Winkelfunktionen

$\sin(x+y)=\sin x\cos y+\cos x\sin y$	$\sin(z\pm\pi)=-\sin z$
$\sin(x-y)=\sin x\cos y-\cos x\sin y$	$\cos(z\pm\pi)=-\cos z$
$\cos(x+y)=\cos x\cos y-\sin x\sin y$	$\sin(\pi/2-x)=\cos x$
$\cos(x-y)=\cos x\cos y+\sin x\sin y$	$\cos(\pi/2-x)=\sin x$

$\sin(nx)=2\cos x\sin((n-1)x)-\sin((n-2)x)$	$\sin(-z)=-\sin z$
$\cos(nx)=2\cos x\cos((n-1)x)-\cos((n-2)x)$	$\cos(-z)=\cos z$

$\cos^2 z+\sin^2 z=1$	$\cosh^2 z-\sinh^2 z=1$	$\cosh(\mathrm{i}z)=\cos z$
$\mathrm{e}^{\mathrm{i}z}=\cos z+\mathrm{i}\sin z$	$\mathrm{e}^z=\cosh z+\sinh z$	$\sinh(\mathrm{i}z)=\mathrm{i}\sin z$
$2\cos z=\mathrm{e}^{\mathrm{i}z}+\mathrm{e}^{-\mathrm{i}z}$	$2\cosh z=\mathrm{e}^z+\mathrm{e}^{-z}$	$\cos(\mathrm{i}z)=\cosh z$
$2\mathrm{i}\sin z=\mathrm{e}^{\mathrm{i}z}-\mathrm{e}^{-\mathrm{i}z}$	$2\sinh z=\mathrm{e}^z-\mathrm{e}^{-z}$	$\sin(\mathrm{i}z)=\mathrm{i}\sinh z$

Reihen

$\mathrm{e}^z=\sum\limits_{k=0}^{\infty}\frac{z^k}{k!}$	$\mathrm{e}^z=\lim\limits_{n\to\infty}\left(1+\frac{z}{n}\right)^n$	$\ln z=\lim\limits_{h\to 0}\frac{z^h-1}{h}$

$\sin z=\sum_{k=0}^{\infty}(-1)^k\frac{z^{2k+1}}{(2k+1)!}$	$\sinh z=\sum_{k=0}^{\infty}\frac{z^{2k+1}}{(2k+1)!}$
$\cos z=\sum_{k=0}^{\infty}(-1)^k\frac{z^{2k}}{(2k)!}$	$\cosh z=\sum_{k=0}^{\infty}\frac{z^{2k}}{(2k)!}$

$\frac{z}{\mathrm{e}^z-1}=\sum\limits_{k=0}^{\infty}\overline{B}_k\frac{z^k}{k!}$	$\ln(1-x)=(-1)\sum\limits_{k=1}^{\infty}\frac{x^k}{k}\quad(-1\le x<1)$
$\frac{z}{1-\mathrm{e}^{-z}}=\sum\limits_{k=0}^{\infty}B_k\frac{z^k}{k!}$	$(z+1)^a=\sum\limits_{k=0}^{\infty}\binom{a}{k}z^k\quad(a\in\mathbb{C},\lvert z\rvert<1)$
$\frac{1}{1-z}=\sum\limits_{k=0}^{\infty}z^k$	$\frac{1}{(1-z)^n}=\sum\limits_{k=0}^{\infty}\binom{n+k-1}{k}z^k\quad(\lvert z\rvert<1)$

$$f[a](z):=\mathrm{e}^{(z-a)D}f(a)=\sum_{k=0}^{\infty}\frac{f^{(k)}(a)}{k!}(z-a)^k$$

Differentialrechnung | $x_{n+1}=x_n-f(x_n)/f'(x_n)$

$f'(x):=\lim\limits_{h\to 0}\frac{f(x+h)-f(x)}{h}$	$T(x)=f(x_0)+f'(x_0)(x-x_0)$ $N(x)=f(x_0)-\frac{1}{f'(x_0)}(x-x_0)$

$(\mathrm{e}^x)'=\mathrm{e}^x$	$(fg)'=f'g+g'f$
$\ln' x=1/x$	$(f/g)'=(f'g-g'f)/g^2$
$(a^x)'=a^x\ln a$	$(g\circ f)'=(g'\circ f)f'$
$(x^n)'=nx^{n-1}$	$(f^{-1})'=1/(f'\circ f^{-1})$

