

## Measuring Motion

The base unit for time is the second. We are used to measuring time using clocks and watches. However, any regular repeated motion can be used as a clock. (Example: water dripping, sand falling through an hour glass, swing of a pendulum, etc.) The timing device we will use is called a "Recording Timer" - (also known as a ticker tape or acceleration timer).

It is a bolt that is caused to tap on a target by a steady flow of electricity. A paper tape and a carbon disc are used to make a record of motion using the timer.

For repeated motion, two quantities often measured are frequency (f) and period (T).

Frequency - the number of cycles per second

Period - the time required for one single cycle.

A common measuring unit is the hertz (Hz) which equals cycles per second.

$$1 \text{ cycle per second} = 1 \text{ Hz}$$

$$60 \text{ cycles in 10 seconds} = 6 \text{ Hz}$$

There is a simple relationship between period and frequency. Imagine a motion where there are 240 cycles in 60 seconds.

$$f = \frac{240 \text{ cycles}}{60 \text{ s}}$$

$$= 4 \text{ Hz}$$

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$$T = \frac{60 \text{ s}}{240 \text{ cycles}}$$

$$= \frac{1}{4} \text{ s}$$

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We can see that  $f = 1/T$  and  $T = 1/f$

- Practice:
1. A recording timer makes 540 dots in 4.0 s. What is its period?
  2. A recording timer has a period of 0.025 s. How many dots does it make in 0.80 s?
  3. A recording timer has a frequency of 25 Hz. How many dots does it make in 0.20 s?
  4. A recording timer makes 465 dots in 8.5 s.
    - a) Calculate its period.
    - b) Its actual period is 0.020 s. Calculate the percentage error.