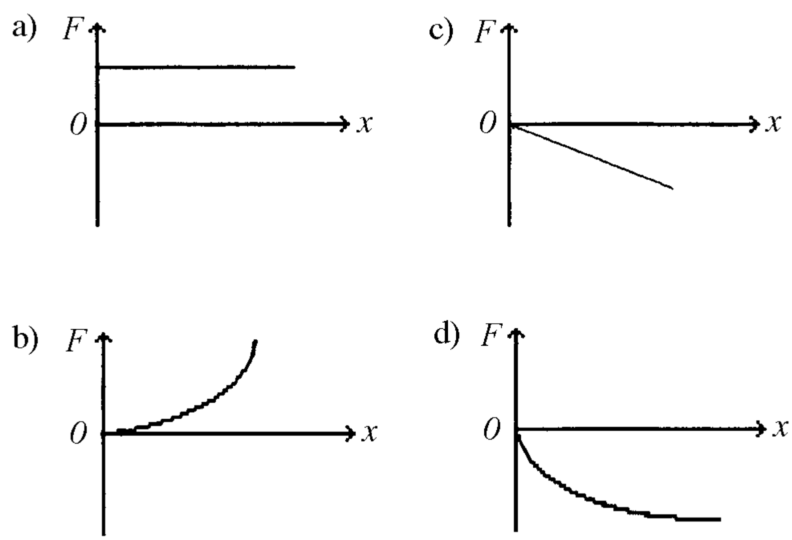
AP Physics Ch 10 & 11 Test Bank **Name**___________________________________ **#:__**

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

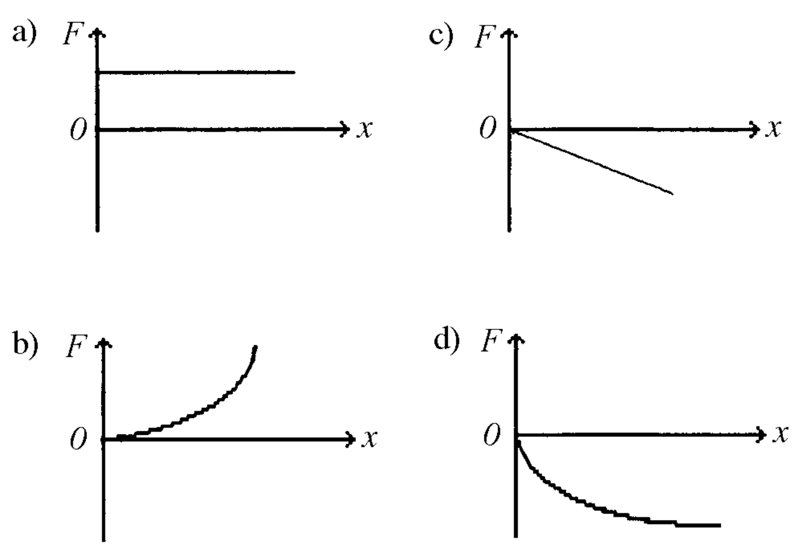
1. Consider a plot of the displacement (x) as a function of the applied force (F) for an ideal elastic spring. The slope of the curve would be
   A) the reciprocal of the acceleration of gravity.
   B) the mass of the object attached to the spring.
   C) the reciprocal of the spring constant.
   D) the acceleration due to gravity.
   E) the spring constant.

2. Which of the graphs in the figure illustrates Hooke's Law?



   A) Graph a   B) Graph b   C) Graph c   D) graph d

3. Which of the graphs in the figure represents a spring that gets less stiff the more it is stretched?



   A) Graph a   B) Graph b   C) Graph c   D) Graph d

4. Is it possible for a system to have negative potential energy?
   A) No, because this would have no physical meaning.
   B) Yes, since the choice of the zero of potential energy is arbitrary.
   C) Yes, as long as the kinetic energy is positive.
   D) No, because the kinetic energy of a system must equal its potential energy.
   E) Yes, as long as the total energy is positive.

5. On a smooth horizontal floor, an object slides into a spring which is attached to another mass that is initially stationary. When the spring is most compressed, both objects are moving at the same speed. Ignoring friction, what is conserved during this interaction?
   A) momentum and potential energy
   B) kinetic energy only
   C) momentum and kinetic energy
   D) momentum and mechanical energy
   E) momentum only

6. A baseball is thrown vertically upward and feels no air resistance. As it is rising
   A) its momentum is not conserved, but its mechanical energy is conserved.
   B) both its momentum and its mechanical energy are conserved.
   C) its gravitational potential energy is not conserved, buts its momentum is conserved.
   D) both its momentum and its kinetic energy are conserved.
   E) its kinetic energy is conserved, but its momentum is not conserved.

7. In a perfectly ELASTIC collision between two perfectly rigid objects
   A) the kinetic energy of each object is conserved.
   B) the momentum of each object is conserved.
   C) the momentum of the system is conserved but the kinetic energy of the system is not conserved.
   D) both the momentum and the kinetic energy of the system are conserved.
   E) the kinetic energy of the system is conserved, but the momentum of the system is not conserved.

8. In an INELASTIC collision between two objects
   A) the momentum of each object is conserved.
   B) both the momentum and the kinetic energy of the system are conserved.
   C) the momentum of the system is conserved but the kinetic energy of the system is not conserved.
   D) the kinetic energy of each object is conserved.
   E) the kinetic energy of the system is conserved, but the momentum of the system is not conserved.

9. A shell explodes into two fragments, one fragment 25 times heavier than the other. If any gas from the explosion has negligible mass, then
   A) the kinetic energy change of the heavier fragment is 25 times as great as the kinetic energy change of the lighter fragment.
   B) the momentum change of the heavier fragment is 25 times as great as the momentum change of the lighter fragment.
   C) the momentum change of the lighter fragment is exactly the same as the momentum change of the heavier fragment.
   D) the momentum change of the lighter fragment is 25 times as great as the momentum change of the heavier fragment.
   E) the kinetic energy change of the lighter fragment is 25 times as great as the kinetic energy change of the heavier fragment.

10. Jacques and George meet in the middle of a lake while paddling in their canoes. They come to a complete stop and talk for a while. When they are ready to leave, Jacques pushes George's canoe with a force $\vec{F}$ to separate the two canoes. What is correct to say about the final momentum and kinetic energy of the system if we can neglect any resistance due to the water?
   A) The final momentum is in the direction of $\vec{F}$ but the final kinetic energy is zero.
   B) The final momentum is in the direction opposite of $\vec{F}$ but the final kinetic energy is zero.
   C) The final momentum is zero and the final kinetic energy is zero.
   D) The final momentum is in the direction of $\vec{F}$ and the final kinetic energy is positive.
   E) The final momentum is zero but the final kinetic energy is positive.

11. A 1.0-kg block and a 2.0-kg block are pressed together on a horizontal frictionless surface with a compressed very light spring between them. They are not attached to the spring. After they are released and have both moved free of the spring
   A) the heavier block will have more kinetic energy than the lighter block.
   B) the magnitude of the momentum of the heavier block will be greater than the magnitude of the momentum of the lighter block.
   C) the lighter block will have more kinetic energy than the heavier block.
   D) both blocks will both have the same amount of kinetic energy.
   E) both blocks will have equal speeds.

