfrak{su}(2n)$, 18
gilmore-lie-groups_F03456	331	0.857	`\mathfrak{s} \mathfrak{u}(n), 80,132,178`	$\mathfrak{su}(n), 80, 132, 178$	$\mathfrak{su}(n)$, 80, 132, 178
gilmore-lie-groups_F03457	331	1.000	`\mathfrak{s} \mathfrak{u}(p, q), 85,178`	$\mathfrak{su}(p, q), 85, 178$	$\mathfrak{su}(p, q)$, 85, 178
gilmore-lie-groups_F03458	331	0.882	`\mathfrak{s} \mathfrak{u}^{*}(2 n), 180`	$\mathfrak{su}^*(2n), 180$	$\mathfrak{su}^*(2n)$, 17
gilmore-lie-groups_F03459	331	0.999	`\mathfrak{u s p}(2 n), 179`	$\mathfrak{usp}(2n), 179$	$\mathfrak{ut}(1, 1)$, 83
gilmore-lie-groups_F03460	331	1.000	`\mathfrak{u t}(1,1), 83`	$\mathfrak{ut}(1, 1), 83$	$\mathfrak{ut}(p, q, r)$
gilmore-lie-groups_F03461	331	0.993	`\mathfrak{u t}(p, q, r), 76`	$\mathfrak{ut}(p, q, r), 76$	$\mathfrak{ut}(p, q)$, 75,
gilmore-lie-groups_F03462	331	1.000	`\mathfrak{u t}(p, q), 75,131`	$\mathfrak{ut}(p, q), 75, 131$	$\mathfrak{u}(n)$, 80
gilmore-lie-groups_F03463	331	0.973	`\mathfrak{u}(n), 80`	$\mathfrak{u}(n), 80$	$\mathfrak{u}(n; \mathbb{F})$
gilmore-lie-groups_F03464	331	1.000	`\mathfrak{u}(n ; G), 79`	$\mathfrak{u}(n; G), 79$	$\mathfrak{u}(p, q)$, 76
gilmore-lie-groups_F03465	331	0.858	`\mathfrak{u}(p, q), 78`	$\mathfrak{u}(p, q), 78$	$\mathfrak{u}(p, q; \mathbb{F})$
gilmore-lie-groups_F03466	331	0.996	`\mathfrak{u}(p, q ; \mathbb{F}), 178`	$\mathfrak{u}(p, q; \mathbb{F}), 178$	Lie algebra. $\mathfrak{sl}(2$
gilmore-lie-groups_F03467	331	0.982	`\mathfrak{s l}(2 ; \mathbb{C}), 154`	$\mathfrak{sl}(2; \mathbb{C}), 154$	Lie algebras. 5
gilmore-lie-groups_F03468	332	0.676	`S U(2), 187`	$SU(2), 187$	representations, of $SU(2)$, 187
gilmore-lie-groups_F03469	332	0.679	`\operatorname{SU}(1,1), 187`	$\mathrm{SU}(1, 1), 187$	of $SU(1, 1)$, 18
gilmore-lie-groups_F03470	332	0.977	`c, 282`	$c, 282$	
gilmore-lie-groups_F03471	333	0.644	`S O(n), 183`	$SO(n), 183$	spin groups, and $SO(n)$, 183
gilmore-lie-groups_F03472	333	0.933	`S O(3), 164`	$SO(3), 164$	spinor, of $SO(3)$, 164
gilmore-lie-groups_F03473	333	0.662	`S O(5), 164`	$SO(5), 164$	of $SO(5)$, 164