1.) Each of the following equations has been written down by a student during an examination. Do a dimensional analysis of each equation and explain why the equation cannot be correct.

$$v = v_0 + at^2$$

$$V = \frac{4}{3}\pi r^2$$

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

2.) The University of Maryland's mascot is a terrapin (a snapping turtle). It is represented on campus by a bronze statue in front of the library named Testudo. Unfortunately, students rub his nose for luck on tests, and he is beginning to wear out. A sculptor decides to propose a replacement. She builds a small scale model and discovers she needs 2 kg of bronze. When she is finished, she finds that she can give it two coats of finishing polyurethane varnish using exactly one small can of varnish. Her final statue will be 5 times as big as her model in all dimensions. How much bronze and how much varnish will she need for the final product?

3.) In the US we specify how efficiently a car uses gas by citing how many miles per gallon it gets (MPG). In Europe they cite liters per 100 kilometers (LPK). Note the conversion factors:

   * 1 mi = 1.6 km   * 1 gal = 3.8 liters

(a) Does a more efficient car have a larger or smaller MPG number? Explain how you know.

(b) Does a more efficient car have a larger or smaller LPK number? Explain how you would know.

(c) If M is the number of miles per gallon a car gets, and L is the number of liters it takes to go 100 km, find a mathematical equation that lets you convert from M to L.

4.) Two physics students decide to go to Little Caesars for a pizza. When they get there they find Little Caesars is having the following special:

> **SPECIAL:**
> **one 20" pizza $15 (toppings extra)**
> **REGULAR PRICE:**
> **one 10" pizza $5**
> **one 20" pizza $18**

student 1 say: "Great! Let's get a large one."

Student 2 says: "Don't be dumb. Let's get three of the small ones for the same price. That'll give us more pizza and be cheaper."

Student 1 says: "Why would it be a special if it's less pizza than we could get for regular price? Let's get the large."

Who's right? Which would you buy? Explain.

What would the difference be if you were buying them at Jets (square pizzas)?

5.) Newton's Law of universal gravitation states that the gravitational force between any two masses can be determined as follows:

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

Where "G" is the *universal constant of gravitation*.

If you know that force is measured in Newtons, mass is in kilograms, and radial distance is in meters, what must the units of G be to make the equation correct (Hint: one Newton is equal to one kg·m/s^2)?