12. A spring stretches by 21.0 cm when a 135 N object is attached. What is the weight of a fish that would stretch the spring by 31 cm?
   A) 91.0 N B) 279 N C) 199 N D) 145 N

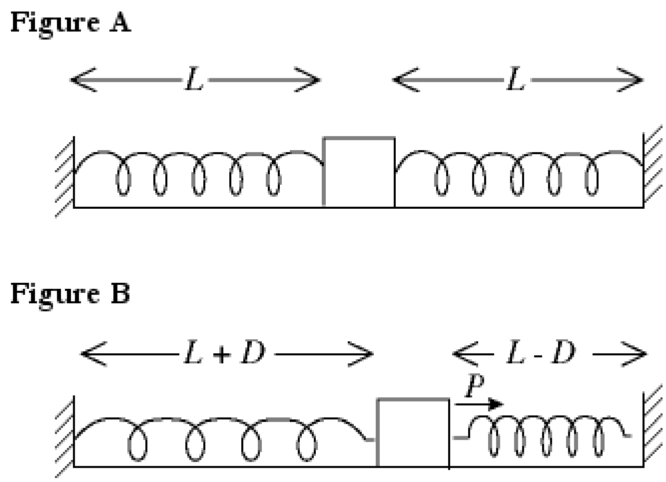
13. An object attached to an ideal massless spring is pulled across a frictionless surface. If the spring constant is 45 N/m and the spring is stretched by 0.88 m when the object is accelerating at 2.0 m/s^2, what is the mass of the object?
   A) 26 kg B) 20 kg C) 22 kg D) 17 kg

14. A force on a particle depends on position such that $F(x) = (3.00\ N/m^2)x^2 + (6.00\ N/m)x$ for a particle constrained to move along the x-axis. What work is done by this force on a particle that moves from $x = 0.00$ m to $x = 2.00$ m?
   A) 48.0 J B) -48.0 J C) 24.0 J D) 10.0 J E) 20.0 J

15. A person pushes horizontally on a heavy box and slides it across the level floor at constant velocity. The person pushes with a 60.0 N force for the first 6.88 m, at which time he begins to tire. The force he exerts then starts to decrease linearly from 60.0 N to 0.00 N across the remaining 6.88 m. How much total work did the person do on the box?
   A) 619 J B) 925 J C) 495 J D) 826 J

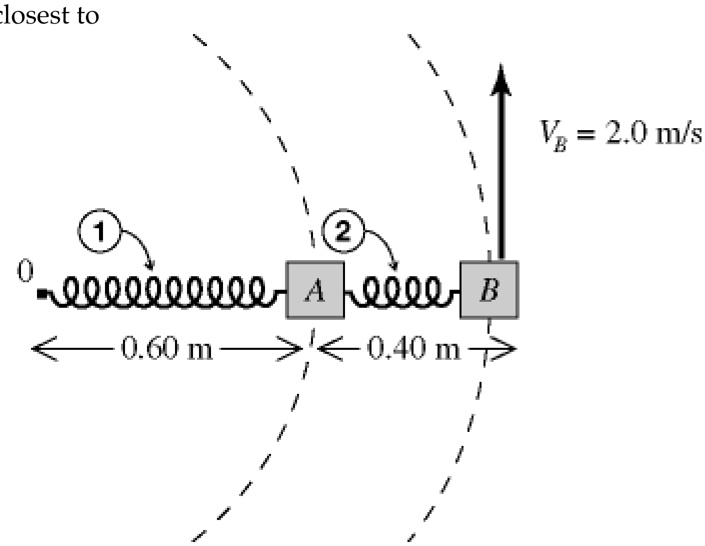
16. It requires 49 J of work to stretch an ideal very light spring from a length of 1.4 m to a length of 2.9 m. What is the value of the spring constant of this spring?
   A) 22 N/m B) 29 N/m C) 44 N/m D) 15 N/m

17. In the figure, two identical ideal massless springs have unstretched lengths of 0.25 m and spring constants of 700 N/m. The springs are attached to a small cube and stretched to a length L of 0.30 m as in Figure A. An external force P pulls the cube a distance $D = 0.020$ m to the right and holds it there. (See Figure B.) The external force P, that holds the cube in place in Figure B, is closest to



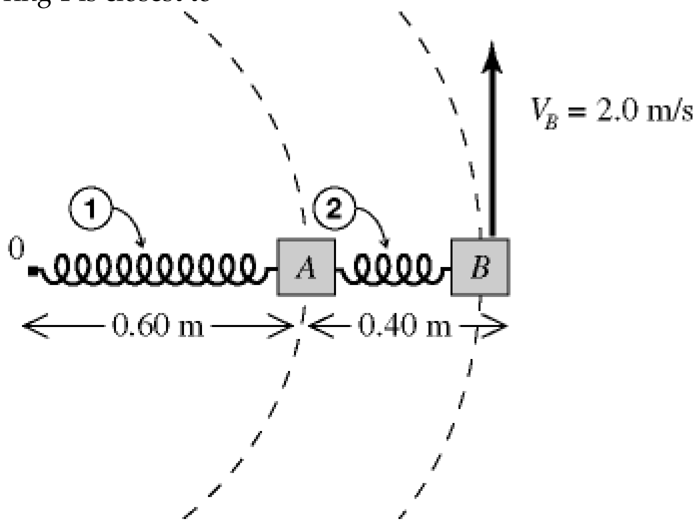
A) 18 N. B) 21 N. C) 25 N. D) 14 N. E) 28 N.

18. Block A (0.40 kg) and block B (0.30 kg) are on a frictionless table (see figure). Spring 1 connects block A to a frictionless peg at 0 and spring 2 connects block A and block B. When the blocks are in uniform circular motion about 0, the springs have lengths of 0.60 m and 0.40 m, as shown. The springs are ideal and massless, and the linear speed of block B is 2.0 m/s. If the distance that spring 2 stretches is 0.060 m, the spring constant of spring 2 is closest to



A) 18 N/m. B) 24 N/m. C) 20 N/m. D) 26 N/m. E) 22 N/m.

19. Block A (0.40 kg) and block B (0.30 kg) are on a frictionless table (see figure). Spring 1 connects block A to a frictionless peg at 0 and spring 2 connects block A and block B. When the blocks are in uniform circular motion about 0, the springs have lengths of 0.60 m and 0.40 m, as shown. The springs are ideal and massless, and the linear speed of block B is 2.0 m/s. If the spring constant of spring 1 is equal to 30 N/m, the unstretched length of spring 1 is closest to

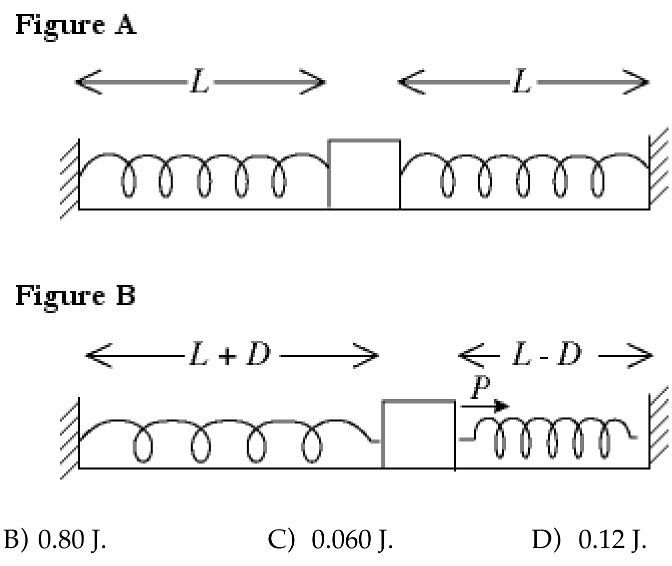


A) 0.53 m. B) 0.52 m. C) 0.54 m. D) 0.51 m. E) 0.55 m.

