Homework Solutions
8/27/2007

Conceptual Question

12. Scotch Tape

½ in = ? sig figs 450 in = 2 sig figs 12.5 yd = 3sig figs
12.7 mm = 3 sig figs 11.4 m = 3 sig figs

Aluminum Foil

37.5 sq ft = 3 sig figs 3.48 sq m = 3 sig figs
7.62 m = 3 sig figs 45.7 cm = 3 sig figs

The aluminum foil manufacturer is using significant figures appropriately because all conversions have the same number of significant digits.

Problems

2. a. $x = Bt^2$

Replacing the variables with their units will help us determine the dimensions of B.

$$m = Bs^2$$

$$\frac{m}{s^2} = B$$

B has units of acceleration, or m/s^2.

b. A has no dimension because it is the amplitude while f must have units that make the trigonometric function unitless.

$$(2\pi ft)$$

$$f \bullet s$$

$$f = \frac{1}{s} = Hz$$

3. $t = 2\pi\sqrt{\frac{l}{g}}$

Replacing the variables with their units will help to see if both sides are indeed equivalent.

$$s = 2\pi\sqrt{\frac{\frac{m}{m}}{s^2}} = 2\pi\sqrt{\frac{\frac{m}{1}}{\frac{m}{s^2}}} = 2\pi\sqrt{\frac{m}{1}\bullet\frac{s^2}{m}} = 2\pi\sqrt{s^2} = s$$

Yes, this equation is dimensionally valid.

4. a.

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_0^{\ 2} + \sqrt{mgh}$$

$$kg\frac{m^2}{s^2} = kg\frac{m^2}{s^2} + \sqrt{kg\frac{m^2}{s^2}}$$

b.

$$v = v_0 + at^2$$

$$\frac{m}{s} = \frac{m}{s} + \frac{m}{s^2}s^2$$

$$\frac{m}{s} = \frac{m}{s} + m$$

c.

$$ma = v^2$$

$$kg\frac{m}{s^2} = \frac{m^2}{s^2}$$

When adding, all terms must have identical dimensions so in the case of a and b, the relationships would not be dimensionally correct. In the case of c, each side of the equation has different units.

5.

$$F = G\frac{m_1 m_2}{r^2}$$

$$N = G\frac{kg \bullet kg}{m^2}$$

$$G = \frac{Nm^2}{kg^2}$$

7. a. 3 sig figs
   b. 4 sig figs
   c. 3 sig figs
   d. 2 sig figs

NOTE – zeros are only significant if they are between non-zeros digits or if they are BOTH to the right of a non-zero digit AND to the right of a decimal. For example:

0.0032 has only 2 sig figs because the 3 zeros are only holding place value. If you wrote this value in scientific notation it would be $3.2 \bullet 10^{-3}$, which only would have 2 sig figs. Thus the zeros must only be holding place value.

23.00 would have 4 sig figs.
101 would have 3 sig figs.

9. a. 756 + 37.2 + 0.83 + 2.5 = 796.53 = 797

   b. 0.0032 • 356.3 = 1.14016 = 1.1

   c. 5.620 • π = 17.655751 = 17.66

10. a. $3.00 \bullet 10^8 \frac{m}{s}$

    b. $2.9979 \bullet 10^8 \frac{m}{s}$

    c. $2.997925 \bullet 10^8 \frac{m}{s}$

14. a.

Performing the calculation yields $2.9593893 \bullet 10^{9}$. However becuase we are multiplying and dividing our answer cannot contain more precision (ie. more sig figs) than we began with thus since $5.37 \bullet 10^{-4}$ only has 3 sig figs our answer can only have 3 sig figs and should be $2.96 \bullet 10^{9}$.

b.

Performing the calculation yields $6.8763651 \bullet 10^{-2}$. We can only have 4 sig figs so the answer should be $6.876 \bullet 10^{-2}$.

21.

$$\frac{3.00 \bullet 10^{8} m}{1 s} \bullet \frac{3600 s}{1 hr} \bullet \frac{1 mi}{1609 m} = 6.37122436 \bullet 10^{8} \frac{mi}{hr} = 6.37 \bullet 10^{8} \frac{mi}{hr}$$

26. a.

$$\frac{1 mi}{hr} \bullet \frac{1.609 km}{1 mi} = 1.609 \frac{km}{hr}$$

b.

$$55 \frac{mi}{hr} \bullet \frac{1.609 \frac{km}{hr}}{1 \frac{mi}{hr}} = 88.495 \frac{km}{hr} = 88 \frac{km}{hr}$$

c.

$$65 \frac{mi}{hr} \bullet \frac{1.609 \frac{km}{hr}}{1 \frac{mi}{hr}} = 104.585 \frac{km}{hr} = 1\bar{0}0 \frac{km}{hr}$$

The increase is $12 \frac{km}{hr}$.