Equations

- Solving without numbers
- Units in expressions
- Dimensional consistency

Solving without Numbers

$$a = \frac{4\pi^2 r}{T^2}$$

a) Solve the equation for r.

b) Solve the equation for T.

$$\frac{a}{1} = \frac{4\pi^2 r}{T^2}$$

$$aT^2 = 4\pi^2 r$$

$$\frac{aT^2}{4\pi^2} = r$$

$$\frac{a}{1} = \frac{4\pi^2 r}{T^2}$$

$$aT^2 = 4\pi^2 r$$

$$T^2 = \frac{4\pi^2 r}{a}$$

$$T = \sqrt{\frac{4\pi^2 r}{a}}$$

Units in Expressions

$$W = F(\Delta x)$$

W is Work in Joules, and Δx is displacement in meters. Show that the units of F are Newtons.

$$\text{Joules} = (\text{Newtons})(\text{meters})$$

$$\frac{kg\,m^2}{s^2} = \left(\frac{kg\,m}{s^2}\right)(m)$$

✓

Units in Expressions

$$U_e = \frac{1}{2}k(\Delta x)^2$$

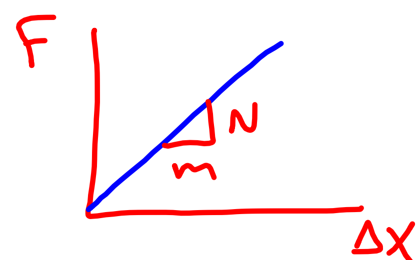
Ue is elastic potential energy in Joules, and Δx is displacement in meters. What are the units of k?

$$(\text{Joules}) = (\ ?\ )(m)^2$$

$$\frac{kg\,m^2}{s^2} = (\ ?\ )\,m^2$$

$$\frac{kg\,m^2}{s^2} = \left(\frac{kg}{s^2}\right)m^2$$

k is in $\frac{kg}{s^2}$



$k = \text{slope}\ \frac{N}{m}$

$$\frac{\frac{kg\,\cancel{m}}{s^2}}{\cancel{m}}$$

Dimensional Consistency

All of the terms* on both sides of an an equation must have matching units.

* terms are separated by + or - signs.

$$E_{mech} = \frac{1}{2}mv^2 + mgh$$

EX: Dimensional Consistency

Determine whether the equation below is dimensionally consistent.

$$E_{mech} = \frac{1}{2} m v^2 + mgh$$

$$(\text{Jules}) = (\text{Jules}) + (\text{Jules})$$

$$\frac{kg\,m^2}{s^2} = (kg)\left(\frac{m}{s}\right)^2 + (kg)\left(\frac{m}{s^2}\right)(m)$$

$$\frac{kg\,m^2}{s^2} \overset{\checkmark}{=} \frac{kg\,m^2}{s^2} + \frac{kg\,m^2}{s^2}$$