20. A force $F = bx^3$ acts in the x direction, where the value of b is 3.7 N/m^3. How much work is done by this force in moving an object from $x = 0.00$ m to $x = 2.6$ m?

A) 50 J B) 42 J C) 13 J D) 57 J

21. In the figure, two identical springs have unstretched lengths of 0.25 m and spring constants of 300 N/m. The springs are attached to a small cube and stretched to a length L of 0.36 m as in Figure A. An external force P pulls the cube a distance D = 0.020 m to the right and holds it there. (See Figure B.) The work done by the external force P in pulling the cube 0.020 m is closest to



A) 6.0 J. B) 0.80 J. C) 0.060 J. D) 0.12 J. E) 12 J.

22. A 1000.0 kg car is moving at 15 km/h. If a 2000.0 kg truck has 18 times the kinetic energy of the car, how fast is the truck moving?

A) 36 km/h B) 54 km/h C) 63 km/h D) 45 km/h

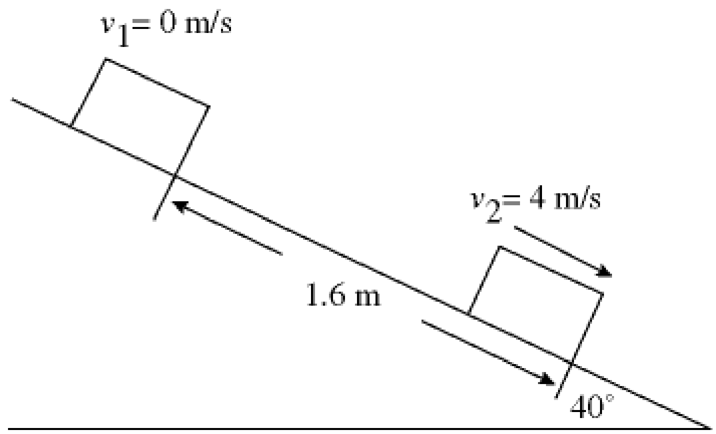
23. How much energy is needed to change the speed of a 1600 kg sport utility vehicle from 15.0 m/s to 40.0 m/s?

A) 40.0 kJ B) 0.960 MJ C) 20.0 kJ D) 1.10 MJ E) 10.0 kJ

24. The coefficient of the restitution of an object is defined as the ratio of its outgoing to incoming speed when the object collides with a rigid surface. For an object with a coefficient of 0.78, what fraction of the object's kinetic energy is lost during a single collision?

A) 47% B) 16% C) 61% D) 39%

25. An 8.0-kg block is released from rest, with v_1 = 0.00 m/s, on a rough incline, as shown in the figure. The block moves a distance of 1.6-m down the incline, in a time interval of 0.80 s, and acquires a velocity of v_2 = 4.0 m/s. How much work does gravity do on the block during this process?



A) –100 J B) +100 J C) +120 J D) +81 J E) –81 J

26. You do 174 J of work while pulling your sister back on a swing, whose chain is 5.10 m long. You start with the swing hanging vertically and pull it until the chain makes an angle of 32.0° with the vertical with your sister is at rest. What is your sister's mass, assuming negligible friction?

A) 19.5 kg B) 26.3 kg C) 28.4 kg D) 22.9 kg

27. An athlete stretches a spring an extra 40.0 cm beyond its initial length. How much energy has he transferred to the spring, if the spring constant is 52.9 N/cm?

A) 4230 kJ B) 423 kJ C) 4230 J D) 423 J

28. A tennis ball bounces on the floor three times. If each time it loses 22.0% of its energy due to heating, how high does it rise after the third bounce, provided we released it 2.3 m from the floor?

A) 110 cm B) 11 cm C) 140 cm D) 110 mm

29. A 0.500-kg ball traveling horizontally on a frictionless surface approaches a very massive stone at 20.0 m/s perpendicular to wall and rebounds with 70.0% of its initial kinetic energy. What is the magnitude of the change in momentum of the stone?

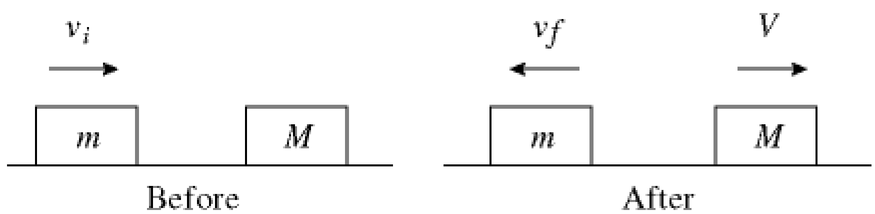
A) 18.4 kg•m/s
B) 14.0 kg•m/s
C) 1.63 kg•m/s
D) 0.000 kg•m/s
E) 3.00 kg•m/s

30. A 620–g object traveling at 2.1 m/s collides head–on with a 320–g object traveling in the opposite direction at 3.8 m/s. If the collision is perfectly elastic, what is the change in the kinetic energy of the 620–g object?
A) It loses 1.4 J.
B) It loses 0.23 J.
C) It gains 0.69 J.
D) It loses 0.47 J.
E) It doesn't lose any kinetic energy because the collision is elastic.

31. A 2.3–kg object traveling at 6.1 m/s collides head–on with a 3.5–kg object traveling in the opposite direction at 4.8 m/s. If the collision is perfectly elastic, what is the final speed of the 2.3–kg object?
A) 7.1 m/s B) 4.3 m/s C) 6.6 m/s D) 0.48 m/s E) 3.8 m/s

32. A car of mass 1689 kg collides head–on with a parked truck of mass 2000 kg. Spring mounted bumpers ensure that the collision is essentially elastic. If the velocity of the truck is 17 km/h (in the same direction as the car's initial velocity) after the collision, what was the initial speed of the car?
A) 19 km/h B) 10 km/h C) 29 km/h D) 38 km/h

33. A block of mass m = 8.40 kg, moving on a horizontal frictionless surface with a speed 4.20 m/s, makes a perfectly elastic collision with a block of mass M at rest. After the collision, the 8.40 block recoils with a speed of 0.400 m/s. In the figure, the blocks are in contact for 0.200 s. The magnitude of the average force on the 8.40–kg block, while the two blocks are in contact, is closest to



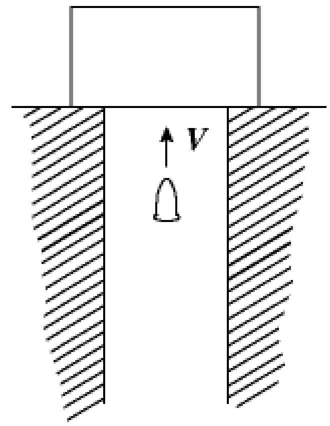
A) 193 N B) 185 N C) 160 N D) 168 N E) 176 N

34. A billiard ball traveling at 3.00 m/s collides perfectly elastically with an identical billiard ball initially at rest on the level table. The initially moving billiard ball deflects 30.0° from its original direction. What is the speed of the initially stationary billiard ball after the collision?
A) 2.00 m/s B) 1.50 m/s C) 0.866 m/s D) 2.59 m/s E) 0.750 m/s

35. A pool player is attempting a fancy shot. He hits the cue ball giving it a speed of 5.57 m/s and directs its center on a path tangent to the surface of the target ball having the same mass as the cue ball. After the collision (on a frictionless table) the initially–stationary ball moves with a speed of 4.82 m/s. After the collision, the new speed of the cue ball and the relative direction of the balls are closest to
A) 2.79 m/s, at 90° to each other.
B) 2.79 m/s, at 60° to each other.
C) 8.34 m/s, at 60° to each other.
D) 8.34 m/s, at 90° to each other.

