Physics 151 Class Exercise: Working with Units

1) An old tradition in Physics classes is to take unit conversion to a ludicrous extreme by working with the units the furlong and the fortnight. They are defined as:

1 furlong = 1/8 mile 1 fortnight = 14 days

Express each of the following quantities in terms of these units using scientific notation.

a) The height of the Eiffel Tower: 301 m

$$(301m)\left(\frac{1mi}{1609\,m}\right)\left(\frac{8\ fur}{1mi}\right)=1.50\ fur$$

b) The world record for running the mile: 3.74 minutes

$$(3.74\,\text{min})\left(\frac{1hr}{60\,\text{min}}\right)\left(\frac{1day}{24\,hr}\right)\left(\frac{1\ fort}{14\,days}\right)=1.86\times10^{-4}\ fort$$

c) The old highway speed limit: 55 mi/hr

$$\left(55\frac{mi}{hr}\right)\left(\frac{8\ fur}{1mi}\right)\left(\frac{24\,hr}{1day}\right)\left(\frac{14\,day}{1\ fort}\right)=1.5\times10^{5}\,\frac{fur}{fort}$$

d) The acceleration of gravity of Earth: 9.81 m/s^2

$$\left(9.81\frac{m}{s^2}\right)\left(\frac{1mi}{1609\,m}\right)\left(\frac{8\ fur}{1mi}\right)\left[\left(\frac{3600\,s}{1hr}\right)\left(\frac{24\,hr}{1day}\right)\left(\frac{14\,day}{1\ fort}\right)\right]^2=7.14\times10^{10}\,\frac{fur}{fort^2}$$

2. Calculate the volume of a geometrical shape that has a surface area of 3.76 m^2 if the shape is a …

a) sphere -- we can use the formula for surface area of a sphere to solve for radius and then use that in the formula for volume of a sphere.

$$A_{sphere} = 4\pi r^2$$

$$r = \sqrt{\frac{A}{4\pi}} = \sqrt{\frac{\left(3.76\,m^2\right)}{4\pi}} = 0.547\,m$$

$$V_{sphere} = \frac{4}{3}\pi r^3 = \left(1.333\right)\pi\left(0.547\,m\right)^3 = 0.686\,m^3$$

b) cube

$$A_{cube} = 6l^2$$

$$l = \sqrt{\frac{A}{6}} = \sqrt{\frac{\left(3.76\,m^2\right)}{6}} = 0.792\,m$$

$$V_{cube} = l^3 = \left(0.792\right)^3 = 0.496\,m^3$$

3. How long is a microcentury?

This question is rather vague – I interpret it as "convert this into a more meaningful form" like minutes or hours that gives you a better feeling for how long it really is.

$$\mu century = \left(10^{-6}\right)\left(100\,yr\right)\left(\frac{365\,days}{1\,yr}\right)\left(\frac{24\,hr}{1\,day}\right) = 0.876\,hr$$

$$\mu century = \left(10^{-6}\right)\left(100\,yr\right)\left(\frac{365\,days}{1\,yr}\right)\left(\frac{24\,hr}{1\,day}\right)\left(\frac{60\,\text{min}}{1\,hr}\right) = 52.6\,\text{min}$$

So you should never get board or be inattentive during class – for it doesn't even last a microcentury!