$\sin' x=\cos x$	$\tan' x=1+\tan^2 x=1/\cos^2 x$
$\cos' x=-\sin x$	$\cot' x=-1-\cot^2 x=-1/\sin^2 x$
$\sinh' x=\cosh x$	$\tanh' x=1-\tanh^2 x=1/\cosh^2 x$
$\cosh' x=\sinh x$	$\coth' x=1-\coth^2 x=-1/\sinh^2 x$

$\arcsin' x=1/\sqrt{1-x^2}$	$\arctan' x=1/(1+x^2)$
$\arccos' x=-1/\sqrt{1-x^2}$	$\operatorname{arccot}' x=-1/(1+x^2)$
$\operatorname{arsinh}' x=1/\sqrt{x^2+1}$	$\operatorname{artanh}' x=1/(1-x^2)$
$\operatorname{arcosh}' x=1/\sqrt{x^2-1}$	$\operatorname{arcoth}' x=1/(1-x^2)$

Integralrechnung

$$\int_a^b f(x)\,\mathrm{d}x:=\lim_{n\to\infty}\sum_{k=1}^{n}f\!\left(a+k\tfrac{b-a}{n}\right)\tfrac{b-a}{n}\qquad(f\in C[a,b])$$

$$\int_a^b f'(x)\,\mathrm{d}x=[f(x)]_a^b:=f(b)-f(a)\qquad(f\in C^1[a,b])$$

$$\int_a^b f(g(x))\,g'(x)\,\mathrm{d}x=\int_{g(a)}^{g(b)}f(u)\,\mathrm{d}u\quad\left(\begin{smallmatrix}f\in C(I,\mathbb{R}),\\ g\in C^1([a,b],I)\end{smallmatrix}\right)$$

$$\int_a^b f'(x)g(x)\,\mathrm{d}x=[f(x)g(x)]_a^b-\int_a^b f(x)g'(x)\,\mathrm{d}x\quad(f,g\in C^1)$$

$$t=\tan(\tfrac{x}{2}),\ \sin x=\tfrac{2t}{1+t^2},\ \cos x=\tfrac{1-t^2}{1+t^2},\ \mathrm{d}x=\tfrac{2\mathrm{d}t}{1+t^2}$$

$$L\{f(t)\}:=\int_0^{\infty}f(t)\mathrm{e}^{-pt}\mathrm{d}t,\ F\{f(t)\}:=\tfrac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty}f(t)\mathrm{e}^{-\mathrm{i}\omega t}\mathrm{d}t$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\int_{a(x)}^{b(x)}f(x,t)\,\mathrm{d}t=\int_{a(x)}^{b(x)}\frac{\partial}{\partial x}f(x,t)\,\mathrm{d}t+g(x)$$

$$g(x)=f(x,b(x))b'(x)-f(x,a(x))a'(x)$$

Komplexe Zahlen

$z=r\mathrm{e}^{\mathrm{i}\varphi}=a+b\mathrm{i}$	$\lvert z\rvert=r=\sqrt{a^2+b^2}$
$\overline{z}=r\mathrm{e}^{-\mathrm{i}\varphi}=a-b\mathrm{i}$	$\arg(z)=\varphi=\operatorname{sgn}(b)\arccos(a/r)$
$\operatorname{Re}z=a=r\cos\varphi$	$z_1+z_2=(a_1+a_2)+(b_1+b_2)\mathrm{i}$
$\operatorname{Im}z=b=r\sin\varphi$	$z_2-z_2=(a_1-a_2)+(b_1-b_2)\mathrm{i}$

$$z_1z_2=r_1r_2\mathrm{e}^{\mathrm{i}(\varphi_1+\varphi_2)}=(a_1a_2-b_1b_2)+(a_1b_2+a_2b_1)\mathrm{i}$$

$$\frac{z_1}{z_2}=\frac{r_1}{r_2}\mathrm{e}^{\mathrm{i}(\varphi_1-\varphi_2)}=\frac{a_1a_2+b_1b_2}{a_2^2+b_2^2}+\frac{a_2b_1-a_1b_2}{a_2^2+b_2^2}\mathrm{i}$$

$$\frac{1}{z}=\frac{1}{r}\mathrm{e}^{-\mathrm{i}\varphi}=\frac{a}{a^2+b^2}-\frac{b}{a^2+b^2}\mathrm{i}$$