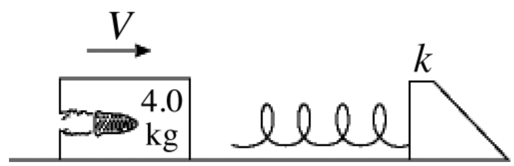
36. A 2.00–kg object traveling east at 20.0 m/s collides with a 3.00–kg object traveling west at 10.0 m/s. After the collision, the 2.00–kg object has a velocity 5.00 m/s to the west. How much kinetic energy was lost during the collision?
A) 516 J B) 0.000 J C) 458 J D) 175 J E) 91.7 J

37. A 15-g bullet is shot vertically into an 2-kg block. The block lifts upward 8.0 mm (see the figure). The bullet penetrates the block and comes to rest in it in a time interval of 0.0010 s. Assume the force on the bullet is constant during penetration and that air resistance is negligible. The initial kinetic energy of the bullet is closest to



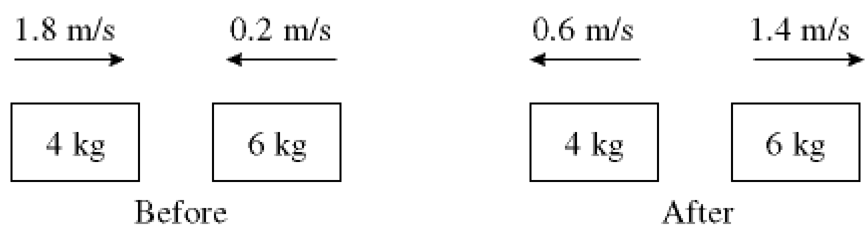
A) 14 J B) 21 J C) 10 J D) 0.16 J E) 0.0012 J

38. An 8.0-g bullet is shot into a 4.0-kg block, at rest on a frictionless horizontal surface (see the figure). The bullet remains lodged in the block. The block moves into an ideal massless spring and compresses it by 8.7 cm. The spring constant of the spring is 2400 N/m. The initial velocity of the bullet is closest to



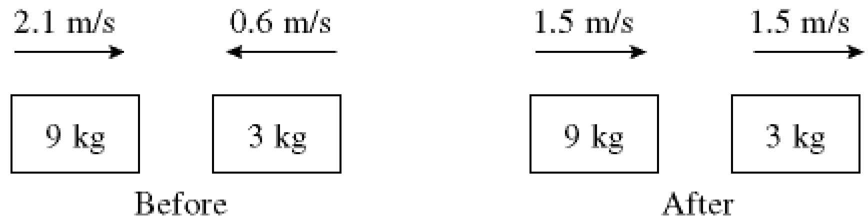
A) 1200 m/s. B) 900 m/s. C) 1100 m/s. D) 1300 m/s. E) 1000 m/s.

39. In the figure, determine the character of the collision. The masses of the blocks, and the velocities before and after are given. The collision is



A) partially inelastic.
B) perfectly elastic.
C) completely inelastic.
D) characterized by an increase in kinetic energy.
E) not possible because momentum is not conserved.

40. In the figure, determine the character of the collision. The masses of the blocks, and the velocities before and after are given, and no other unbalanced forces act on these blocks. The collision is

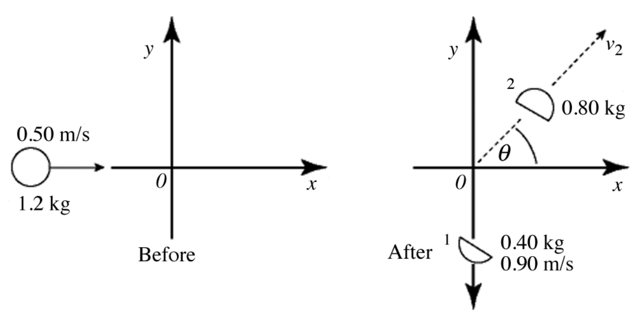


A) completely inelastic.
B) perfectly elastic.
C) not possible because momentum is not conserved.
D) partially inelastic.
E) characterized by an increase in kinetic energy.

41. A 5.00-kg ball is hanging from a long but very light flexible wire when it is struck by a 1.50-kg stone traveling horizontally to the right at 12.0 m/s. The stone rebounds to the left with a speed of 8.50 m/s, and the ball swings to a maximum height h above its original level. The value of h is closest to
A) 1.93 m. B) 0.0563 m. C) 3.69 m. D) 1.10 m. E) 2.20 m.

42. On a frictionless horizontal table, two blocks (A of mass 2.00 kg and B of mass 3.00 kg) are pressed together against an ideal massless spring that stores 75.0 J of elastic potential energy. The blocks are not attached to the spring and are free to move free of it once they are released from rest. The maximum speed achieved by each block is closest to:
A) 6.12 m/s (A), 5.00 m/s (B)
B) 5.48 m/s for both
C) 6.71 m/s (A), 4.47 m/s (B)
D) 5.00 m/s (A), 6.12 m/s (B)
E) 4.47 m/s (A), 6.71 m/s (B)

43. A 1.2-kg spring-activated toy bomb slides on a smooth surface along the x-axis with a speed of 0.50 m/s. At the origin 0, the bomb explodes into two fragments. Fragment 1 has a mass of 0.40 kg and a speed of 0.90 m/s along the negative y-axis. In the figure, the energy released by the explosion is closest to



A) 0.20 J. B) 0.32 J. C) 0.24 J. D) 0.36 J. E) 0.28 J.

CHAPTER 11 STARTS HERE

44. If the dot product of two nonzero vectors is zero, the vectors must be perpendicular to each other.
A) True B) False

45. If two nonzero vectors point in the same direction, their dot product must be zero.
A) True B) False

46. The value of the dot product of two vectors depends on the particular coordinate system being used.
A) True B) False

47. Two men, Joel and Jerry, push against a wall. Jerry stops after 10 min, while Joel is able to push for 5.0 min longer. Compare the work they do.
A) Both men do positive work, but Joel does 50% more work than Jerry.
B) Both men do positive work, but Joel does 25% more work than Jerry.
C) Both men do positive work, but Joel does 75% more work than Jerry.
D) Both men do positive work, but Jerry does 50% more work than Joel.
E) Neither of them does any work.

