Note: To simplify calculations, you may use g = 10 m/s^2 in all multiple choice problems.

1. The position of a 2-kg object moving along the x-axis is given by the equation
   $x(t) = 3t^3 - 2t^2 + t$,
   where x is in meters and t is in seconds. What is its kinetic energy at time t = 3 s?
   (A) 700 J
   (B) 1400 J
   (C) 4900 J
   (D) 7200 J
   (E) 8400 J

2. A 1000-kg truck moving along a straight road at 30 m/s applies its brakes such that its velocity is given by the equation
   $v(t) = 30 - 2t$,
   where v is in m/s and t is in seconds. What is the net force on the truck at t = 6 s?
   (A) 500 N
   (B) 1000 N
   (C) 2000 N
   (D) –1000 N
   (E) –2000 N

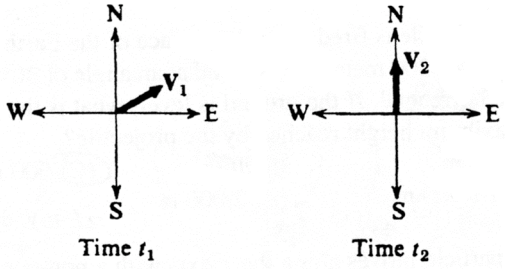
3. A stone is dropped from a bridge 45 m above the surface of a river. Approximately how many seconds does the stone take to reach the water's surface?
   (A) 1 s
   (B) 3 s
   (C) 5 s
   (D) 14 s
   (E) 22 s

4. An object is shot vertically upward into the air with a positive initial velocity. Which of the following correctly describes the velocity and acceleration of the object at its maximum elevation?

	Velocity	Acceleration
(A)	Positive	Positive
(B)	Zero	Zero
(C)	Negative	Negative
(D)	Zero	Negative
(E)	Positive	Negative

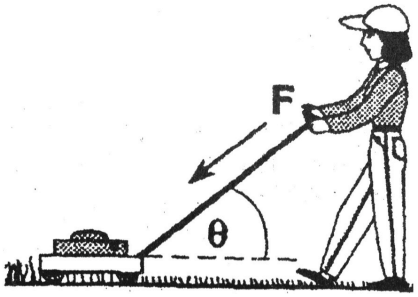
5. A block with initial velocity 4.0 m/s slides 8.0 m across a rough horizontal floor before coming to rest. The coefficient of friction is:
   (A) 0.80
   (B) 0.40
   (C) 0.20
   (D) 0.10
   (E) 0.05

6. Vectors $\mathbf{V_1}$ and $\mathbf{V_2}$ shown in the diagram have equal magnitudes. The vectors represent the velocities of an object at times t_1 and t_2 respectively.



   The average acceleration of the object between time t_1 and t_2 was
   (A) Zero
   (B) Directed northwest
   (C) Directed northeast
   (D) Directed southwest
   (E) Directed southeast

7. A woman pushes a lawn mower with a force of F at an angle θ to the ground.

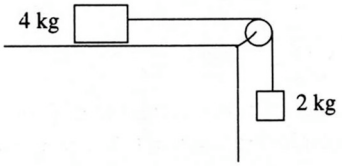


   If F = 20N and θ = 30°, what is the net work done in moving the lawnmower 5m?
   (A) 25.0 J
   (B) 50.0 J
   (C) 86.7 J
   (D) 14.4 J
   (E) 35.0 J

8. An object moving horizontally with speed v falls off the edge of a vertical cliff and lands a distance d from the base of the cliff. How far from the base of the cliff would the object land if it was moving horizontally with speed $2v$?
   (A) d
   (B) $\sqrt{2}d$
   (C) $2d$
   (D) $2\sqrt{2}d$
   (E) $4d$

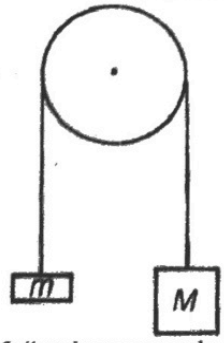
9. A horizontal force of 140 N is applied to a 20 kg box at rest on a floor. Determine the acceleration of the block if the coefficient of static friction between the box and floor is 0.6 and the coefficient of kinetic friction between the box and the floor is 0.4.
(A) 0 m/s^2
(B) 1 m/s^2
(C) 2 m/s^2
(D) 3 m/s^2
(E) 4 m/s^2

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



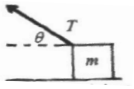
When the 2 kg mass is released, what is the acceleration of the system?
(A) 0 m/s^2
(B) 3.3 m/s^2
(C) 5.0 m/s^2
(D) 10 m/s^2
(E) 20 m/s^2

11. Blocks of mass *M* and *m* are connected by a massless string across a massless, frictionless pulley, as shown in the diagram.



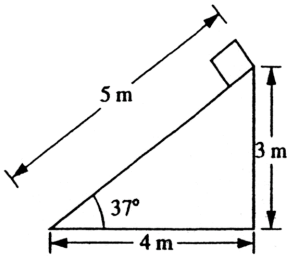
Which of the following properly represents the magnitude of the acceleration of the block with mass *M* when released from rest?
(A) $\frac{Mg}{m}$
(B) $\frac{mg}{M+m}$
(C) $\frac{Mg}{M+m}$
(D) $\frac{(M+m)g}{M-m}$
(E) $\frac{(M-m)g}{M+m}$

12. A box of mass *m* being pulled across a rough horizontal floor by a force of magnitude T at an angle θ. The coefficient of friction between the box and the floor is μ.



The acceleration of the block has magnitude:
(A) $T\sin\theta + \mu(mg + T\sin\theta)$
(B) $\frac{T\sin\theta - \mu(mg + T\sin\theta)}{m}$
(C) $\frac{T\cos\theta - \mu(mg - T\sin\theta)}{m}$
(D) $\frac{T\cos\theta - \mu(mg + T\sin\theta)}{m}$
(E) $T\sin\theta + \mu(mg - T\sin\theta)$

13. A plane 5 m in length is inclined at an angle of 37° as shown. A student uses the plane to push a 20 N block at a constant speed to a height of 3 m.



How much work does the student do if the plane is frictionless?
(A) 20 J
(B) 60 J
(C) 80 J
(D) 100 J
(E) 130 J

14. If the power delivered to an object by a force acting on it is given by $P(t) = t^3 - 2t$ and the velocity of the object is given by $v(t) = 2t$, what is the force acting on the object in terms of *t*?
(A) F(t) = $t^3 - 4t$
(B) F(t) = t^3
(C) F(t) = $t^2/2 - 1$
(D) F(t) = $3t^2 - 2$
(E) More information is needed.

15. The potential energy of an object is given by $U(x) = 0.5kx^2 + 3kx$, where *U* is in joules, *x* is in meters and *k* is a constant. What is the force acting on the object when *x* = 0?
(A) -3k
(B) –k
(C) zero
(D) k
(E) 3k