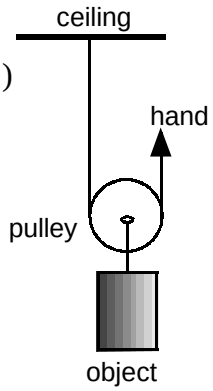
A. Measuring Variables and Describing Relations



1. Hang an object from a "movable pulley" as in the illustration at the right.
   a. Raising the free end of the string causes the object to _____. (One word, please!)
   b. Use another short word to describe the *direction* in which the object moves when you raise the free end of the string: _____

2. Suppose somebody wrote a noun or an adjective into the blank in 1a: Could the resulting statement make any sense?__ -Would a verb make any sense in 1b? ____
   a. The word in the blank in 1a must be a _____. (noun, adjective, intransitive verb)
   b. In 1a both the cause and the effect are _____s. (actions, conditions, things)

3. How far does the object move when you raise the free end of the string a distance of one meter? (Circle the *best* answer.)

one half	0.5 gallon	0.5 meter	0.5 inch	2.00
1.00	one quart	one meter	1 degree	two pounds

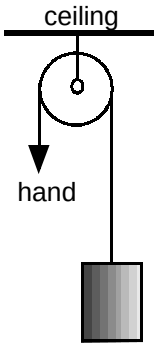
* 4. Write a simple rule that enables anyone to predict the amount of movement that results when the free end is moved up or down a given distance. Write it clearly enough so that no one can misinterpret it, not even a teacher. Remember to *test* your rule to make sure that it always works.

NOTE: The asterisk by #4 indicates that a complete statement is required. It must be written on the back of this paper or on a separate sheet, and must make sense even when taken out of context.

5. Name the measuring instrument that you used in #3: _____

6. Name the thing that you measured with it. (length? mass? temperature?...)

7. In what *units* were your measurements made? (grams? pounds? meters?...)



8. A "fixed" pulley is illustrated at the right.
   Notice that this pulley system is *different* from the one used in #1.
   a. Does the rule that you wrote for #4 work for this pulley system?
   b. Give evidence (data) to support your answer to 8a.
   c. Rewrite your answer to #4 (if necessary) so that it cannot be misinterpreted.

9. Suppose we make a movable pulley system like the one in #1 but using a pulley with different diameter:
   a. Will the rule be different from the one in #4? ____
   b. Is your answer to 9a a fact? ____ -Is it an opinion? ____
   c. Explain how you know that your answer to 9a is correct.

10. A "scale division" is the space between one mark and the next on a number line. For example, the scale divisions on the clock on our wall represent intervals of one second, or one sixtieth of a minute. Each scale division on a meter stick represents one _____th of a cm., or one _____th of a meter.

11. Suppose the size of an object changes (by magic) just after you measure it with a meter stick:
   a. If it changes by ten scale divisions will you be able to detect that change by measuring again?___
   b. If the change amounts to only one division can you still notice it? _____
   c. How about one third, one tenth, a hundredth, or a thousandth of a division? ___, ___, ___

12. I claim that *somewhere* in a series of questions like #11 the answer surely must change from "yes" to "no". If you can find some kind of measurement for which that is not the case, please bring it to the attention of the class.

13. In #11 and 12 you made a very rough estimate of the "**smallest detectable change**", or "**SDC**" of the thing that you measured. (You can also think of it as the "greatest undetectable change".) Suppose you have several different strips of paper between 5 and 95 centimeters long and you measure each with a meter stick. Under ideal conditions will those measurements all have different SDC's?