Algebra

$x^2+px+q=0\ \Leftrightarrow\ 2x=-p\pm\sqrt{p^2-4q}$

$f(x)=f(2a-x)$ (Achsensymmetrie)

$f(x)=2b-f(2a-x)$ (Punktsymmetrie)

Lineare Algebra | $\det(\lambda A)=\lambda^n\det(A),\ \det(A^{-1})=\frac{1}{\det A}$

$\langle Av,w\rangle=\langle v,A^Hw\rangle$	$(AB)^H=B^HA^H$
$\langle v,w\rangle=\lvert v\rvert\lvert w\rvert\cos\varphi$	$(AB)^{-1}=B^{-1}A^{-1}$
$\lvert v\times w\rvert=\lvert v\rvert\lvert w\rvert\sin\varphi$	$\det(AB)=\det(A)\det(B)$

$\operatorname{proj}[w](v)=\frac{\langle v,w\rangle}{\langle w,w\rangle}w,\quad w_k:=v_k-\sum_{i=1}^{k-1}\operatorname{proj}[w_i](v_k)$

$$\begin{pmatrix}a_1\\a_2\\a_3\end{pmatrix}\times\begin{pmatrix}b_1\\b_2\\b_3\end{pmatrix}=\begin{pmatrix}a_2b_3-a_3b_2\\a_3b_1-a_1b_3\\a_1b_2-a_2b_1\end{pmatrix}$$

$$\begin{pmatrix}a&b\\c&d\end{pmatrix}^{-1}=\frac{1}{ad-bc}\begin{pmatrix}d&-b\\-c&a\end{pmatrix},\quad R(\varphi)=\begin{pmatrix}\cos\varphi&-\sin\varphi\\\sin\varphi&\cos\varphi\end{pmatrix}$$

Polarkoordinaten	**Kugelkoordinaten**
$x=r\cos\varphi$	$x=r\sin\theta\ \cos\varphi$
$y=r\sin\varphi$	$y=r\sin\theta\ \sin\varphi$
$\varphi\in(-\pi,\pi]$	$z=r\cos\theta$
$\det J=r$	$\varphi\in(-\pi,\pi],\ \theta\in[0,\pi]$
Zylinderkoordinaten	$\det J=r^2\sin\theta$
$x=r_{xy}\cos\varphi$	$\theta=\beta-\pi/2$
$y=r_{xy}\sin\varphi$	$\beta\in[-\pi/2,\pi/2]$
$z=z$	$\cos\theta=\sin\beta$
$\det J=r_{xy}$	$\sin\theta=\cos\beta$

Vektoranalysis

$\nabla(\lvert\mathbf{x}\rvert^2)=2\mathbf{x}$	$\nabla(fg)=g\nabla f+f\nabla g$
$\nabla\lvert\mathbf{x}\rvert=\mathbf{x}/\lvert\mathbf{x}\rvert$	$\nabla\langle f,g\rangle=(Df)^Tg+(Dg)^Tf$
$\nabla(\frac{1}{g})=-\frac{\nabla g}{g^2}$	$\nabla(f/g)=(g\nabla f-f\nabla g)/g^2$
$\nabla\times\nabla f=0$	$\langle\nabla,f\mathbf{v}\rangle=\langle\nabla f,\mathbf{v}\rangle+f\langle\nabla,\mathbf{v}\rangle$
$\langle\nabla,\nabla\times\mathbf{v}\rangle=0$	$\nabla\times(f\mathbf{v})=f(\nabla\times\mathbf{v})-\mathbf{v}\times\nabla f$

$\nabla\times\nabla\times\mathbf{v}=\nabla\langle\nabla,\mathbf{v}\rangle-\Delta\mathbf{v}$

$\langle\nabla,v\times w\rangle=\langle\mathbf{w},\nabla\times\mathbf{v}\rangle-\langle\mathbf{v},\nabla\times\mathbf{w}\rangle$

