

Some Comments on Homework 3

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14.4,14.12: Normally, vector identities (with some other conditions if necessary) does not depend on the particular presentation of the vector, like Cartesian or Polar coordinate. You can work directly on the vectors without their presentation, like

$$\frac{d}{dt} \left(\vec{x} \times m \frac{d\vec{x}}{dt} \right) = \frac{d\vec{x}}{dt} \times m \frac{d\vec{x}}{dt} + \vec{x} \times m \frac{d^2\vec{x}}{dt^2} \quad (1)$$

$$\frac{d}{dt} |\vec{f}|^2 = 2\vec{f} \cdot \frac{d\vec{f}}{dt} \quad (2)$$

but make sure you have confidence in using them.

If you want to choose a coordinate system, then choose the one that can give the desired results fastest, which is not necessary Cartesian coordinates. Be careful that the derivative of the unit vectors in polar coordinates is not zero, but

$$\frac{d}{dt} \hat{r} = \dot{\theta} \hat{\theta}, \quad \frac{d}{dt} \hat{\theta} = -\dot{\theta} \hat{r}$$

For both problem, nothing is said about the dimension of vectors, thus you'd better not use polar coordinates which is restricted to two dimension.

18.5 Sloppy Notation in the text book: In the text book, the system analyzed is

$$m \frac{d^2x}{dt^2} = -f(x)$$

Notice the minus sign in front. Therefore, f is actually the negative of force, **not** the force. Because of the sign convention used in the book, many students get the opposite conclusion for the stability of the equilibrium point x_E based on $f'(x_E)$.

19.7 Once again, you'd better step up a coordinate system (though just one dimension). **0 CAN NOT** appear in upper or lower limit of the integration for potential energy, because we start at the surface of the earth. By convention, the potential energy is always negative, and zero at infinity.

21.8 You can use the form $x(t) = c_1 \sin \omega t + c_2 \cos \omega t$, or the more "compact" form $x(t) = A \sin(\omega t + \phi)$, which is much easy to work with when computing the average kinetic and potential energy. The **key** is to choose the right length **time** for the average, which obviously should be the period of the oscillator.