Useful Definitions for Oscillating Systems

When describing the characteristics of oscillating systems, it is useful if everyone uses a common vocabulary. The four terms used most often in describing oscillations are:

> **Temporal Period:** The time it takes an object to go through one complete cycle. This is commonly denoted by the capital letter T.
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> **Temporal Frequency:** The number of (complete) cycles the object undergoes in one second. This is typically denoted by the symbol f or the Greek letter small ν (nu, pronounced *new*). In standard SI units, frequency is measured in hertz, abbreviated Hz, where 1 Hz = 1 cycle/sec.
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> **Amplitude:** The maximum displacement of the oscillating object from its equilibrium position. The symbol for amplitude is often the capital letter A, although if the displacement is measured along a particular axis, you may also see X (or Y) representing the amplitude. In the case of a simple pendulum, which has an angular displacement, the amplitude is usually measured in radians and denoted by Θ. The amplitude of oscillation is assumed to be positive.
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> **Phase:** Qualitatively, the phase represents how far along an object is in its oscillation. For example, the phase describes whether you are near the beginning, middle, or end of the oscillation. Phase is the trickiest of these concepts to understand, so we will postpone further discussion until later in this unit.

Two of these definitions, *frequency* and *period*, are closely related to each other. By observing the systems shown in Fig. 14.1, you should be able to find a mathematical equation that relates the frequency of a given oscillating system to its period.

Warning! If you add too much mass to a spring, it will become permanently deformed and will no longer act like a spring (*i.e.*, it will be ruined). Please be careful! Your instructor may have specific instructions for what mass to use.

14.2.2. Activity: Relating Period and Frequency

Observe the three systems discussed above. Use a ruler or protractor to measure the amplitude of oscillation for each case.[1] Then use a stopwatch to measure both the average period and frequency. (Don't try to measure the time of a single oscillation or the number of cycles in one second; instead, measure the time of many oscillations or the number of cycles in a longer time and then divide, as this produces a much better average.) Note: Your goal is to *separately* measure both the period and frequency to verify the relation between them.

[1] For the peg on a rotating disk, you will need to think carefully about how to measure the amplitude.