$\int_\gamma f\mathrm{d}s:=\int_a^b f(t)\,\lvert\gamma'(t)\rvert\,\mathrm{d}t,\ \int_\gamma\langle\mathbf{F},\mathrm{d}\mathbf{x}\rangle:=\int_a^b\langle\mathbf{F}(\mathbf{x}(t)),\mathbf{x}'(t)\rangle\,\mathrm{d}t$

$\int_{\varphi(U)}f(\mathbf{x})\,\mathrm{d}\mathbf{x}=\int_U f(\varphi(\mathbf{u}))\,\lvert\det D\varphi(\mathbf{u})\rvert\,\mathrm{d}\mathbf{u}$

Extremwerte

$f(x)=\text{extrem}\Rightarrow f'(x)=0,\ f(p)=\text{extrem}\Rightarrow \mathrm{d}f_p=0$

$f(x,y)=\text{extrem unter }g(x,y)=0\Rightarrow\mathrm{d}f=\lambda\mathrm{d}g$

$$J[\mathbf{x}]:=\int_a^b L(t,\mathbf{x}(t),\mathbf{x}'(t))\,\mathrm{d}t=\text{extrem}\Rightarrow\frac{\partial L}{\partial x_k}=\frac{\mathrm{d}}{\mathrm{d}t}\frac{\partial L}{\partial x_k'}$$

Interpolation

Linear: $p(x)=y_1+\dfrac{y_2-y_1}{x_2-x_1}(x-x_1)$

Quadratisch: $p(x)=y_0+a_1(x-x_0)+a_2(x-x_0)(x-x_1)$

$$a_1=\frac{y_1-y_0}{x_1-x_0},\quad a_2=\frac{1}{x_2-x_1}\left(\frac{y_2-y_0}{x_2-x_0}-a_1\right)$$

Regression

$$y=\overline{y}+\frac{s_{xy}}{s_{xx}}(x-\overline{x}),\ s_{xx}=\sum_{k=1}^{n}(x_k-\overline{x})^2,\ s_{xy}=\sum_{k=1}^{n}(x_k-\overline{x})(y_k-\overline{y})$$

Logik

A	B	$A \wedge B$	$A \vee B$	$A \rightarrow B$	$A \leftrightarrow B$	$A \oplus B$	$A \uparrow B$
0	0	0	0	1	1	0	1
0	1	0	1	1	0	1	1
1	0	0	1	0	0	1	1
1	1	1	1	1	1	0	0

Disjunktion	**Konjunktion**	**Bezeichnung**
$A \vee A \equiv A$	$A \wedge A \equiv A$	Idempotenzgesetze
$A \vee 0 \equiv A$	$A \wedge 1 \equiv A$	Neutralitätsgesetze
$A \vee 1 \equiv 1$	$A \wedge 0 \equiv 0$	Extremalgesetze
$A \vee \overline{A} \equiv 1$	$A \wedge \overline{A} \equiv 0$	Komplementärgesetze
$A \vee B \equiv B \vee A$	$A \wedge B \equiv B \wedge A$	Kommutativgesetze
$(A \vee B) \vee C \equiv A \vee (B \vee C)$	$(A \wedge B) \wedge C \equiv A \wedge (B \wedge C)$	Assoziativgesetze
$\overline{A \vee B} \equiv \overline{A} \wedge \overline{B}$	$\overline{A \wedge B} \equiv \overline{A} \vee \overline{B}$	De morgansche Regeln
$A \vee (A \wedge B) \equiv A$	$A \wedge (A \vee B) \equiv A$	Absorptionsgesetze

$(A \rightarrow B) \equiv \overline{A} \vee B$ | $(A \leftrightarrow B) \equiv (A \rightarrow B) \wedge (B \rightarrow A)$

$(A \rightarrow B) \equiv (\overline{B} \rightarrow \overline{A})$ | $(A \leftrightarrow B) \equiv (\overline{A} \vee B) \wedge (\overline{B} \vee A)$

$A \vee \forall_x P_x \equiv \forall_x (A \vee P_x)$ | $\forall_x (P_x \wedge Q_x) \equiv \forall_x P_x \wedge \forall_x Q_x$

$A \wedge \exists_x P_x \equiv \exists_x (A \wedge P_x)$ | $\exists_x (P_x \vee Q_x) \equiv \exists_x P_x \vee \exists_x Q_x$