48. A stock person at the local grocery store has a job consisting of the following five segments:
(1) picking up boxes of tomatoes from the stockroom floor
(2) accelerating to a comfortable speed
(3) carrying the boxes to the tomato display at constant speed
(4) decelerating to a stop
(5) lowering the boxes slowly to the floor.
During which of the five segments of the job does the stock person do positive work on the boxes?
A) (2) and (3)
B) (1) and (5)
C) (1) and (2)
D) (1), (2), (4), and (5)
E) (1) only

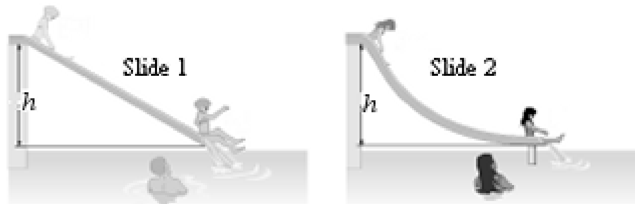
49. A 3.00-kg ball swings rapidly in a complete vertical circle of radius 2.00 m by a light string that is fixed at one end. The ball moves so fast that the string is always taut and perpendicular to the velocity of the ball. As the ball swings from its lowest point to its highest point
A) the work done on it by gravity is -118 J and the work done on it by the tension in the string is zero.
B) the work done on it by gravity and the work done on it by the tension in the string are both equal to -118 J.
C) the work done on it by gravity is -118 J and the work done on it by the tension in the string is +118 J.
D) the work done on it by gravity and the work done on it by the tension in the string are both equal to zero.
E) the work done on it by gravity is +118 J and the work done on it by the tension in the string is -118 J.

50. A 4.0-kg object is moving with speed 2.0 m/s. A 1.0-kg object is moving with speed 4.0 m/s. Both objects encounter the same constant braking force, and are brought to rest. Which object travels the greater distance before stopping?
A) the 4.0-kg object
B) the 1.0-kg object
C) Both objects travel the same distance.
D) It is impossible to know without knowing how long each force acts.

51. If a force always acts perpendicular to an object's direction of motion, that force cannot change the object's kinetic energy.
A) True B) False

52. Two objects, one of mass m and the other of mass $2m$, are dropped from the top of a building. When they hit the ground
   A) the heavier one will have $\sqrt{2}$ times the kinetic energy of the lighter one.
   B) the heavier one will have twice the kinetic energy of the lighter one.
   C) the heavier one will have four times the kinetic energy of the lighter one.
   D) both of them will have the same kinetic energy.

53. Swimmers at a water park have a choice of two frictionless water slides as shown in the figure. Although both slides drop over the same height, h, slide 1 is straight while slide 2 is curved, dropping quickly at first and then leveling out. How does the speed v_1 of a swimmer reaching the end of slide 1 compares with v_2, the speed of a swimmer reaching the end of slide 2?

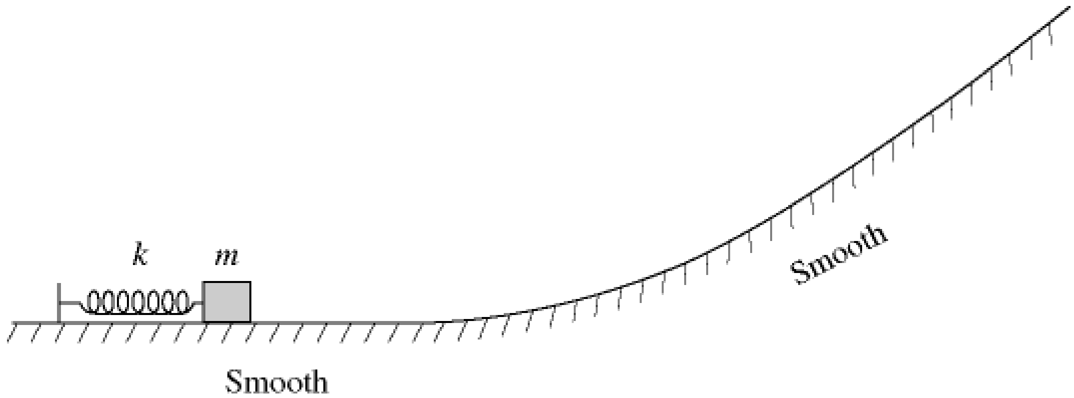


   A) $v_1 < v_2$
   B) $v_1 = v_2$
   C) $v_1 > v_2$
   D) No simple relationship exists between v_1 and v_2 because we do not know the curvature of slide 2.

54. Two stones, one of mass m and the other of mass $2m$, are thrown directly upward with the same velocity at the same time from ground level and feel no air resistance. Which statement about these stones is true?
   A) At its highest point, the heavier stone will have twice as much gravitational potential energy as the lighter one because it is twice as heavy.
   B) The lighter stone will reach its maximum height sooner than the heavier one.
   C) The heavier stone will go twice as high as the lighter one because it initially had twice as much kinetic energy.
   D) At their highest point, both stones will have the same gravitational potential energy because they reach the same height.
   E) Both stones will reach the same height because they initially had the same amount of kinetic energy.

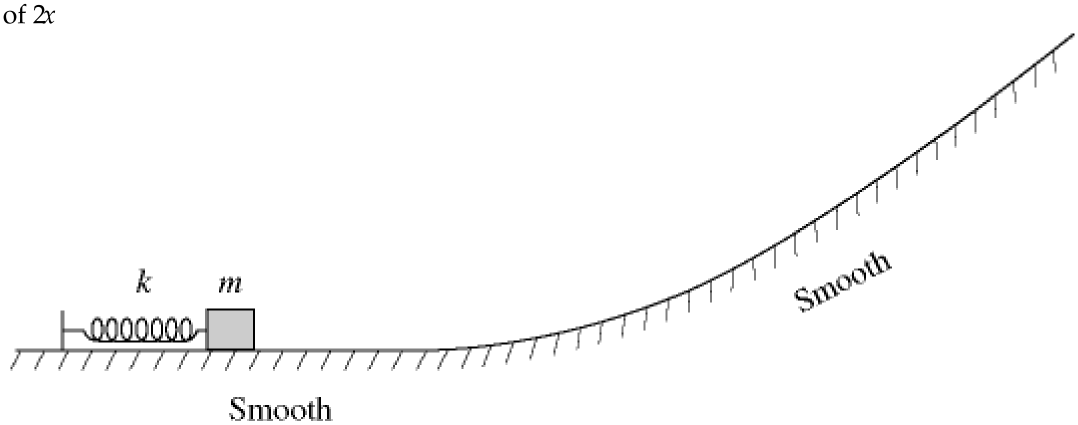
55. Two identical balls are thrown directly upward, ball A at speed v and ball B at speed $2v$, and they feel no air resistance. Which statement about these balls is correct?
   A) Ball B will go four times as high as ball A because it had four times the initial kinetic energy.
   B) The balls will reach the same height because they have the same mass and the same acceleration.
   C) At its highest point, ball B will have twice as much gravitational potential energy as ball A because it started out moving twice as fast.
   D) At their highest point, the acceleration of each ball is instantaneously equal to zero because they stop for an instant.
   E) Ball B will go twice as high as ball A because it had twice the initial speed.

