* 1. Under what conditions can quantities with different units be equal? For example, we know that one inch equals 2.54 centimeters, but is it possible for one inch to equal any number of pounds?

* 2. As you know, pounds are commonly used as units of weight, and newtons are standard units of force. Since weight is a type of force, we can correctly say that a pound is equal to a certain number of newtons. Why is it absurd to claim that one kg is equal to 2.2 pounds? (See page 6.)

3. How strong is the moon's gravity? Show how you get your answer, using SI units. (See page 6.)

4. Suppose you know that A is proportional to B and you ***ADD*** a given amount to one of those variables. Is it possible to figure out how much of a change this will cause in the other variable if you don't know the value of the proportionality constant? ____ *Sketching graphs may help you answer this question.* If you said "yes", then please describe your procedure and give a numerical example.

* 5. An old cylindrical water tank is to be replaced with a new one. The diameter of the new tank is one foot greater than the old one. By how much does the new circumference differ from the old one? Show *how* you obtain your answer, using only the given information. Don't forget its units. (Like most physics problems, this one is easiest if you finish the algebra *before* starting the arithmetic.)

6. In what important way does #5 differ from #4?

7. Imagine that you want to manufacture short grandfather clocks for affluent Eskimos. You have one authentic antique model, and you wish to make 3/4-size duplicates for your clients' igloos. Making the pendulum shorter will decrease its period, so the clock will not keep time right unless you change the gears. Since experimental clock gears are expensive, you want to get it right the first time. You need to predict the period of the new pendulum very accurately. Your *first* consultant says that shortening the pendulum to 3/4 of its original length should reduce the period by the same factor. Since the period of the original pendulum is 1.00 seconds, this person predicts that the period of the new one will be 0.75 seconds. Your *second* consultant claims that the period of a pendulum is proportional to the *square root* of its length, so the new period will be the original period multiplied by the square root of 3/4. An experiment seems necessary. You make a 3/4-size pendulum and time one swing with a stopwatch. You get 0.8 seconds. Examining the stopwatch, you notice that its hand moves in 0.1-second jerks. It is impossible to decide if the first jerk occurs at the moment the watch is started, a tenth of a second later, or somewhere in between.
   a. Estimate the roundoff error of this 0.8-second measurement.
   b. Can you decide which theory is correct with this information? (If so, please explain.)
   * c. What must you do next to find out? (If you need a clue, see page 4.)

8. Sometimes we need to write a simple sentence describing a newly-discovered cause-and-effect relationship. Such a statement is called a "conclusion". A conclusion is not a prediction. By definition, a conclusion must employ a verb in the _____ or _____ tense. Two such statements written by Amity students are quoted below. Can you understand them? If not, please explain why you can't. If possible, translate both statements into *conclusion language* that is so simple that even a physics teacher can understand.
   a. "The change in the amplitude has a significancy on the period."
   b. "The period with the larger amplitude formed by its pivot point will show the greatest loss in the pendulum motion when it is observed."

9. Imagine two children on identical swings in a playground, swinging side-by-side:
   a. How must the periods of their swinging motions compare? _____
   b. Is it possible for the two kids to remain very close together while they swing? _____
   c. Suppose they suddenly stick together with a dab of super-glue while swinging, so they form a single pendulum with double mass. Will that cause the period to change suddenly? _____
   d. How must the period of the new pendulum (with double mass) compare with the original period?
   e. This imaginary experiment proves that the period of a simple pendulum _____ depend on the mass of its bob. (must, cannot) -Do 9d & 9e contradict 9b or 9c? ___