$(I \models M) :\Leftrightarrow \forall \varphi{\in}M\colon I(\varphi)$

$(\models \varphi) :\Leftrightarrow \forall I\colon I(\varphi)$ | $(M \models \varphi) :\Leftrightarrow \forall I\colon ((I \models M) \Rightarrow I(\varphi))$

$\mathrm{erf}(\varphi) :\Leftrightarrow \exists I\colon I(\varphi)$ | $\mathrm{erf}(M) :\Leftrightarrow \exists I\colon (I \models M)$

$\mathrm{erf}(\{\varphi_1, \ldots, \varphi_n\}) \Leftrightarrow \mathrm{erf}(\varphi_1 \wedge \ldots \wedge \varphi_n)$

$\mathrm{erf}(\varphi_1 \vee \ldots \vee \varphi_n) \Leftrightarrow \mathrm{erf}(\varphi_1) \vee \ldots \vee \mathrm{erf}(\varphi_n)$

$(M \vdash \varphi) \Rightarrow (M \models \varphi)$ (Korrektheit)

$(M \models \varphi) \Rightarrow (M \vdash \varphi)$ (Vollständigkeit)

$(M \cup \{\varphi\} \vdash \psi) \Leftrightarrow (M \vdash \varphi \rightarrow \psi)$

$(M \cup \{\varphi\} \models \psi) \Leftrightarrow (M \models \varphi \rightarrow \psi)$

$(M \models \varphi_1) \wedge (M \models \varphi_2) \wedge (\{\varphi_1, \varphi_2\} \models \psi) \Rightarrow (M \models \psi)$

Mengenlehre

$A \cap B := \{x \mid x \in A \wedge x \in B\}$ | $A \subseteq B :\Leftrightarrow \forall_x (x \in A \Rightarrow x \in B)$

$A \cup B := \{x \mid x \in A \vee x \in B\}$ | $A = B :\Leftrightarrow \forall_x (x \in A \Leftrightarrow x \in B)$

$A \setminus B := \{x \mid x \in A \wedge x \notin B\}$ | $A = B :\Leftrightarrow A \subseteq B \wedge B \subseteq A$

$\bigcap_{i \in I} A_i := \{x \mid \forall i{\in}I\colon x{\in}A_i\}$ | $f(M) := \{y \mid \exists x{\in}M\colon y{=}f(x)\}$

$\bigcup_{i \in I} A_i := \{x \mid \exists i{\in}I\colon x{\in}A_i\}$ | $f^{-1}(N) := \{x \mid f(x) \in N\}$

$A \times B := \{t \mid \exists x{\in}A\colon \exists y{\in}B\colon t = (x, y)\}$

$A \subseteq B \Leftrightarrow A \cup B = B \Leftrightarrow A \cap B = A \Leftrightarrow A \setminus B = \emptyset$

$f(M \cup N) = f(M) \cup f(N)$ | $f^{-1}(M \cup N) = f^{-1}(M) \cup f^{-1}(N)$

$f(M \cap N) \subseteq f(M) \cap f(N)$ | $f^{-1}(M \cap N) = f^{-1}(M) \cap f^{-1}(N)$

$M \subseteq N \Rightarrow f(M) \subseteq f(N)$ | $M \subseteq N \Rightarrow f^{-1}(M) \subseteq f^{-1}(N)$

$(g \circ f)(M) = g(f(M))$ | $(g \circ f)^{-1}(M) = f^{-1}(g^{-1}(M))$

Kombinatorik

$$\sum_{k=m}^{n-1} q^k = \frac{q^n - q^m}{q - 1}, \qquad \sum_{k=m}^{n-1} k^p q^k = \left(q \frac{\mathrm{d}}{\mathrm{d}q}\right)^p \frac{q^n - q^m}{q - 1}$$

