SHM Practice

1. A *0.50 kg* block is attached to a spring with $k = 400\ N\ m^{-1}$. It is placed on a horizontal surface, displaced 15 cm from equilibrium and released from rest.
    a. Calculate the period of the resulting motion.
    b. Calculate the value of the greatest acceleration.
    c. Identify the position(s) where the block has this acceleration.
    d. Calculate the maximum speed of the block during the motion.
    e. Identify the position(s) where the block has this speed.

2. A *1.5 kg* block is attached to a spring with $k = 300\ N\ m^{-1}$. It is placed on a horizontal surface, displaced 20 cm from equilibrium and released from rest.
    a. Sketch the position vs time, velocity vs time and acceleration vs time graphs for the first three cycles of motion.
    b. Label the extreme positions and the time when the block is back at the equilibrium position.
    c. Sketch the same set of graphs for the motion if you began taking data when the block first reached the equilibrium position.

3. A block on the end of a $200\ N\ m^{-1}$ spring oscillates with a period of *1.5 s* and has a maximum speed of $3.0\ m\ s^{-1}$. The block is on a horizontal surface with no friction.
    a. Calculate the mass of the block.
    b. Calculate the maximum kinetic energy in the system.
    c. Calculate the maximum potential energy in the system.
    d. Calculate the amplitude of the motion.
    e. Calculate the speed when the block is halfway between the equilibrium point and the maximum position.
    f. Sketch the graph of the potential energy vs time for the motion.
    g. Sketch the corresponding graph of the kinetic energy vs time for the motion.

4. Two springs ($k_1 = 200\ N\ m^{-1}$ *and* $k_2 = 300\ N\ m^{-1}$) are connected in parallel to a *2.0 kg* block that is on a horizontal frictionless surface. The block is pulled to a position *30 cm* from the equilibrium position and released from rest.
    a. Show the combination of springs acts as a single spring.
    b. Calculate the frequency of the system.
    c. Calculate the maximum potential energy stored in each spring.
    d. Calculate the maximum speed of the block.

5. Two springs ($k_1 = 200\ N\ m^{-1}$ *and* $k_2 = 300\ N\ m^{-1}$) are connected in series to a *2.0 kg* block that is on a horizontal frictionless surface. The block is pulled to a position *30 cm* from the equilibrium position and released from rest.
    a. Show the combination of springs acts as a single spring.
    b. Calculate the frequency of the system.
    c. Calculate the maximum potential energy stored in each spring.
    d. Calculate the maximum speed of the block.

6. A 5.0 kg block is attached to 200 N m^{-1} spring and hung vertically from crossbar.
    a. Calculate the distance the block will extend the spring to hang at rest.
    b. The block is displaced 10 cm from the position identified and released from rest.
        i. Prove the block will exhibit simple harmonic motion about the equilibrium point.
        ii. Calculate the spring potential energy at the bottom of the motion.
        iii. Calculate the spring potential energy at the top of the motion.
        iv. Calculate the change in the gravitational potential energy between the bottom of the motion and the top of the motion.
        v. Sketch the graphs of the potential energies vs position for the motion.