56. A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x. After it is released, the box slides up a frictionless incline as shown in the figure and eventually stops. If we repeat this experiment with a box of mass $2m$



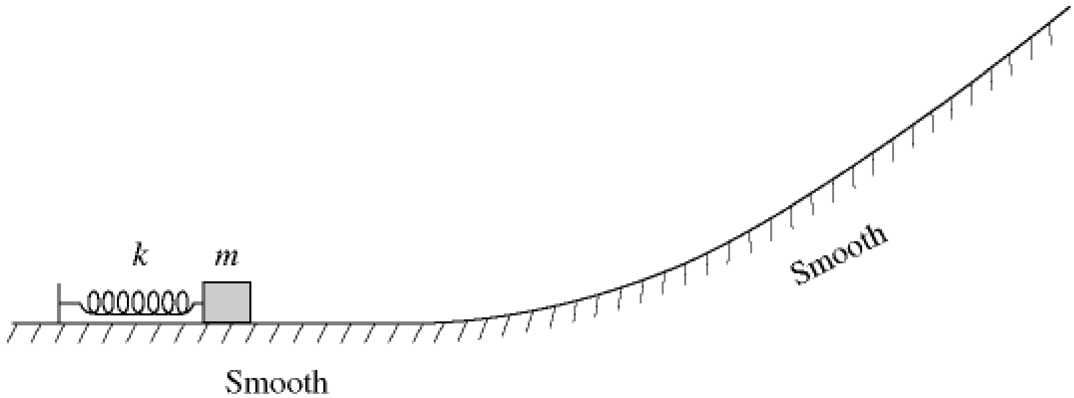
A) just as it moves free of the spring, the lighter box will be moving twice as fast as the heavier box.
B) both boxes will reach the same maximum height on the incline.
C) the lighter box will go twice as high up the incline as the heavier box.
D) just as it moves free of the spring, the heavier box will have twice as much kinetic energy as the lighter box.
E) both boxes will have the same speed just as they move free of the spring.

57. A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x. After it is released, the box slides up a frictionless incline as shown in the figure and eventually stops. If we repeat this experiment but instead compress the spring a distance of $2x$



A) just as it moves free of the spring, the box will be traveling twice as fast as before.
B) just before it is released, the box has twice as much elastic potential energy as before.
C) just as it moves free of the spring, the box will be traveling four times as fast as before.
D) the box will go up the incline twice as high as before.
E) just as it moves free of the spring, the box will have twice as much kinetic energy as before.

58. A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x. After it is released, the box slides up a frictionless incline as shown in the figure and eventually stops. If we repeat this experiment but instead use a spring having force constant $2k$



A) just as it moves free of the spring, the kinetic energy of the box will be twice as great as before.
B) the box will go up the incline twice as high as before.
C) just as it moves free of the spring, the speed of the box will be $\sqrt{2}$ times as great as before.
D) All of the above choices are correct.
E) None of the above choices is correct.

59. When an object is solely under the influence of conservative forces, the sum of its kinetic and potential energies does not change.
A) True
B) False

60. A ball drops some distance and gains 30 J of kinetic energy. Do NOT ignore air resistance. How much gravitational potential energy did the ball lose?
A) exactly 30 J
B) more than 30 J
C) less than 30 J

61. A ball drops some distance and loses 30 J of gravitational potential energy. Do NOT ignore air resistance. How much kinetic energy did the ball gain?
A) less than 30 J
B) more than 30 J
C) exactly 30 J

62. Block 1 and block 2 have the same mass, m, and are released from the top of two inclined planes of the same height making 30° and 60° angles with the horizontal direction, respectively. If the coefficient of friction is the same in both cases, which of the blocks is going faster when it reaches the bottom of its respective incline?
A) Block 2 is faster.
B) Both blocks have the same speed at the bottom.
C) Block 1 is faster.
D) We must know the actual masses of the blocks to answer.
E) There is not enough information to answer the question because we do not know the value of the coefficient of kinetic friction.

63. A girl throws a stone from a bridge. Consider the following ways she might throw the stone. The speed of the stone as it leaves her hand is the same in each case, and air resistance is negligible.

Case A: Thrown straight up.
Case B: Thrown straight down.
Case C: Thrown out at an angle of 45° above horizontal.
Case D: Thrown straight out horizontally.

In which case will the speed of the stone be greatest when it hits the water below?

A) Case A
B) Case B
C) Case C
D) Case D
E) The speed will be the same in all cases.

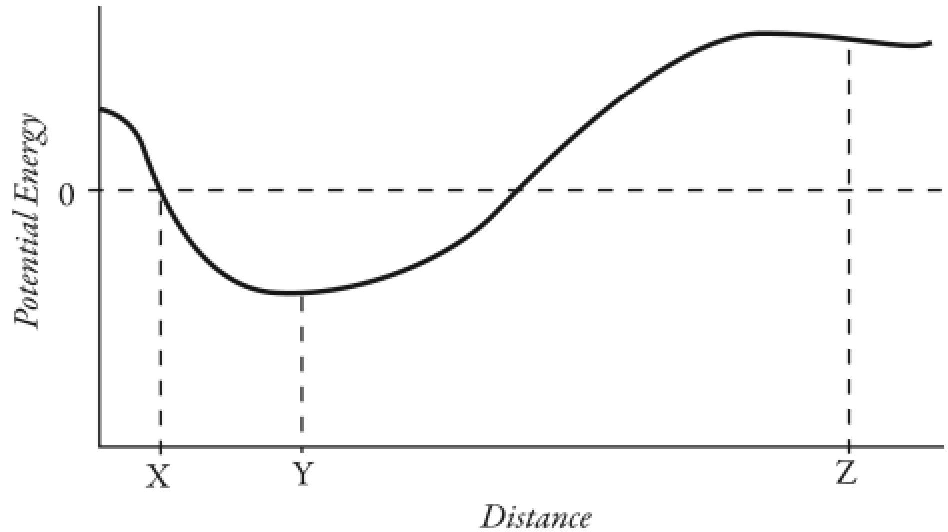
64. Which, if any, of the following statements concerning the work done by a conservative force is NOT true?

A) It is independent of the path of the body and depends only on the starting and ending points.
B) When the starting and ending points are the same, the total work is zero.
C) It can always be expressed as the difference between the initial and final values of a potential energy function.
D) All of the above statements are true.
E) None of the above statements are true.

65. A potential energy function for system 1 is given by $U_1(x) = Cx^2 + Bx^3$. The potential energy function for system 2 is given by $U_2(x) = A + Cx^2 + Bx^3$, where A is a positive quantity. How does the force on system 1 relate to the force on system 2 at a given position?

A) The force on the second system will be with less than the force on the first system.
B) The force on the two systems will be in opposite directions.
C) There is no relationship between the forces on the two systems.
D) The force on the second system will be with greater than the force on the first system.
E) The force is identical on the two systems.

66. The plot in the figure shows the potential energy of a particle, due to the force exerted on it by another particle, as a function of distance. At which of the three points labeled in the figure is the magnitude of the force on the particle greatest?



A) point X B) point Y C) point Z

67. Determine the scalar product of $\vec{A} = 6.0\,\hat{i} + 4.0\hat{j} - 2.0\hat{k}$ and $\vec{B} = 5.0\hat{i} - 6.0\hat{j} - 3.0\hat{k}$.

A) $30\,\hat{i} + 24\hat{j} + 6\hat{k}$
B) 60
C) $30\,\hat{i} - 24\hat{j} + 6\hat{k}$
D) 12
E) undefined

68. Determine the angle between the directions of vector $\vec{A} = 3.00\hat{i} + 1.00\hat{j}$ and vector $\vec{B} = -3.00\hat{i} + 3.00\hat{j}$.

A) 30.0° B) 88.1° C) 45.2° D) 26.6° E) 117°

69. The scalar product of vector $\vec{A} = 3.00\hat{i} + 2.00\hat{j}$ and vector $\vec{B}$ is 10.0. Which of the following vectors could be vector $\vec{B}$?