$\sum_{k=1}^{n} k = (n/2)(n+1)$ | $\sum_{k=m}^{n-1} (\Delta a)_k = a_n - a_m$

$\sum_{k=1}^{n} k^2 = (n/6)(n+1)(2n+1)$ | $(\Delta a)_k := a_{k+1} - a_k$

$\sum_{k=1}^{n} k^3 = (n/2)^2 (n+1)^2$ | $n! = n \cdot (n-1)!$

$$(a+b)^n = \sum_{k=0}^{n} \binom{n}{k} a^{n-k} b^k, \qquad \binom{n}{k} := \frac{1}{k!} n^{\underline{k}} = \frac{n!}{k!(n-k)!}$$

$$n! = \Gamma(n+1), \quad \Gamma(z+1) = z\Gamma(z), \quad \Gamma(z)\Gamma(1-z) = \tfrac{\pi}{\sin(\pi z)}$$

$$\tbinom{n+1}{k+1} = \tbinom{n}{k} + \tbinom{n+1}{k}, \quad \tbinom{n}{k} = \tbinom{n}{n-k}, \quad \tbinom{n}{0} = \tbinom{n}{n} = 1$$

$$n! \approx \sqrt{2\pi n}\, n^n \exp\left(\tfrac{1}{12n} - n\right) \approx \sqrt{2\pi n}\, (n/e)^n$$

Twelvefold way. Fächer: $n := |N|$, Karten: $k := |K|$

	$f\colon K \longrightarrow N$	$f \in \mathrm{Inj}(K, N)$	$f \in \mathrm{Sur}(K, N)$
f	n^k	$n^{\underline{k}}$	$n! \genfrac{\{}{\}}{0pt}{}{k}{n}$
$f \circ S_k$	$\binom{n+k-1}{k}$	$\binom{n}{k}$	$\binom{k-1}{k-n}$
$S_n \circ f$	$\sum_{i=0}^{n} \genfrac{\{}{\}}{0pt}{}{k}{i}$	$[k \leq n]$	$\genfrac{\{}{\}}{0pt}{}{k}{n}$
$S_n \circ f \circ S_k$	$p_n(n+k)$	$[k \leq n]$	$p_n(k)$

S_k: Karten nicht unterscheidbar | Inj: max. 1 Karte pro Fach

S_n: Fächer nicht unterscheidbar | Sur: mind. 1 Karte pro Fach

$\genfrac{\{}{\}}{0pt}{}{n}{k} = k \genfrac{\{}{\}}{0pt}{}{n-1}{k} + \genfrac{\{}{\}}{0pt}{}{n-1}{k-1}$ | $\genfrac{\{}{\}}{0pt}{}{n}{0} = \genfrac{[}{]}{0pt}{}{n}{0} = [n{=}0]$

$\genfrac{[}{]}{0pt}{}{n}{k} = (n-1) \genfrac{[}{]}{0pt}{}{n-1}{k} + \genfrac{[}{]}{0pt}{}{n-1}{k-1}$ | $\genfrac{\{}{\}}{0pt}{}{n}{1} = [n{>}0]$

$x^n = \sum_{k=0}^{n} \genfrac{\{}{\}}{0pt}{}{n}{k} x^{\underline{k}}$ | $\genfrac{\{}{\}}{0pt}{}{n}{2} = (2^{n-1} - 1)[n{>}0]$

Wahrscheinlichkeitsrechnung

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(A \cap B) = P(A)P(B \mid A)$

A unabhängig zu $B :\Leftrightarrow P(A \cap B) = P(A)P(B)$

$P(A) = \sum_{k=1}^{n} P(A \mid B_k)P(B_k)$ für Zerlegung (B_k) von Ω

$P(A) = \int_{-\infty}^{\infty} P(A \mid X = x)\, \mathrm{d}F_X(x)$

$P(g(X) = y) = \sum_{x \in g^{-1}(\{y\})} P(X = x)$

$P(g(X, Y) = z) = \sum_{(x,y) \in g^{-1}(\{z\})} P(X = x, Y = y)$

$E(X) = \sum_{\omega \in \Omega} X(\omega)P(\{\omega\}) = \sum_x xP(X = x)$

$E(g(X)) = \sum_{\omega \in \Omega} g(X(\omega))P(\{\omega\}) = \sum_x g(x)P(X = x)$

$E(g(X, Y) = \sum_{(x,y)} g(x, y)P(X = x, Y = y)$

$E(X) = \int_{-\infty}^{\infty} xf(x)\, \mathrm{d}x = \int_0^{\infty} (1 - F(x))\, \mathrm{d}x - \int_{-\infty}^{0} F(x)\, \mathrm{d}x$

