Student #: _____ Student Name: _____

AP PHYSICS 1 & C: WORK AND ENERGY

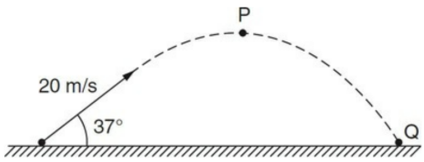
Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and place the letter of your choice in the corresponding box on the student answer sheet.

Note: To simplify calculations, you may use $g = 10\,\text{m/s}^2$ in all problems.

1. A 1 kg ball is thrown vertically downward from a 50-meter-high tower with an initial speed of 4 m/s. Just before striking the ground, the speed of the ball is 20 m/s. The energy lost to air friction is most nearly

   (A) 101 J
   (B) 210 J
   (C) 308 J
   (D) 406 J
   (E) 508 J

Questions 2–3. A 2 kg projectile is launched with a speed of 20 m/s from horizontal ground at an angle of 37° to the horizontal as shown. Point P is at the top of the path, and point Q is at the end of the path, just before the projectile again reaches the ground.



2. The kinetic energy of the projectile at point P is

   (A) 108 J
   (B) 225 J
   (C) 256 J
   (D) 400 J
   (E) 525 J

3. The kinetic energy of the projectile at point Q is

   (A) 108 J
   (B) 225 J
   (C) 256 J
   (D) 400 J
   (E) 525 J

4. If a projectile thrown directly upward reaches a maximum height h and spends a total time in the air of T, the average power of the gravitational force during the trajectory is

   (A) $P = 2mgh/T$
   (B) $P = -2mgh/T$
   (C) 0
   (D) $P = mgh/T$
   (E) $P = -mgh/T$

5. Given that the constant net force on an object and the object's displacement, which of the following quantities can be calculated?

   (A) the net change in the object's velocity
   (B) the net change in the object's mechanical energy
   (C) the average acceleration
   (D) the net change in the object's kinetic energy
   (E) the net change in the object's potential energy

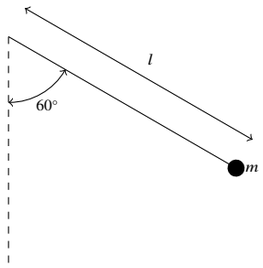
6. An electron travels in a circle around a hydrogen nucleus at a very high speed. The work done by the electrostatic force acting on the electron after one complete revolution is

   (A) zero
   (B) positive
   (C) negative
   (D) equal to the kinetic energy of the electron
   (E) equal to the potential energy of the electron

7. An object is moved from rest at point P to rest at point Q in a gravitational field. The net work against the gravitational field depends on the

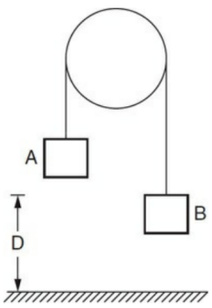
   (A) mass of the object and the positions of P and Q
   (B) mass of the object only
   (C) positions of P and Q only
   (D) length moved between points P and Q
   (E) coefficient of friction

8. A pendulum bob of mass m is released from rest as shown in the figure below. What is the tension in the string as the pendulum swings through the lowest point of its motion?



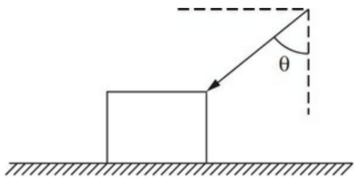
(A) $T = \frac{1}{2}mg$
(B) $T = mg$
(C) $T = \frac{3}{2}mg$
(D) $T = 2mg$
(E) None of the above

9. Two blocks of mass m_A and m_B are connected by a string that passes over a light pulley. The mass of A is larger than the mass of B. The speed of mass A just before reaching the floor is:



(A) $\sqrt{\frac{m_A - m_B}{m_A + m_B} gD}$
(B) $\sqrt{\frac{m_A + m_B}{m_A - m_B} gD}$
(C) $\sqrt{\frac{m_A}{m_A + m_B} gD}$
(D) $\sqrt{\frac{m_B}{m_A + m_B} gD}$
(E) $\sqrt{\frac{m_A}{m_B} gD}$

Questions 10–11. A force is applied to a block of mass m at a downward angle of θ to the vertical as shown. The block moves with a constant speed across a rough floor for a distance x.



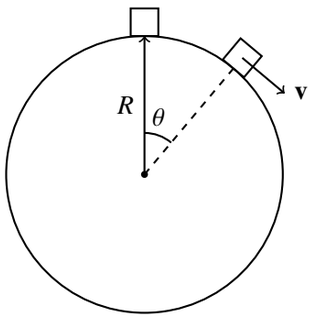
10. The work done by the applied force on the block is

(A) $Fx \sin\theta$
(B) $Fx \cos\theta$
(C) $Fmx \sin\theta$
(D) $Fmx \cos\theta$
(E) zero

11. The coefficient of friction between the block and the floor is

(A) $\frac{F}{mg}$
(B) $\frac{F\cos\theta}{mg}$
(C) $\frac{F\cos\theta}{F\sin\theta + mg}$
(D) $\frac{F\sin\theta}{F\cos\theta + mg}$
(E) $\frac{F\cos\theta}{F\sin\theta}$

Questions 12–13. A small block rests on the top of a smooth sphere of radius R when it is given a light tap so that it just begins sliding on the sphere. When the block reaches the angle θ, it loses contact with the surface of the sphere.



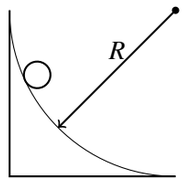
12. The kinetic energy of the block as it leaves the surface of the sphere is

(A) mgR
(B) $mgR\cos\theta$
(C) $mgR\sin\theta$
(D) $mg(R - R\cos\theta)$
(E) $mg(R - R\sin\theta)$

13. The speed of the block as it leaves the surface of the sphere is

(A) $\sqrt{2g}m$
(B) $\sqrt{2gR}m$
(C) $2gR\cos\theta$
(D) $2g(R - R\cos\theta)$
(E) $2g(R - R\sin\theta)$

14. A small ball starts from rest and rolls down a quarter-circle ramp of radius R. The speed of the ball at the point halfway down the ramp is most nearly



(A) gR
(B) $2gR$
(C) $\sqrt{gR\sin 45°}$
(D) $\sqrt{2gR\sin 45°}$
(E) The speed cannot be determined without knowing the mass of the ball.