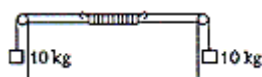


PHYSICS B
SAMPLE EXAM I
 Time - 90 minutes
 70 Questions

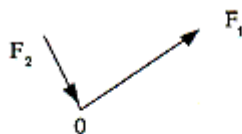
Directions: Each of the questions or incomplete statements below is followed by five suggested Solutions or completions. Select the one that is best in each case.

1. A spring scale is supported on a horizontal table by two equal hanging masses, each 10 kg, as shown below.



The scale reading will be

- (A) 0 n
 (B) 50 n
 (C) 100 n
 (D) 150 n
 (E) 200 n
2. Two forces \vec{F}_1 and \vec{F}_2 are acting at a point O, as shown below.



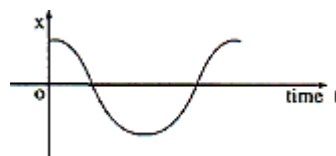
Which of the following is very nearly the resultant vector of $\vec{F}_2 - \vec{F}_1$?

- (A) (B)
 (C) (D)
 (E)

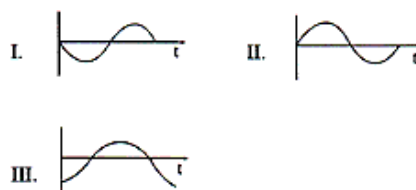
3. A 1200 kg car is driven over the top of a hill, the cross section of which is assumed to be circular having a radius of 90 meters. The greatest speed at which a person can drive without the car leaving contact with the road at the top of the hill would be

- (A) 22 m/s

4. A mass m attached to the end of a spring vibrating about its equilibrium position is described by the displacement x vs time graph as shown below.

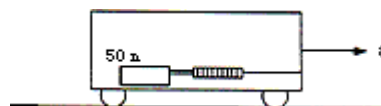


Which of the following graphs represent the velocity vs time and the acceleration vs time graph?



- | | Velocity | Acceleration |
|-----|----------|--------------|
| (A) | I | II |
| (B) | I | III |
| (C) | II | III |
| (D) | II | I |
| (E) | III | I |

5. A 50 newton block is attached to a spring scale which is attached to the front of a cart. The block is on a horizontal frictionless surface. When the cart accelerates the scale reads 16 newtons.



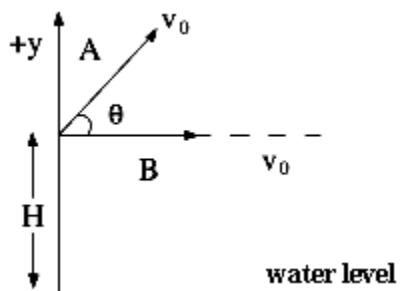
- (B) 26 m/s
- (C) 30 m/s
- (D) 42 m/s
- (E) any speed

The acceleration of the cart above would be

- (A) 13.2 m/s^2
- (B) 10 m/s^2
- (C) 6.8 m/s^2
- (D) 3.2 m/s^2
- (E) 0.32 m/s^2

PHYSICS B SAMPLE EXAM I

6. Person A throws a stone of mass m with initial velocity v_0 at an angle θ with the horizontal from a bridge that is H meters above the water level. At the same instant, Person B throws a stone of mass $2m$ with the same initial velocity in the horizontal direction as shown below.



Which of the following is correct for the speeds of each stone v_A and v_B for the time t_A and t_B , respectively, when they strike the water?

- (A) $v_A < v_B$ and $t_A > t_B$
- (B) $v_A > v_B$ and $t_A < t_B$
- (C) $v_A < v_B$ and $t_A = t_B$
- (D) $v_A = v_B$ and $t_A > t_B$
- (E) $v_A = v_B$ and $t_A = t_B$

8. The coefficient of kinetic friction between the 4 kg block and the horizontal surface would be

- (A) 0.47
- (B) 0.40
- (C) 0.23
- (D) 0.20
- (E) 0.18

9. A mass m attached to a string rotates in a circular path of radius r with angular velocity ω on a frictionless horizontal table. The tension in the string is T_0 . If the angular velocity (ω) and the radius (r) are both doubled, the tension in the string will be

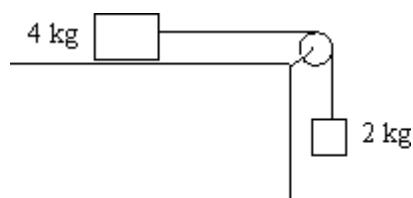
- (A) $\frac{1}{2} T_0$
- (B) T_0
- (C) $2T_0$
- (D) $4T_0$
- (E) $8T_0$

10. A mass m on a string of length R is released from rest from the horizontal position.

Questions 7 and 8

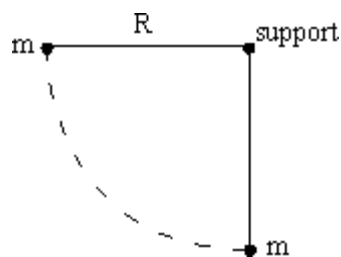
Two blocks are attached to a string that passes over a frictionless pulley as shown below. The 4 kg mass rests on a rough

horizontal surface. When the system is released the 2 kg mass falls from rest and attains the speed of 2 m/s after traveling a distance of 3 meters.



