Investigation 1-1 Measuring the Frequency of a Recording Timer

Purpose

To measure the frequency of a recording timer and calculate its period

Procedure

1. Load the recording timer with a fresh piece of carbon paper. Pass a piece of ticker tape through the guiding staples, so that the carbon side of the paper faces the ticker tape. When the timer arm vibrates, it should leave a black mark on the tape.
2. To measure the frequency of the recording timer, you must determine how many times the arm swings in 1 s. Since it is difficult to time 1 s with any reasonable accuracy, let the timer run for 5 s, as precisely as you can measure it, then count the number of carbon dots made on the tape and divide by 5. Practise moving the tape through the timer until you find a suitable speed that will spread the dots out for easy counting, but do not waste ticker tape.
3. When you are ready, start the tape moving through the timer. Have your partner start the timer and the stopwatch simultaneously. Stop the timer when 5 s have elapsed. Count the number of dots made in 5 s and then calculate the frequency of your timer in hertz (Hz).

Concluding Questions

1. What was the frequency of your recording timer in Hz?
2. Estimate the possible error in the timing of your experiment. (It might be 0.10 s, 0.20 s, or whatever you think is likely.) Calculate the percent possible error in your timing. To do this, simply divide your estimate of the possible error in timing by 5.0 s and then multiply by 100.

   Example: If you estimate your timing error to be 0.50 s, then

   $$\text{percent possible error in timing} = \frac{0.50\ \text{s}}{5.0\ \text{s}} \times 100\% = 10\%$$

3. Your calculated frequency will have the same percent possible error as you calculated for your timing error. Calculate the range within which your timer's frequency probably falls.

   Example: If you calculate the frequency to be 57 Hz, and the possible error is 10%, then the range is 57 Hz $\pm$ 5.7 Hz, or between 51.3 Hz and 62.7 Hz. Rounded off, the range is between 51 Hz and 63 Hz. You might therefore conclude that the frequency of your timer is 57 $\pm$ 6 Hz.

4. If your timer operates on household voltage, its frequency (in North America) should be 60 Hz. Is 60 Hz within your estimated range for your timer?
5. (a) What is the period of your timer?
   (b) How many dots on the ticker tape represent
   (i) 1.0 s?
   (ii) 0.10 s?

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