$E(g(X)) = \int_{-\infty}^{\infty} g(x)f(x)\, \mathrm{d}x$ | $P(A) = E(1_A)$

$E(X \mid A) = E(1_A X)/P(A)$ | $P(A \mid B) = E(1_A \mid B)$

$P(X \leq x) = F(x) = \int_{-\infty}^{x} f(t)\, \mathrm{d}t$

$P(a \leq X \leq b) = F(b) - F(a) = \int_a^b f(t)\, \mathrm{d}t$

Normalverteilung

$\Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} \mathrm{e}^{-t^2/2}\, \mathrm{d}t = \frac{1}{2} + \frac{1}{2} \mathrm{erf}(\frac{x}{\sqrt{2}})$

$F(x) = \Phi(\frac{x-\mu}{\sigma})$

Mechanik

$\mathbf{v} = \mathbf{x}'(t)$	$\omega = \varphi'(t)$
$\mathbf{a} = \mathbf{v}'(t)$	$\alpha = \omega'(t)$
$\mathbf{F} = \mathbf{p}'(t)$	$\mathbf{M} = \mathbf{L}'(t)$
$\mathbf{p} = m\mathbf{v}$	$L = J\omega$
$\mathbf{F} = m\mathbf{a}$	$M = J\alpha$
$P = \langle \mathbf{F}, \mathbf{v} \rangle$	$P = \langle \mathbf{M}, \boldsymbol{\omega} \rangle$
$E_{\text{kin}} = \frac{1}{2}m\lvert\mathbf{v}\rvert^2$	$E_{\text{rot}} = \frac{1}{2}J\omega^2$

$s = \varphi r$	$\mathbf{M} = \mathbf{r} \times \mathbf{F}$	$E_{\text{pot}} = mgh$
$v = \omega r$	$\mathbf{L} = \mathbf{r} \times \mathbf{p}$	$E_{\text{kin}} + E_{\text{pot}} = \text{const.}$
$a = \alpha r$	$\mathbf{v} = \boldsymbol{\omega} \times \mathbf{r}$	$F = Ds \quad \text{(Feder)}$

Gleichstrom

$U = RI$	$Q = It$	$GR = 1$
$I = GU$	$W = Pt$	
$P = UI$	$W = QU$	

Wechselstrom

$\underline{U} = \underline{Z}\underline{I}$	$\underline{Z} = R + jX$	$Z^2 = R^2 + X^2$
$\underline{I} = \underline{Y}\underline{U}$	$\underline{Y} = G + jQ$	$R = Z\cos\varphi$
$\underline{S} = \underline{U}\underline{I}$	$\underline{S} = P + jB$	$X = Z\sin\varphi$

$\underline{Z} = R$	Widerstand	$\omega = 2\pi f$
$\underline{Z} = jX_C$	Kondensator	$X_C = -1/(\omega C)$
$\underline{Z} = jX_L$	Spule	$X_L = \omega L$

$u_s = \sqrt{2}\,U_{\text{eff}}$	$u = u_s \sin(\omega t + \varphi_0)$
$i_s = \sqrt{2}\,I_{\text{eff}}$	$i = i_s \sin(\omega t + \varphi_0)$

Allgemeine Gleichungen

$u = Ri$	$p = ui$
$i = Cu'(t)$	
$u = Li'(t)$	

Elektrostatisches Feld

$$F = \frac{1}{4\pi\varepsilon}\frac{Q_1Q_2}{r^2} \quad \Big| \quad \mathbf{F}_1 = \frac{1}{4\pi\varepsilon}Q_1Q_2\frac{\mathbf{x}_1 - \mathbf{x}_2}{\lvert\mathbf{x}_1 - \mathbf{x}_2\rvert^3}$$

$\mathbf{F} = q\mathbf{E}$	$Q = CU$	$U = \varphi(B) - \varphi(A)$
$\mathbf{D} = \varepsilon\mathbf{E}$	$\varepsilon = \varepsilon_0\varepsilon_r$	$W = QU$

$\mathbf{E} = -\nabla\varphi$

$\varepsilon_0 E^2 = 2w_e$

Plattenkondensator

$U = Ed \;\big|\; C = \varepsilon A/d$

Homogenes Feld in der Spule

$Hl = NI \;\big|\; Bl = \mu NI \;\big|\; \Theta = NI$

Magnetostatisches Feld

$\mathbf{F} = q\mathbf{v} \times \mathbf{B}$	$\Phi = BA$
$F = qvB$	$\mathbf{B} = \mu\mathbf{H}$
$F = BIl$	$\mu = \mu_0\mu_r$

