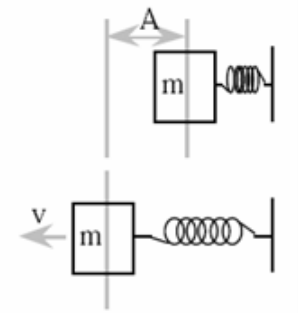


1. A mass m attached to a horizontal massless spring with spring constant k, is set into simple harmonic motion. Its maximum displacement from its equilibrium position is A. What is the masses speed as it passes through its equilibrium position?

$(A)\ 0 \qquad (B)\ A\sqrt{\frac{k}{m}} \qquad (C)\ A\sqrt{\frac{m}{k}} \qquad (D)\ \frac{1}{A}\sqrt{\frac{k}{m}} \qquad (E)\ \frac{1}{A}\sqrt{\frac{m}{k}}$

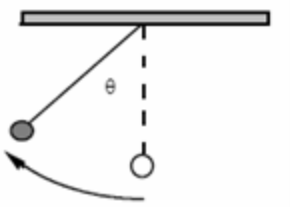
2. A force F at an angle θ above the horizontal is used to pull a heavy suitcase of weight mg a distance d along a level floor at constant velocity. The coefficient of friction between the floor and the suitcase is μ. The work done by the frictional force is:
(A) –Fd cos θ (B) mgh – Fd cos θ (C) – μ Fd cos θ (D) -μmgd (E) -μ mgd cos θ

3. If the unit for force is F, the unit for velocity V, and the unit for time T, then the unit for energy is:
(A) FVT (B) F/T (C) FV/T (D) F/T^2 (E) FV^2/T^2

4. A force of 10 N stretches a spring that has a spring constant of 20 N/m. The potential energy stored in the spring is:
(A) 2.5 J (B) 5.0 J (C) 10 J (D) 40 J (E) 200 J

5. A 2 kg ball is attached to a 0.80 m string and whirled in a horizontal circle at a constant speed of 6 m/s. The work done on the ball during each revolution is:
(A) 450 J (B) 90 J (C) 72 J (D) 16 J (E) zero

6. A pendulum bob of mass m on a cord of length L is pulled sideways until the cord makes an angle θ with the vertical as shown in the figure to the right. The change in potential energy of the bob during the displacement is:
(A) mgL (1–cos θ) (B) mgL (1–sin θ) (C) mgL sin θ
(D) mgL cos θ (E) 2mgL (1–sin θ)



7. A 3 kg block with initial speed 4 m/s slides across a rough horizontal floor before coming to rest. The frictional force acting on the block is 3 N. How far does the block slide before coming to rest?
(A) 1.0 m (B) 2.0 m (C) 4.0 m (D) 8.0 m (E) 16 m

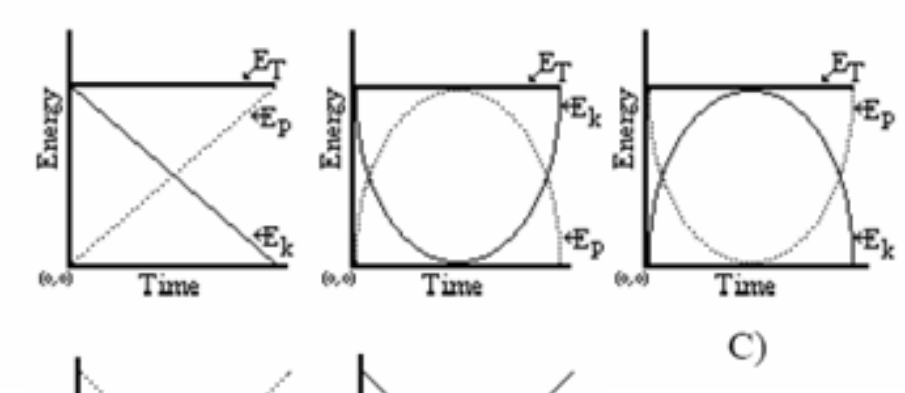
8. A construction laborer holds a 20 kg sheet of wallboard 3 m above the floor for 4 seconds. During these 4 seconds how much power was expended on the wallboard?
(A) 2400 W (B) 340 W (C) 27 W (D) 15 W (E) none of these

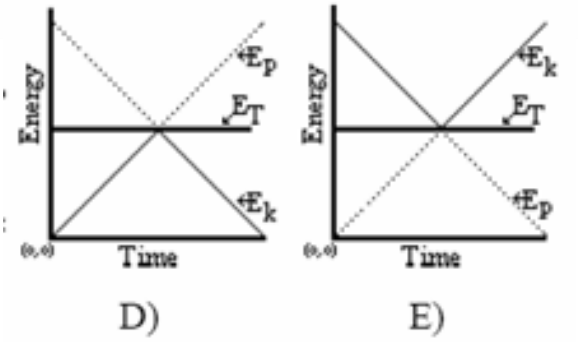
9. If M represents units of mass, L represents units of length, and T represents units of time, the dimensions of power would be:

