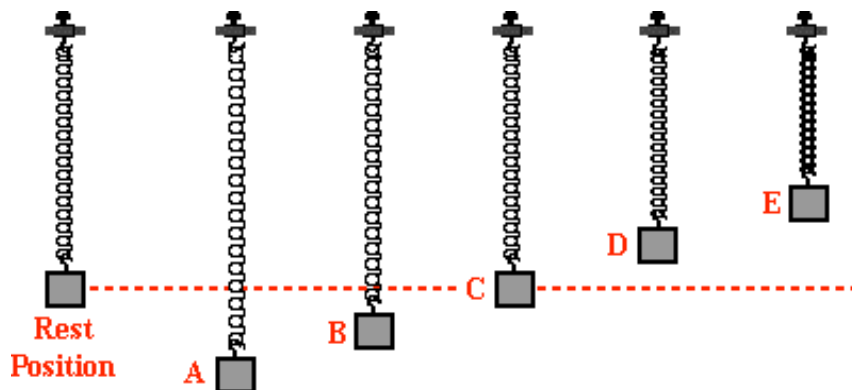


Mass on a Spring

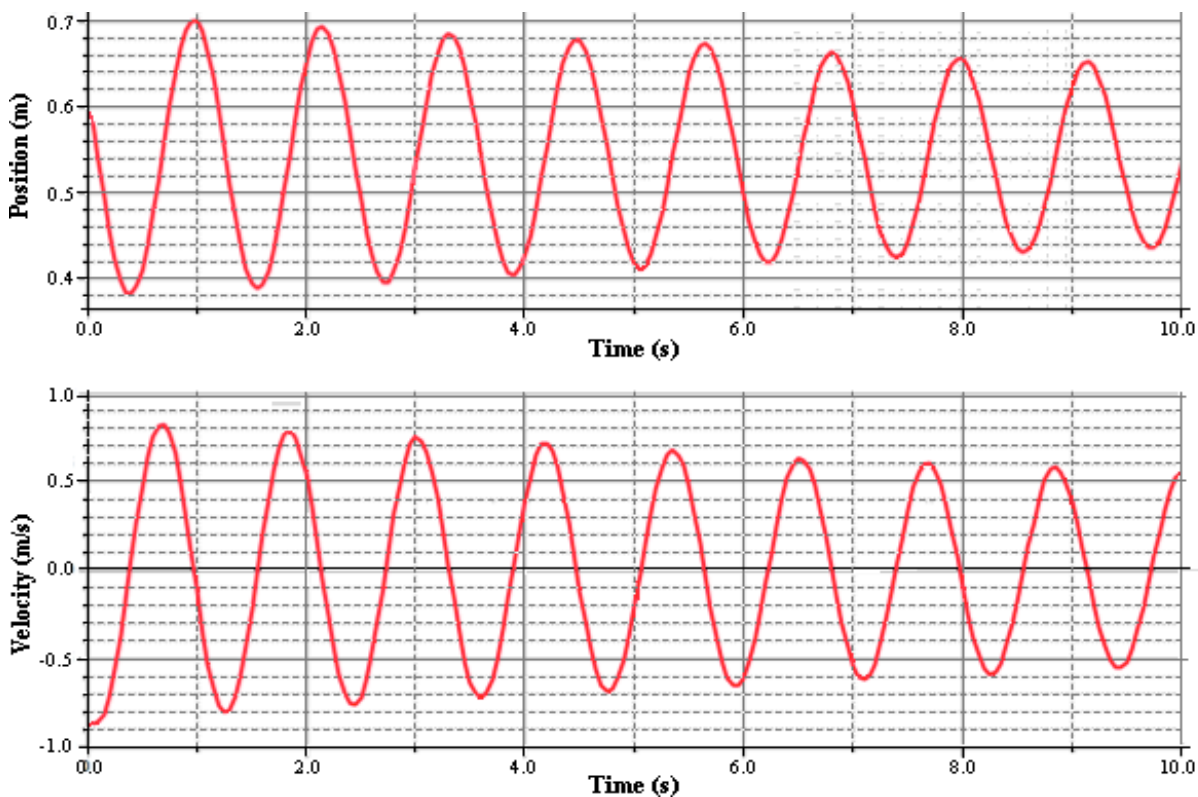
When a mass is suspended on a spring, the mass hangs at its **rest position**. If the mass is pulled below its rest position and released, it begins to vibrate up and down. It moves from position A to B to C (the original rest position) to D to E, and then back down to A. See **Figure 1**. The motion repeats itself in cyclic fashion over and over again.

Figure 1: Up and Down Motion of a Mass on a Spring



The vertical position is not the only property of the mass that changes over time. The velocity of the mass also changes. **Velocity** describes how fast an object moves and in what direction it moves. A + and - sign is used to indicate the directional aspect of velocity. A + sign indicates an upward direction of motion and a - sign indicates a downward direction of motion. If a motion detector is placed below the vibrating mass, it will detect the vertical position (height above the detector) and velocity as a function of time. The resulting graphical display is shown in **Figure 2**.

Figure 2: Plots of Position and Velocity as a Function of Time



Questions

- At what position is the mass located when it is at the same height as the rest position?
 - Position A
 - Position B
 - Position C
 - Position D
 - Position E
- How high above the motion detector is the mass when it is at its rest position?
 - 0.38 meters above the detector.
 - 0.54 meters above the detector.
 - 0.59 meters above the detector.
 - 0.70 meters above the detector.
 - The distance from the rest position to the detector varies with time.
- At which one of its positions is the mass located at a time of 3.0 seconds?
 - Position A
 - Position B
 - Position C
 - Position D
 - Position E
- At which one of the following times is the mass located at a lowest vertical position?
 - 1.0 seconds
 - 2.4 seconds
 - 3.9 seconds
 - 6.5 seconds
- At which of the following times is the mass moving with a velocity of -0.60 m/s?
 - 2.9 seconds
 - 6.0 seconds
 - 7.0 seconds
 - 8.8 seconds
- At which one of the following times is the mass moving upward with the greatest speed?
 - 1.0 seconds
 - 3.0 seconds
 - 5.1 seconds
 - 5.9 seconds
- According to **Figure 2**, at which of the following times is the mass moving in the downward direction?
 - 2.0 seconds
 - 4.0 seconds
 - 5.0 seconds
 - 9.0 seconds
- According to **Figure 2**, at which of the following times is the mass located above its rest position and moving in the downward direction?
 - 2.0 seconds
 - 3.0 seconds
 - 4.0 seconds
 - 7.0 seconds
- A vibrating mass is often described as having an *amplitude*. Amplitude is the distance from the rest position to its most extreme point above or below the rest position. What is the amplitude for this vibrating mass during the first few seconds?
 - Approximately 0.11 m
 - Approximately 0.16 m
 - Approximately 0.40 m
 - Approximately 0.32 m
 - Approximately 0.80 m

10. How much time does it take the mass on this spring to complete one full up-and down cycle of vibration?
- a. Approximately 0.6 seconds
 - b. Approximately 1.2 seconds
 - c. Approximately 1.8 seconds
 - d. Approximately 10.0 seconds
11. At which one of these positions is the mass located when it is moving the fastest?
- a. At Position C - exactly.
 - b. Between position C and position B.
 - c. At Position B - exactly.
 - d. Between position B and position A.
 - e. At Position A - exactly.
12. At which one of these positions is the mass located when it is moving the slowest?
- a. At Position C - exactly.
 - b. Between position C and position D.
 - c. At Position D - exactly.
 - d. Between position D and position E.
 - e. At Position E - exactly.