7. What is the loss in mechanical energy?

- (A) 168 J
- (B) 56 J
- (C) 48 J
- (D) 28 J
- (E) 22 J



At its lowest position, the tension in the string above would be

- (A) mg downward
- (B) $3mg$ downward
- (C) $2mg$ upward
- (D) $3mg$ upward
- (E) $mg/2$ upward

PHYSICS C
MECHANICS: SAMPLE EXAM I

Time - 45 minutes

35 Questions

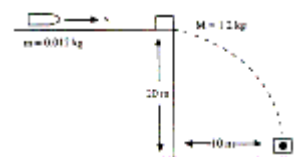
Directions: Each of the questions or incomplete statements below is followed by five suggested Solutions or completions. Select the one that is best in each case.

1. Traveler A starts from rest at a constant acceleration of 6 m/s^2 . Two seconds later, traveler B starts with an initial velocity of 20 m/s at the same acceleration of 6 m/s^2 . As measured by A, at what time will traveler B overtake traveler A?

- (A) 0.4 s
- (B) 1.5 s
- (C) 2.0 s
- (D) 2.5 s
- (E) 3.5 s

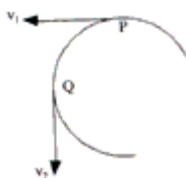
2. A particle, as shown below, moving from point P to a point Q on a curved path has velocities v_1 and v_2 respectively.

3. A 0.012 kg bullet is fired into a 1.2 kg block which is at rest at the edge of a frictionless table 20 meters in height, as shown below.

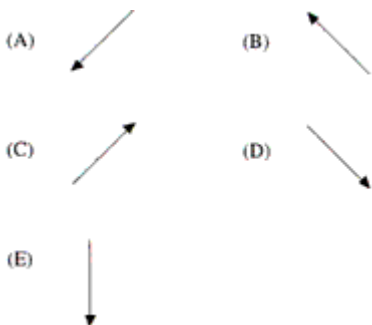


The bullet stays in the block and after impact the block-bullet lands 10 meters away from the bottom of the table. The initial speed of the bullet is

- (A) 100 m/s
- (B) 135 m/s
- (C) 250 m/s
- (D) 500 m/s
- (E) 1250 m/s



The direction of the average force on the particle is best given by



4. The frequency of oscillation of a pendulum of length L_0 is f_0 for a small amplitude. If the frequency is doubled, the length of the pendulum would be

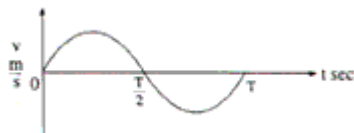
- (A) $2L_0$
- (B) $\sqrt{2}L_0$
- (C) $\frac{L_0}{\sqrt{2}}$
- (D) $\frac{L_0}{2}$
- (E) $\frac{L_0}{4}$

PHYSICS C

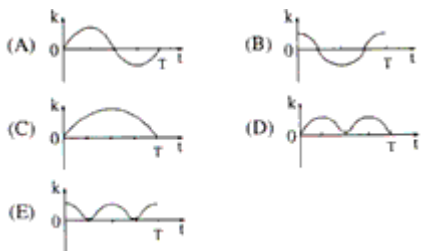
MECHANICS: SAMPLE EXAM I

Questions 5 and 6

The graph of velocity v vs time shown below describes the motion of a mass attached to one end of a spring that performs a simple harmonic motion for one cycle of period T .



5. Which of the following graphs best represents the kinetic energy k of the mass as a function of time t ?

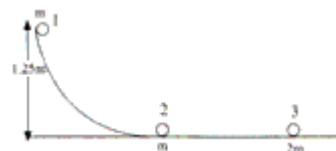


6.

Which of the following graphs best represents the elastic potential energy U of a spring as a function of its displacement x from equilibrium position for only half the cycle?

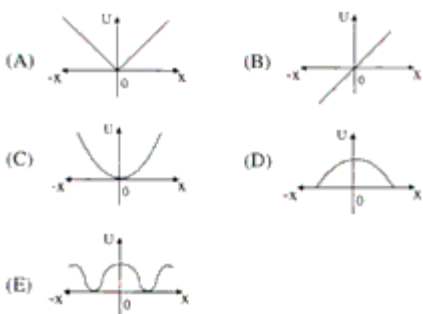
Question 7

A particle of mass m initially at rest slides down a height of 1.25 meters on a frictionless ramp, collides with and sticks to an identical particle 2 of mass m at rest as shown below. Then particle 1 and 2 together collide elastically with the particle 3 of mass $2m$ at rest.



