UNITS OF MEASUREMENT

1) We define v as dx/dt and we define a as dv/dt. What are their units of measurement?

2) $F = m \cdot a$ What are the units for force (F)? These are also known as newtons (N).

3) $PE_{spring} = \frac{1}{2} k \cdot x^2$ What are the units for spring constant (k)?

4) $F_{spring} = -k \cdot x$ What are the units for spring constant (k)? Do these match?

5) $F_{elec} = q \cdot E$ What are the units for electric field (E)? (q is measured in coulombs, C)

6) $E = \frac{k_e \cdot q}{r^2}$ What are the units for the electrical constant (k_e)?

7) $F_{mag} = q v B \sin\theta$ What are the units for magnetic field (B)? These are known as teslas (T).

8) $F_{grav} = \frac{G m_1 m_2}{r^2}$ What are the units for the gravitational constant (G)? Compare to k_e.

9) $I = \frac{\Delta q}{\Delta t}$ What are the units for electrical current (I)? These are also known as amps (A).

10) $V = \frac{\Delta E}{\Delta q}$ What are the units for potential (V)? These are also known as volts (V).

11) $V = I \cdot R$ What are the units for resistance (R)? These are also known as ohms ($\mathbf{\Omega}$).

12) What units do you get if you multiply amps times volts? What does this mean?

13) Convert 1 g/cm^3, the density of water, to kg/m^3.

DIMENSIONAL ANALYSIS

For each formula, check if the units "match up" on both sides of the equation.
If not, suggest a small change to the formula that makes it work.

14) $F = \dfrac{m \cdot v}{r}$

15) $v = \dfrac{F}{\left(\dfrac{\Delta m}{\Delta x}\right)}$

16) $\dfrac{\Delta \text{volume}}{\Delta t} = \dfrac{v}{\text{area}}$

17) If the units on both sides of an equation *do* match up, does that guarantee that the equation is true? If yes, explain why; if no, find a counterexample.

SCIENTIFIC NOTATION

Evaluate each expression by hand *and* by calculator make sure you know how to do both! and compare the results. If they don't match, do not automatically trust one method over the other check your steps for *both* methods and figure out what went wrong. Write your answers in scientific notation, and include units when appropriate.

18) $(5\times10^{3}\,\text{m})\times(6.2\times10^{4}\,\text{m}^2) =$

19) $(3\times10^{4}\,\text{m})^3 =$

20) $\dfrac{(2.4\times10^{2}\,\text{kg})}{(8\times10^{10}\,\text{m}^3)} =$

21) $(4.18\times10^{2}\,\text{kJ})+(7.9\times10^{4}\,\text{J}) =$

22) Given the following information, find the gravitational force between Sun and Earth.

Try estimating without a calculator first by rounding off the numbers!

$G = 6.67\times10^{-11}\dfrac{\text{m}^3}{\text{kg}\cdot\text{s}^2}$ $\quad m_{Earth} = 5.97\times10^{24}\,\text{kg}$ $\quad m_{Sun} = 1.99\times10^{30}\,\text{kg}$ $\quad r = 9.4\times10^{8}\,\text{km}$