A) $2.00\hat{i} + 4.00\hat{j}$
B) $5.00\hat{i} + 4.00\hat{j}$
C) $12.0\hat{i}$
D) $4.00\hat{i} + 6.00\hat{j}$
E) $2.00\hat{i} + 2.00\hat{j}$

70. The angle between vector $\vec{A} = 2.00\hat{i} + 3.00\hat{j}$ and vector $\vec{B}$ is 45.0°. The scalar product of vectors $\vec{A}$ and $\vec{B}$ is 3.00. If the x component of vector $\vec{B}$ is positive, what is vector $\vec{B}$.

A) $3.42\hat{i} + 0.684\hat{j}$

B) $4.76\hat{i} + 0.952\hat{j}$

C) $0.871\hat{i} + 0.419\hat{j}$

D) $1.15\hat{i} + 0.231\hat{j}$

E) $2.96\hat{i} + -0.973\hat{j}$

71. What is the angle between the vector $\vec{A} = +3\hat{i} - 2\hat{j} - 3\hat{k}$ and the $+y$–axis?

A) 65° B) 115° C) 25° D) 90° E) 155°

72. A rectangular box is positioned with its vertices at the following points:

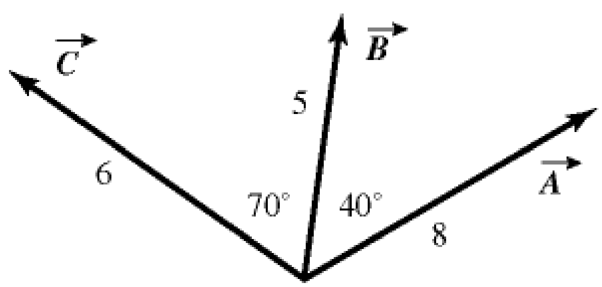
$A = (0,0,0)$ $C = (2,4,0)$ $E = (0,0,3)$ $G = (2,4,3)$

$B = (2,0,0)$ $D = (0,4,0)$ $F = (2,0,3)$ $H = (0,4,3)$

If the coordinates all have three significant figures, the angle between the line segments AG and AH is closest to:

A) 26.6°. B) 21.8°. C) 36.9°. D) 45.0°. E) 22.5°.

73. For the vectors shown in the figure, assume numbers are accurate to two significant figures. The scalar product $\vec{A} \times \vec{C}$ is closest to



A) zero. B) 16. C) −45. D) −16. E) 45.

74. You carry a 7.0 kg bag of groceries 1.2 m above the level floor at a constant velocity of 75 cm/s across a room that is 2.3 m room. How much work do you do on the bag in the process?

A) 82 J B) 0.0 J C) 134 J D) 158 J

75. A student slides her 80.0-kg desk across the level floor of her dormitory room a distance 4.00 m at constant speed. If the coefficient of kinetic friction between the desk and the floor is 0.400, how much work did she do?

A) 128 J B) 26.7 J C) 3.14 kJ D) 24.0 J E) 1.26 kJ

76. Find the net work done by friction on the body of a snake slithering in a complete circle of 3.93 m radius. The coefficient of friction between the ground and the snake is 0.25, and the snake's weight is 54.0 N.

A) −3300 J B) −670 J C) 0 J D) −330 J

77. A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work does the crane do on the beam if the beam accelerates upward at 1.8 m/s^2? Neglect frictional forces.

A) 4.0×10^5 J B) 5.8×10^5 J C) 4.9×10^5 J D) 3.4×10^5 J

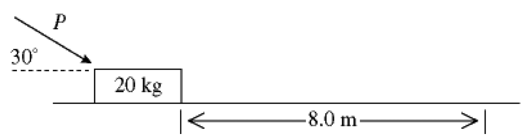
78. An airplane flies 120 km at a constant altitude in a direction 30.0° north of east. A wind is blowing that results in a net horizontal force on the plane due to the air of 2.40 kN in a direction 10.0° south of west. How much work is done on the plane by the air?

A) -2.71×10^8 J
B) 0.821×10^8 J
C) 221×10^8 J
D) -221×10^8 J
E) -0.985×10^8 J

79. A traveler pulls on a suitcase strap at an angle 36° above the horizontal. If 908 J of work are done by the strap while moving the suitcase a horizontal distance of 15 m, what is the tension in the strap?

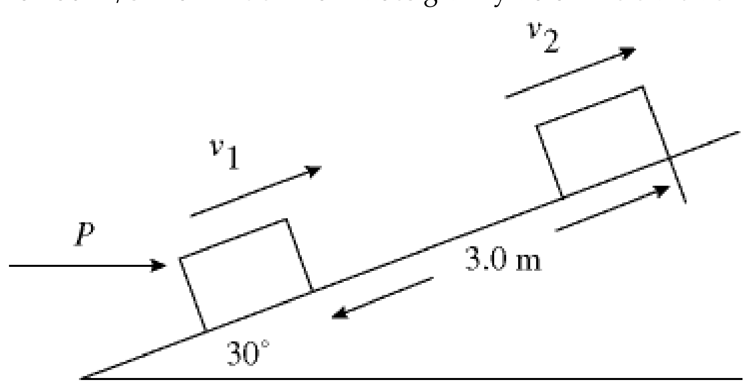
A) 61 N B) 75 N C) 92 N D) 85 N

80. In the figure, a constant external force P = 160 N is applied to a 20.0-kg box, which is on a rough horizontal surface. While the force pushes the box a distance of 8.00 m, the speed changes from 0.500 m/s to 2.60 m/s. The work done by friction during this process is closest to



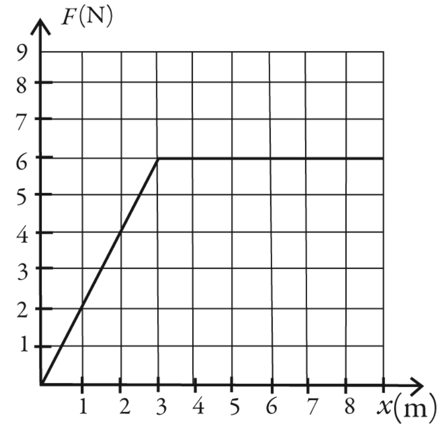
A) +1040 J. B) −1170 J. C) +1170 J. D) +1110 J. E) −1040 J.

81. In the figure, a 700-kg crate is on a rough surface inclined at 30°. A constant external force P = 5600 N is applied horizontally to the crate. As the force pushes the crate a distance of 3.00 m up the incline, the speed changes from 1.40 m/s to 2.50 m/s. How much work does gravity do on the crate during this process?



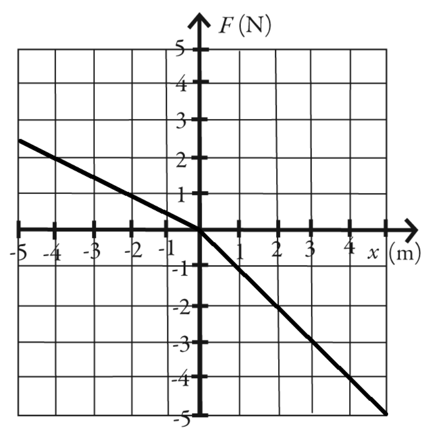
A) −3400 J B) zero C) +10,300 J D) −10,300 J E) +3400 J

82. A graph of the force on an object as a function of its position is shown in the figure. Determine the amount of work done by this force on an object that moves from $x = 1.0$ m to $x = 6.0$ m. (Assume an accuracy of 2 significant figures for the numbers on the graph.)