7. The speed of particle 1 after the collision with particle 2 would be

- (A) 0 m/s
- (B) 1.25 m/s
- (C) 2.5 m/s
- (D) 5 m/s
- (E) 7.5 m/s



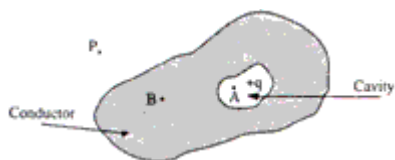
PHYSICS C
ELECTRICITY AND MAGNETISM: SAMPLE EXAM I

Time - 45 minutes

35 Questions

Directions: Each of the questions or incomplete statements below is followed by five suggested Solutions or completions. Select the one that is best in each case.

36. Inside the uncharged conductor below there is a cavity. A small isolated conductor with a charge $+q$ on it is placed inside the cavity.



Which of the following statements is correct?

- (A) The charge on the wall of the cavity is zero.
 (B) The charge on the outer surface of the conductor is zero.
 (C) The electric field at a point A in the cavity is zero.
 (D) The electric field at a point P outside the conductor is zero.
 (E) The work done in bringing a charge q_0 from point P to point B is not zero.
37. The electrical potential due to a dipole on its axis at a point P at a large distance x from the dipole is given by



where C is a constant as shown below.

38. A nonconducting sphere of radius R is charged uniformly throughout its volume. The volume charge density is ρ . The electric field intensity E inside the sphere at a distance r from the center of the sphere is proportional to

- (A) Zero
 (B) r^2
 (C) r^{-2}
 (D) r
 (E) r^{-1}

Questions 39 and 40 relate to the following equations, where E = electric field, B = magnetic field, l = distance, and A = Area.

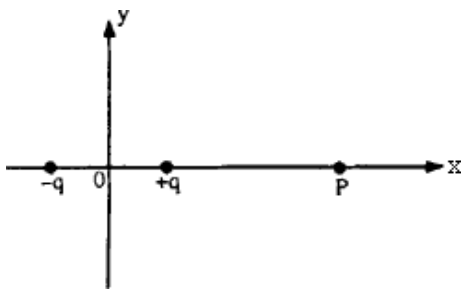
$$\text{I. } \oint \vec{E} \cdot d\vec{A} = 0$$

$$\text{II. } \oint \vec{E} \cdot d\vec{l} = 0$$

$$\text{III. } \oint \vec{E} \cdot d\vec{l} = -\frac{d}{dt} \left(\int \vec{B} \cdot d\vec{A} \right)$$

39. Which of the above equations predict the electric field E to be zero?

- (A) I only



The magnitude and direction of the electric field at P is

- (A) $\frac{2C}{x} \longrightarrow$ (B) $\frac{2C}{x} \longleftarrow$
 (C) $\frac{2C}{x^3} \longrightarrow$ (D) $\frac{2C}{x^3} \longleftarrow$
 (E) $\frac{C}{x} \longrightarrow$

- (B) II only
 (C) I and II only
 (D) I, II, and III
 (E) None of the above

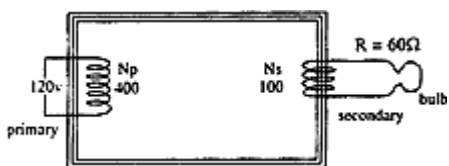
40. Which of the above equations predict the electric field E to be conservative?

- (A) I only
 (B) II only
 (C) I and II
 (D) I and III
 (E) II and III

PHYSICS C

ELECTRICITY AND MAGNETISM: SAMPLE EXAM I

41. A 400 turn primary coil of an ideal transformer is connected to an alternating current power line, as shown below. A secondary coil of 100 turns is connected to a light bulb of 60Ω resistance.



The maximum current induced in the secondary coil would be

- (A) 2 Amps
 (B) 1 Amp
 (C) 0.5 Amps
 (D) 0.25 Amps
 (E) 0.125 Amps
42. Which of the following is not a unit of power?
- (A) Kilowatt (KW)
 (B) Volt Coulomb second⁻¹ (VCS⁻¹)
 (C) Volt² ohm⁻¹ (V Ω ⁻¹)

- (D) Ampere² ohm ($A^2\Omega$)
- (E) Kilowatt-hour (KWh)

43. A piece of copper is to be drawn into a cylindrical wire of length ℓ and radius r . Which of the following combinations of ℓ and r gives the maximum current in the wire when connected in a circuit?

- (A) 2ℓ and r
- (B) ℓ and $2r$
- (C) $\ell/2$ and r
- (D) $\ell/2$ and $2r$
- (E) $\ell/2$ and $r/2$