1. In describing the results of our free-fall experiments we should use "seconds" instead of ticks. The number of ticks in one second is called the "**frequency**" of the ticker, in _____s per _____.
   a. You can easily hear a small difference in frequency. Do our tickers sound as if they all have the same frequency? ___ If not, find the ones sounding lowest & highest.
   * b. Using the tricks on p. 4, measure the frequencies of those tickers. Describe your procedure clearly.
   c. Make histograms of the two sets of results obtained by your class. *Keep one for page 12.*
   d. Use #20 on RS I to find the MLV's of the frequencies, and the uncertainty of your method.
   e. The two MLV's differ by ___%. Even if the frequencies were really equal we would expect the two results to differ by roughly ___% because of our sloppy measuring technique. (Use #19 on RS I.)
   * f. Show how the two percentages in 1e were calculated.
   g. Our results suggest that the two frequencies are _____. (unequal, about equal, exactly equal)

2. What happens if you double the *speed* with which the tape is pulled through the ticker?
   a. As on page 8, the distance between dots will be _____ed. (doubled, halved, unchanged)
   b. If the length of the tape is unchanged, then the amount of time it takes to reach the end will be _____ed, so the number of dots on the tape will be _____ed. Does 2b contradict 2a? ___
   c. The frequency obtained by dividing those two numbers will be _____ed.

3. Why don't repeated frequency measurements for one ticker agree with each other?
   a. Is it because the frequency keeps changing? ___ *If so, the sound of the ticker must also change.*
   b. Is it because you are unable to count the dots without making random errors? ____
   c. Is it because you did not always pull the tape with the same speed? ___ (See #5, below.)
   d. Is it due to your inability to start and stop your clock at exactly the right moments? _____
   e. Does 2c contradict 2b?___ Does 2c agree with 3c? ___ -with 3a? ___ If not, which is wrong? ___

4. When measuring ticker frequency some students shout a word while stopping the clock or the ticker, trying to make the partner stop the other device at the same time. Does that work? ____ (See p. 4.)

5. Others stop the clock when the end of the tape goes through the ticker. Is this method better than #4?_ Does that opinion contradict 2 & 4 on page 4? ___ *If so, explain*. -Is there any reaction error in this method? ___ If so, explain what *unforeseen* event you react to, and why can't you see it coming.

6. What happens if you double the amount of *time* spent pulling the tape through the ticker?
   a. According to 3a, the frequency is _____ed, so the number of dots on the tape will be _____ed.
   b. Will the accuracy of the dot count be affected? ____ -Does 3b agree? ___
   c. Suppose a *five-second* interval can be measured with a precision of **± 0.1 second:** -The percentage uncertainty of that measurement is **(0.1 sec) ÷ (5 sec) = _____%**.
   d. According to #13 on page 1, the SDC of a measurement like this _____ depend on the size of the thing being measured. (does, doesn't) Therefore a ***ten-second*** interval can be measured by this same method with a precision of ± ___ sec.
   e. The percentage uncertainty of the *new* interval in 6d is **(___ __) ÷ (___ __) = ___%.**
   f. Doubling the duration of a measured time interval causes its percent uncertainty to be _____ed.

7. Suppose there were 100 dots on the original 5-second tape in 6c.
   a. Using 1b, the ***SLV*** of the frequency must have been **(___ __) ÷ (___ __) = _____ _____**.
   b. Similarly, the ***GLV*** of the frequency must have been **(___ __) ÷ (___ __) = _____ _____**.
   c. According to #16 on RS I, we can calculate the absolute ***uncertainty*** of the frequency by _____ing those two frequencies and dividing that result by ___.
   d. The absolute uncertainty of the frequency is **± _____ _____**.
   e. To convert that uncertainty into a **percentage** we must _____ it by the MLV of the _____.
   f. Because uncertainties are only rough estimates, we round them off to one or two digits:
      Percent uncertainty of frequency = ____%
   g. The percentage uncertainty of the frequency is _____ _____ ____ the percentage uncertainty of the original 5-second *time interval* in 6c. (much greater than, much less than, about equal to)

8. The original 5-second tape in 6c and #7 had ____ dots on it. The *new* time interval in 6d was 10 ± ___ sec, so the *new* tape in 6d must have about _____ dots. -Does 6a agree? _____
   a. We find that the *new* frequency is _____ ± ____ ____, or ___ ____ ± ___%. * ***Show*** *how these results are obtained, as in #7. Use the* ***new*** *time interval in* ***range*** *form, with the* ***new*** *number of dots.*
   b. It seems that doubling the time interval causes the uncertainty of the frequency to be _____ed.