Student #: _____ Student Name: _____

Physics 12 Homework Class 6: Simple Harmonic Motion

_____ 1. A mass is attached to a spring and allowed to oscillate vertically. Which of the following would *not* change the period to the oscillation?

(a) Double the mass and double the spring constant
(b) Double the amplitude of vibration and the double the mass
(c) Double the gravitational field strength and double the mass
(d) Double the gravitational field strength and double the spring constant
(e) Double the gravitational field strength and quadruple the mass

_____ 2. A particle oscillated with simple harmonic motion with no damping. Which of the following statements about the acceleration of the particle is true?

(a) It has a value of $9.8\,\mathrm{m/s^2}$ when the oscillation is vertical
(b) It is zero when the spring is minimum
(c) I is proportional to the frequency
(d) It is zero throughout the oscillation
(e) It is zero when the speed is maximum

_____ 3. At what position does the mass attached to a spring in SHM have the greatest acceleration? (A is amplitude)

(a) A
(b) $A/2$
(c) 0
(d) $A/2$
(e) $A/4$

_____ 4. A spring mass system oscillated up and down in a gravitational field. When is the kinetic energy the greatest?

(a) When it is passing through equilibrium
(b) At the top of its motion
(c) At the bottom of its motion
(d) When its gravitational potential energy is the greatest
(e) When its elastic energy is the greatest

_____ 5. An object with a mass M is suspended from an elastic spring with a spring constant k. The object oscillates with period T on the surface of Earth. If the oscillating system is moved to the surface of Moon, how it will change the period of oscillations? Acceleration due to gravity on moon is $1.6\,\mathrm{m/s^2}$.

(a) The period is increased by factor $\sqrt{6}$
(b) The period is increased by factor four
(c) The period is decreased by factor $\sqrt{6}$
(d) The period is decreased by factor four
(e) The period remains the same

_____ 6. A simple pendulum of mass M and length l is moved from the Earth to the Moon. How does it change the period of oscillations?

(a) The period is increased by factor $\sqrt{6}$
(b) The period is increased by factor four
(c) The period is decreased by factor $\sqrt{6}$
(d) The period is decreased by factor four
(e) The period remains the same

7. A mass hangs from a vertical spring and is initially at rest. A person then pulls down on the mass, stretching the spring. Does the total mechanical energy of this system (the mass plus the spring) increase, decrease, or stay the same? Explain.

8. A bungee jumper of mass $75\,\mathrm{kg}$ is standing on a platform $53\,\mathrm{m}$ above a river. The length of the unstretched bungee cord is $11\,\mathrm{m}$. The spring constant of the cord is $65.5\,\mathrm{N/m}$. Calculate the jumper's speed at $19\,\mathrm{m}$ below the bridge on the first fall.

9. A model car of mass $5.0\,\mathrm{kg}$ slides down a frictionless ramp into a spring with spring constant $k = 4.9\,\mathrm{kN/m}$. The spring experiences a maximum compression of $22\,\mathrm{cm}$.

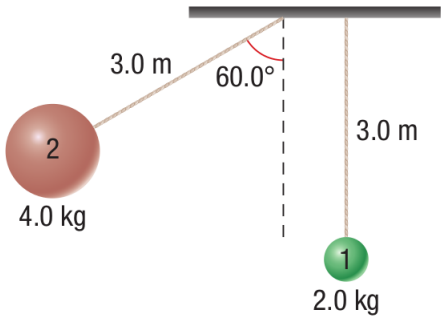
   (a) Determine the height of the initial release point.
   (b) Calculate the speed of the model car when the spring has been compressed $15\,\mathrm{cm}$.
   (c) Determine the maximum acceleration of the car after it hits the spring.

10. Suppose you set a spring with spring constant $4.5\,\mathrm{N/m}$ into damped harmonic motion at noon, measuring its maximum displacement from equilibrium to be $0.75\,\mathrm{m}$. When you return $15\,\mathrm{min}$ later, the spring is still oscillating, but its maximum displacement has decreased to $0.5\,\mathrm{m}$.

   (a) Determine how much energy the system has lost.
   (b) What is the power loss of the system?

11. A simple pendulum is $5.0\,\text{m}$.
    (a) What is the period of simple harmonic motion for this pendulum if it is located in an elevator accelerating upward at $5.0\,\text{m}/\text{s}^2$?
    (b) What is the answer to part (a) if the elevator is accelerating downward at $5.0\,\text{m}/\text{s}^2$
    (c) What is the period of simple harmonic motion for this pendulum if it is placed in a truck that is accelerating horizontally at $5.0\,\text{m}/\text{s}^2$?

12. Ball 1 has a mass of $2.0\,\text{kg}$ and is suspended with a $3.0\,\text{m}$ rope from a post so that the ball is stationary. Ball 2 has a mass of $4.0\,\text{kg}$ and is tied to another rope. The second rope also measures $3.0\,\text{m}$ but is held at a 60.0° angle, as shown in the figure below. When ball 2 is released, it collides, head-on, with ball 1 in an elastic collision.
    (a) Calculate the speed of each ball immediately after the first collision.
    (b) Calculate the maximum height of each ball after the first collision.
    (c) If the balls are allowed to oscillate freely after the collision, what are their period of oscillation?



13. A $20\,\mathrm{g}$ particle moves in simple harmonic motion with a frequency of $3.0\,\mathrm{Hz}$ and an amplitude of $5.0\,\mathrm{cm}$.
    (a) Through what total distance does the particle move during one cycle of its motion?
    (b) What is its maximum speed? Where does that occur?
    (c) Find the maximum acceleration of the particle. Where does that occur?