PHY 110 Spring 2018 Quiz 1 Solution

1. (2 pts) In the equation $F = \frac{GMm}{r^2}$, F has units of $\frac{kg \cdot m}{s^2}$, M and m have units of kg, and r has units of m. What are the units of G ?

a) $\frac{kg \cdot m}{s}$ b) $\frac{m \cdot kg^2}{s^3}$ c) $\frac{s^2}{kg \cdot m^2}$ **d)** $\frac{m^3}{kg \cdot s^2}$

Let's rewrite the equation, this time plugging in the units for each variable in the equations, leaving G in the equation to stand for the units of G, then solve for G.

$$\frac{kg \cdot m}{s^2} = G\frac{kg^2}{m^2} \quad or \quad G = \frac{m^3}{kg \cdot s^2}$$

2. (2 pts) Water flows through a pipe at a rate of 100000 $\frac{gal}{hr}$. Convert this flow rate to $\frac{m^3}{s}$. Note that $1\,L = 1000\,cm^3$ and 1 gal = 3.785 L.

a) 0.105 $\frac{m^3}{s}$ b) 2.71 $\frac{m^3}{s}$ c) 12.5 $\frac{m^3}{s}$ d) 286 $\frac{m^3}{s}$

$$100000\frac{gal}{hr} \times \left[\frac{3.785\,L}{1\,gal}\right] \times \left[\frac{1000\,cm^3}{1\,L}\right] \times \left[\frac{1\,m}{100\,cm}\right]^3 \times \left[\frac{1\,hr}{60\,\min}\right] \times \left[\frac{1\min}{60\,s}\right] = 0.105\frac{m^3}{s}$$

3. (2 pts) What is the value of $\frac{0.0370(297.2)}{11.56} + 3.14159$ **<u>to the correct number of significant digits</u>**? Assume all values were reported by the experimenter who measured them.

Since 0.0370 only has 3 sig figs, the first term must be rounded to 3 sig figs. Then when you add the next term, you can only go out to the column in which there are significant figures in both terms. Thus 0.951 + 3.14159 = ***4.093*** *(since there's a 5 in the next column of the other term, you round that one up regardless of the unknown value in the other term).*

4. (2 pts) Suppose you measure $x = 10 \pm 1\,m$, $y = 20 \pm 1\,m$, and $z = 100 \pm 1\,m$. If you now calculate $R = \frac{x\,y^3}{z^2}$, what is $\frac{\Delta R}{R}$?

a) 6% b) 14% **c) 27%** d) 35%

As we discussed in class, this equation fits the special case (one term, only multiplication, division, and powers), so we can write

$$\frac{\Delta R}{R} = \frac{\Delta x}{x} + 3\frac{\Delta y}{y} + 2\frac{\Delta z}{z} = \frac{1}{10} + 3\left(\frac{1}{20}\right) + 2\left(\frac{1}{100}\right) = 0.27 = 27\%$$

5. (2 pts) Suppose $f(x) = x^3 - 9$.

$\frac{df}{dx} =$ $3x^2$

$\int f(x)dx =$ $\frac{x^4}{4} - 9x + C$, *where C is a constant.*