$(A)\ \frac{ML}{T^2} \qquad (B)\ \frac{ML^2}{T^2} \qquad (C)\ \frac{ML^2}{T^3} \qquad (D)\ \frac{ML}{T} \qquad (E)\ \frac{ML^2}{T}$

10. An automobile engine delivers 24000 watts of power to a car's driving wheels. If the car maintains a constant speed of 30 m/s, what is the magnitude of the retarding force acting on the car?
(A) 800 N (B) 960 N (C) 1950 N (D) 720,000 N (E) 1,560,000 N

11. A fan blows the air and gives it kinetic energy. An hour after the fan has been turned off, what has happened to the kinetic energy of the air?
(A) it disappears (B) it turns into potential energy (C) it turns into thermal energy
(D) it turns into sound energy (E) it turns into electrical energy





Problems 12 and 13 refer to the following situation: A car of mass m slides across a patch of ice at a speed v with its brakes locked. It the hits dry pavement and skids to a stop in a distance d. The coefficient of kinetic friction between the tires and the dry road is μ.

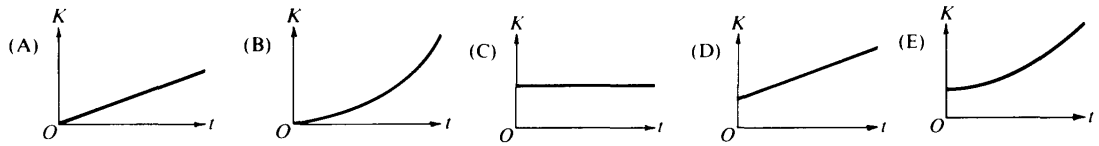
12. If the car has a mass of 2m, it would have skidded a distance of
(A) 0.5 d (B) d (C) 1.41 d (D) 2d (E) 4 d

13. If the car has a speed of 2v, it would have skidded a distance of
(A) 0.5 d (B) d (C) 1.41 d (D) 2d (E) 4 d

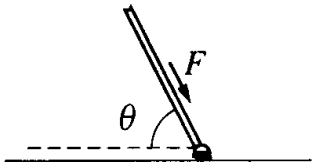
14. A mass, M, is at rest on a frictionless surface, connected to an ideal horizontal spring that is unstretched. A person extends the spring 30 cm from equilibrium and holds it by applying a 10 N force. The spring is brought back to equilibrium and the mass connected to it is now doubled to 2M. If the spring is extended back 30 cm from equilibrium, what is the necessary force applied by the person to hold the mass stationary there?
(A) 20 N (B) 14.1 N (C) 10 N (D) 7.07 N (E) 5 N

15. A deliveryman moves 10 cartons from the sidewalk, along a 10-meter ramp to a loading dock, which is 1.5 meters above the sidewalk. If each carton has a mass of 25 kg, what is the total work done by the deliveryman on the cartons to move them to the loading dock?
(A) 2500 J (B) 3750 J (C) 10000 J (D) 25000 J (E) 37500 J

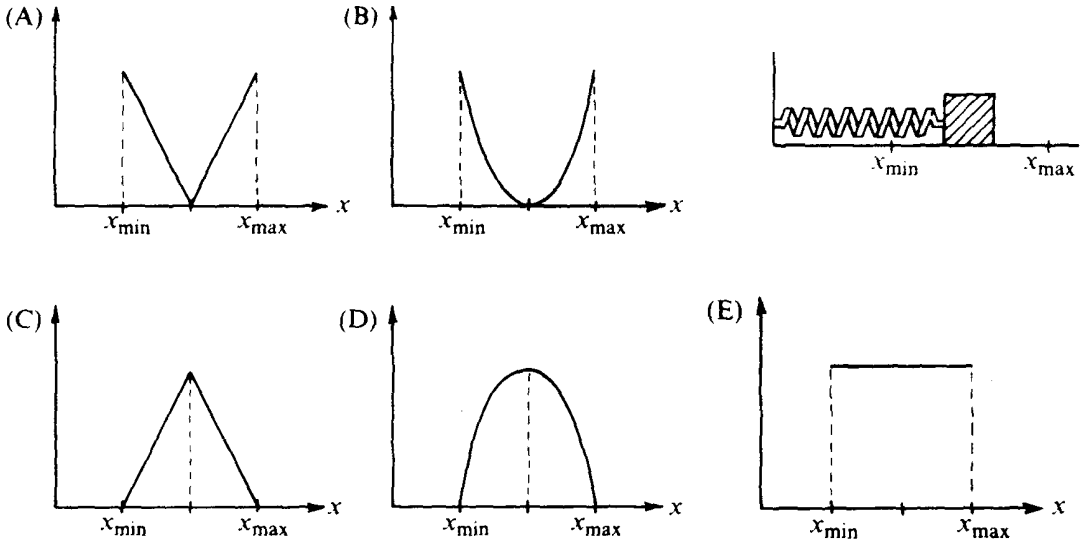
16. From the top of a high cliff, a ball is thrown horizontally with initial speed v_o. Which of the following graphs best represents the ball's kinetic energy K as a function of time t ?