$H = I/(2\pi r) \quad$ (Feld um einen geraden Leiter)

$B^2 = 2\mu_0 w_m$

Elektrodynamik

$\mathbf{E} = -\nabla\varphi$

$\varepsilon\Delta\varphi = -\rho(x)$

$\varepsilon_0 E^2 = 2w_e$

$B^2 = 2\mu_0 w_m$

Maxwell-Gleichungen

$\langle \nabla, \mathbf{D} \rangle = \rho_f(x)$	$\langle \nabla, \varepsilon_0\mathbf{E} \rangle = \rho(x)$
$\langle \nabla, \mathbf{B} \rangle = 0$	$\langle \nabla, \mathbf{B} \rangle = 0$
$\nabla \times \mathbf{E} = -\partial_t\mathbf{B}$	$\nabla \times \mathbf{E} = -\partial_t\mathbf{B}$
$\nabla \times \mathbf{H} = \mathbf{J}_f + \partial_t\mathbf{D}$	$\nabla \times \mathbf{B} = \mu_0(\mathbf{J} + \varepsilon_0\partial_t\mathbf{E})$

Spezielle Relativitätstheorie

$$\gamma = \frac{1}{\sqrt{1-\beta^2}}, \quad \beta = v/c$$

$\gamma = \cosh\varphi, \quad \beta\gamma = \sinh\varphi, \quad \beta = \tanh\varphi$

$ct' = \gamma(ct - \beta x), \quad x' = \gamma(x - vt), \quad (y,z)' = (y,z)$

$t = \gamma\tau$	$E_{\text{kin}} = E - E_0$
$p = \gamma mv$	$E_{\text{kin}} = \gamma mc^2 - mc^2$
$E = \gamma mc^2$	$E^2 = (pc)^2 + (mc^2)^2$

$$\Lambda_v = \begin{bmatrix} \gamma & -\beta\gamma & 0 & 0 \\ -\beta\gamma & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$g = \operatorname{diag}(1, -1, -1, -1)$

$(\partial_\mu) = (\partial_{ct}, \partial_x, \partial_y, \partial_z)$

$(\partial^\mu) = (\partial_{ct}, -\partial_x, -\partial_y, -\partial_z)$

Optik

$$\frac{1}{f} = \frac{1}{g} + \frac{1}{b}, \quad A = \frac{B}{G} = \frac{b}{g}$$

$n_1 \sin(\varphi_1) = n_2 \sin(\varphi_2)$

$c_0 = nc$

Thermodynamik

$R = N_A k_B$	$m = nM$	$V = nV_m$
$R = R_s M$	$m = Nm_T$	$N = nN_A$

$pV = nRT$

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$Q = mc\Delta T$

Konstanten

$\varepsilon_0 = 8.8542 \times 10^{-12}\,\mathrm{C/(V\,m)}$

$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{H/m}$

$c_0 = 2.9979 \times 10^{8}\,\mathrm{m/s}$

$e = 1.6022 \times 10^{-19}\,\mathrm{C}$

$G = 6.674 \times 10^{-11}\,\mathrm{m^3/(kg\,s^2)}$

$N_A = 6.0221 \times 10^{23}\,\mathrm{mol^{-1}}$

$k_B = 1.3806 \times 10^{-23}\,\mathrm{J/K}$

$R = 8.3145\,\mathrm{J/(mol\,K)}$

$0\,\mathrm{K} = -273.15\,^\circ\mathrm{C}$

$u = 1.6605 \times 10^{-27}\,\mathrm{kg}$

$h = 6.6261 \times 10^{-34}\,\mathrm{Js}$

$\hbar = 1.0546 \times 10^{-34}\,\mathrm{Js}$

$\sigma = 5.6704 \times 10^{-8}\,\mathrm{W/(m^2K^4)}$

$m_e = 9.1094 \times 10^{-31}\,\mathrm{kg}$

$m_p = 1.6726 \times 10^{-27}\,\mathrm{kg}$

$m_n = 1.6749 \times 10^{-27}\,\mathrm{kg}$

$m_\alpha = 6.6447 \times 10^{-27}\,\mathrm{kg}$