Physics 103 Practice for Midterm Exam 2, to be given November 11-12, 2009

1. Which of the following statements necessarily applies in a collision?
I. Total kinetic energy is conserved (remains the same).
II. Total momentum is conserved (remains the same).
III. The speed of each object remains the same.
(A) I only; (B) II only; (C) I and II only; (D) I, II, and III.

2. The SI unit of Newton's gravitational constant G is (A) $\mathrm{kg \cdot m/s^2}$; (B) $\mathrm{kg^2/m^2}$; (C) $\mathrm{m^2/kg^2}$; (D) $\mathrm{m^3/kg \cdot s^2}$.

3. Assume that a spring with spring constant k is fixed at one end. If the spring is compressed to the point that it has potential energy U, which one of the following expressions gives the distance by which the spring has been compressed? (A) $U/2k$. (B) $2U/k$. (C) $\sqrt{U/2k}$. (D) $\sqrt{2U/k}$.

4. A simple pendulum has a period of 3 seconds on the Earth. If it is taken to the Moon, where the acceleration g due to gravity is 1/6 that on Earth, what will be its period there? (The angular frequency is given by $\omega = \sqrt{g/L}$.) (A) 0.5 s. (B) 1.2 s. (C) 7.4 s. (D) 18.0 s.

5. The period of a mass m on a spring of spring constant k is $T = 2\pi\sqrt{m/k}$. a 5-kg mass on a certain spring oscillates with frequency f. If the mass had instead been 10 kg, what would be the frequency of the oscillations? (A) 0.5 f. (B) 0.7 f. (C) 1.4 f. (D) 2.0 f.

6. The Moon is about 60 Earth radii distant from the Earth, and its radius is only about 1/4 that of the Earth. The Earth is roughly 100 times as massive as the Moon. If the gravitational force exerted by the Earth on the Moon is denoted F_1, and the gravitational force exerted by the Moon on the Earth is F_2, then (A)$F_1 = 1600F_2$. (B) $F_1 = 100F_2$. (C) $F_1 = 6.25F_2$. (D) $F_1 = F_2$.

7. If the height to which a pendulum is raised is doubled, its velocity as it passes through its equilibrium position will: (A) increase by less than a factor of 2. (B) increase by a factor of 2. (C) increase by more than a factor of 2. (D) remain the same.

8. A measurement of the frequency $\omega = \sqrt{g/L}$ of a pendulum can be used to determine g. A 10% error in the measurement of which of the following quantities would result in the greatest error in the measurement of g? (A) Mass of the pendulum bob. (B) Length of the pendulum arm. (C) Amplitude of the motion. (D) Number of cycles per minute.

9. A 50 kg projectile is launched from ground level with an initial velocity of 200 m/s at an angle of 30°. If the projectile travels over level ground and lands 3460 meters from its launch point, calculate the projectile's total flight time. (A) 10.0 s. (B) 17.3 s. (C) 20.0 s. (D) 34.6 s.

10. A radioactive sample has a half-life of 10 days. Initially a measurement using a Geiger counter recorded 800 clicks per second. What do we expect the click rate to be from the same sample 60 days later? (A) 12 per second. (B) 25 per second. (C) 80 per second. (D) 130 per second.

11. A particle is moving on a circular path whose radius is 4 cm, with a frequency 4 Hz (i.e., 4 cycles per second). How long will it take for the particle to move through a distance of 16π along the circle? (A) 1/4 s. (B) 1/2 s. (C) 1 s. (D) 4 s.

12. Two children start down a hill on sleds, from rest, one from a point 10 m above the bottom of the hill, and the other from a point 20 m above the bottom of the hill. How does the speed of the first sled compare to the speed of the second sled when they reach the bottom? (A) Slower by a factor of 4. (B) Slower by a factor of $2\sqrt{2}$. (C) Slower by a factor of 2. (D) Slower by a factor of $\sqrt{2}$.