17. A force F is exerted by a broom handle on the head of the broom, which has a mass m. The handle is at an angle θ to the horizontal, as shown. The work done by the force on the head of the broom as it moves a distance d across a horizontal floor is
(A) Fd sin θ (B) Fd cosθ (C) Fm cosθ (D) Fm tanθ (E) Fmd sinθ



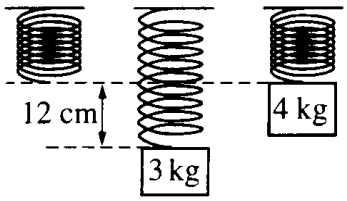
Questions 18-19: A block oscillates without friction on the end of a spring as shown. The minimum and maximum lengths of the spring as it oscillates are, respectively, x_{min} and x_{max}. The graphs below can represent quantities associated with the oscillation as functions of the length x of the spring.



18. Which graph can represent the total mechanical energy of the block-spring system as a function of x ?
(A) A (B) B (C) C (D) D (E) E

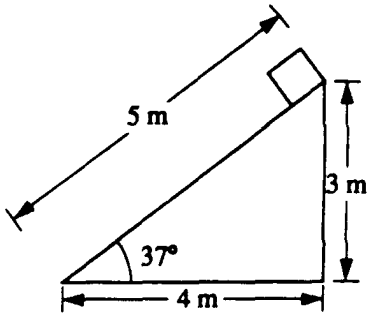
19. Which graph can represent the kinetic energy of the block as a function of x ?
(A) A (B) B (C) C (D) D (E) E

20. A block of mass 3.0 kg is hung from a spring, causing it to stretch 12 cm at equilibrium, as shown. The 3.0 kg block is then replaced by a 4.0 kg block, and the new block is released from the position shown, at which the spring is unstretched. How far will the 4.0 kg block fall before its direction is reversed?
(A) 9 cm (B) 18 cm (C) 24 cm
(D) 32 cm (E) 48 cm



Questions 21-23

A plane 5 meters in length is inclined at an angle of 37°, as shown. A block of weight 20 newtons is placed at the top of the plane and allowed to slide down.

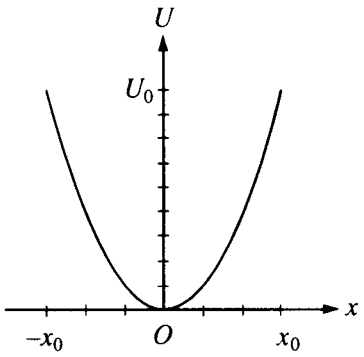


21. The mass of the block is most nearly
(A) 1.0 kg (B) 1.2 kg (C) 1.6 kg (D) 2.0 kg (E) 2.5 kg

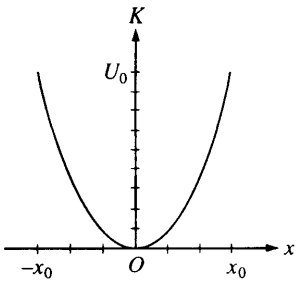
22. The magnitude of the normal force exerted on the block by the plane is most nearly
(A) 10 N (B) 12 N (C) 16 N (D) 20 N (E) 33 N

23. The work done on the block by the gravitational force during the 5-meter slide down the plane is most nearly
(A) 20 J (B) 60 J (C) 80 J (D) 100 J (E) 130 J

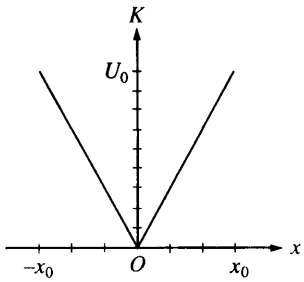
24. The graph shown represents the potential energy *U* as a function of displacement *x* for an object on the end of a spring moving back and forth with amplitude x_0. Which of the following graphs represents the kinetic energy *K* of the object as a function of displacement *x* ?



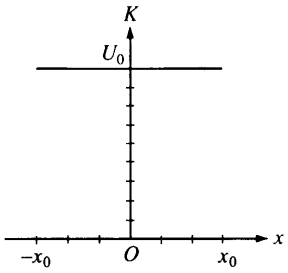
(A)



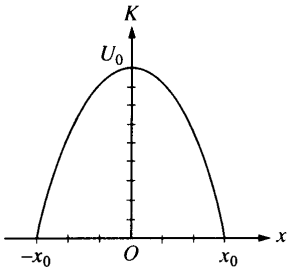
(B)



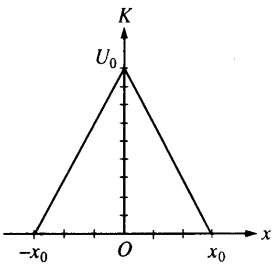
(C)



(D)



(E)



25. A football is kicked off the ground a distance of 50 yards downfield. Neglecting air resistance, which of the following statements would be INCORRECT when the football reaches the highest point?
(A) all of the balls original kinetic energy has been changed into potential energy
(B) the balls horizontal velocity is the same as when it left the kickers foot
(C) the ball will have been in the air one-half of its total flight time
(D) the ball has an acceleration of g
(E) the vertical component of the velocity is equal to zero