Ex0909A3: The generalized canonical transformation

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The problem: A system is described by the Hamiltonian H(q,p,t). The coordinate q is transformed q → Q=ψ(q,t)

1. Find the most general transformation p → P(q,p,t) so that (q,p) → (Q,P) will be canonical.
2. Calculate the appropriate generating function (explain why F_1(q,Q,t) isn't relevant).
3. Given the new Hamiltonian H'=0. Find the original Hamiltonian.
4. Prove that for ψ(q+ωt), the original Hamiltonian is a function of p alone. What does it mean?

The solution:

1. answer 1
2. answer 2
3. answer 3
4. answer 4
5. This is how you write an equation

$$\mathcal{I} = \int_0^z d^4x\sqrt{-g}\left[\varphi^2\left(\mathcal{R} - 6sg^{\mu\nu}\kappa_\mu\kappa_\nu\right) + 4\omega g^{\mu\nu}D_\mu\varphi D_\nu\varphi + \lambda\varphi^4 + \frac{1}{4}g^{\mu\nu}g^{\lambda\sigma}X_{\mu\lambda}X_{\nu\sigma}\right]. \quad (1)$$

6. If you wish to add a set of equations (add the ampersands to align the two equations):

$$\begin{aligned} s &= \frac{3+2\omega}{2\omega} \neq 1, & (2)\\ D_\mu\varphi &= \varphi_{;\mu} + s\kappa_\mu\varphi, & (3) \end{aligned}$$

If you wish to have equations with no numbers add an asterisk

$$\begin{aligned} &g^{\mu\nu}\left(\varphi^2_{;\mu} + 2\kappa_\mu\varphi^2\right)_{;\nu} = \frac{\partial W_{eff}(\varphi^2)}{\partial\varphi^2},\\ &\frac{\partial W_{eff}(\varphi^2)}{\partial\varphi^2} = \frac{1}{3+2}\omega\left(\frac{1}{2}\varphi V'(\varphi) - 2V(\varphi)\right). \end{aligned}$$

To write a vector

$$\vec{r} = x\hat{x} + y\hat{y} + z\hat{z} \quad ; \quad \vec{r}_i = |\vec{r}|\,\hat{r} \quad (4)$$

To write a matrix

$$\lambda_1 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}, \qquad \text{“\qquad” makes space in equations and this is how you add text.} \quad (5)$$

You can also use "align" to tightly align the equal sign, i.e "=" is aligned: see Eq. (**??**) and Eq. (**??**), also note that **every end** of an equation needs to be punctuated, i.e : "," or ".", according to the sentence.

$$\lambda_7 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & -i \\ 0 & i & 0 \end{pmatrix}, \tag{6}$$

$$\lambda_8 = \frac{1}{\sqrt{3}} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -2 & 0 \end{pmatrix}, \tag{7}$$

and centered

$$\left[\frac{\lambda_i}{2}, \frac{\lambda_j}{2}\right] = i \sum_{k=1}^{n} f^{ijk} \frac{\lambda_k}{2},$$

$$f^{147} = f^{165} = f^{246} = f^{257} = f^{345} = f^{376} = \frac{1}{2}.$$

7. Known arguments are **not** *written in italic mode*, some have special syntax in LaTeX otherwise just use "\mathrm":

$$\cos(\omega t); \quad \sin(\omega t); \quad \mathrm{Tr}\left[\hat{\mathrm{A}}\right]; \quad \det\left[\hat{\mathcal{A}}\right]; \quad \tan(\omega t); \quad \mathrm{e}^{\frac{t}{\tau}}; \quad \exp\left(\frac{t}{\tau}\right); \quad \log\left(\frac{t}{\tau}\right). \tag{8}$$

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To include a picture use, note that the picture file has to be in the same folder as the *.tex file.