A) 27 J B) 26 J C) 22 J D) 35 J E) 29 J

83. A graph of the force on an object as a function of its position is shown in the figure. Determine the amount of work done by this force on the object during a displacement from $x = -2.00$ m to $x = 2.00$ m. (Assume an accuracy of 3 significant figures for the numbers on the graph.)



A) –12.0 J B) –3.00 J C) 3.00 J D) 12.0 J E) –1.00 J

84. A force $\vec{F} = 12\text{ N}\,\hat{i} - 10\text{ N}\,\hat{j}$ acts on an object. How much work does this force do as the object moves from the origin to the point $\vec{r} = 13\text{ m}\,\hat{i} + 11\text{ m}\,\hat{j}$?

A) 37 J B) 266 J C) 46 J D) 62 J

85. A worker lifts a 20.0–kg bucket of concrete from the ground up to the top of a 20.0–m tall building. The bucket is initially at rest, but is traveling at 4.0 m/s when it reaches the top of the building. What is the minimum amount of work that the worker did in lifting the bucket?

A) 400 J B) 560 J C) 3.92 kJ D) 160 J E) 4.08 kJ

86. A ball is thrown upward at an angle with a speed and direction such that it reaches a maximum height of 16.0 m above the point it was released, with no appreciable air resistance. At its maximum height it has a speed of 18.0 m/s. With what speed was the ball released?

A) 25.3 m/s B) 22.2 m/s C) 33.0 m/s D) 36.9 m/s E) 29.2 m/s

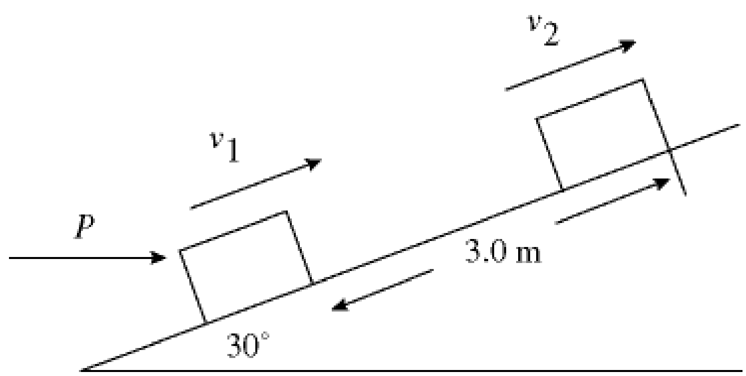
87. A 1000 kg car experiences a net force of 9500 N while decelerating from 30.0 m/s to 23.4 m/s. How far does it travel while slowing down?

A) 17.4 m B) 20.2 m C) 18.5 m D) 21.9 m

88. A constant horizontal pull acts on a sled on a horizontal frictionless ice pond. The sled starts from rest. When the pull acts over a distance x, the sled acquires a speed v and a kinetic energy K. If the same pull instead acts over twice this distance:

A) The sled's speed will be $4v$ and its kinetic energy will be $2K$.
B) The sled's speed will be $2v$ and its kinetic energy will be $K\sqrt{2}$.
C) The sled's speed will be $2v$ and its kinetic energy will be $2K$.
D) The sled's speed will be $v\sqrt{2}$ and its kinetic energy will be $2K$.
E) The sled's speed will be $v\sqrt{2}$ and its kinetic energy will be $K\sqrt{2}$.

89. In the figure, a 900-kg crate is on a rough surface inclined at 30°. A constant external force $P = 7200$ N is applied horizontally to the crate. While this force pushes the crate a distance of 3.0 m up the incline, its velocity changes from 1.2 m/s to 2.3 m/s. How much work does friction do during this process?



A) +7200 J B) −7200 J C) −3700 J D) +3700 J E) zero

90. A 5.00-kg box slides 4.00 m across the floor before coming to rest. What is the coefficient of kinetic friction between the floor and the box if the box had an initial speed of 3.00 m/s?

A) 0.267 B) 0.115 C) 0.587 D) 1.13 E) 0.229

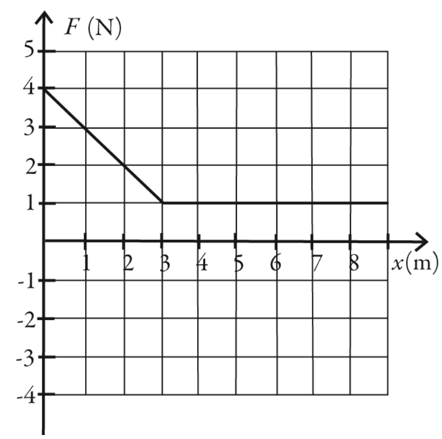
91. You slam on the brakes of your car in a panic, and skid a certain distance on a straight, level road. If you had been traveling twice as fast, what distance would the car have skidded, under identical conditions?

A) It would have skidded 4 times farther.
B) It would have skidded 1/2 as far.
C) It would have skidded 2 times farther.
D) It would have skidded $\sqrt{2}$ times farther.
E) It would have skidded $1/\sqrt{2}$ times farther.

92. A 4.00-kg mass is attached to a very light ideal spring hanging vertically and hangs at rest in the equilibrium position. The spring constant of the spring is 1.00 N/cm. The mass is pulled downward 2.00 cm and released. What is the speed of the mass when it is 1.00 cm above the point from which it was released?
A) 0.0866 m/s
B) 0.0443 m/s
C) 0.0744 m/s
D) 0.0201 m/s
E) The mass will not reach the height specified.

93. An unusual spring has a restoring force of magnitude $F = (2.00\ \mathrm{N/m})x + (1.00\ \mathrm{N/m^2})x^2$, where x is the stretch of the spring from its equilibrium length. A 3.00-kg object is attached to this spring and released from rest after stretching the spring 1.50 m. If the object slides over a frictionless horizontal surface, how fast is it moving when the spring returns to its equilibrium length?
A) 1.50 m/s B) 4.33 m/s C) 3.27 m/s D) 5.48 m/s E) 2.06 m/s

94. The force on a 3.00-kg object as a function of position is shown in the figure. If an object is moving at 2.50 m/s when it is located at $x = 2.00$ m, what will its speed be when it reaches $x = 8.00$ m? (Assume that the numbers on the graph are accurate to 3 significant figures.)



A) 3.70 m/s B) 3.25 m/s C) 2.90 m/s D) 4.10 m/s E) 4.50 m/s

95. A 1500-kg car accelerates from 0 to 25 m/s in 7.0 s with negligible friction and air resistance. What is the average power delivered by the engine? (1 hp = 746 W)
A) 60 hp B) 70 hp C) 80 hp D) 90 hp E) 50 hp

96. A child pulls on a wagon with a horizontal force of 75 N. If the wagon moves horizontally a total of 42 m in 3.0 min, what is the average power generated by the child?
A) 22 W B) 24 W C) 27 W D) 18 W

97. A car needs to generate 75.0 hp in order to maintain a constant velocity of 27.3 m/s on a flat road. What is the magnitude of the total resistive force acting on the car (due to friction, air resistance, etc.)? (1 hp = 746 W)
A) 1.03×10^3 N B) 2.75 N C) 2.87×10^3 N D) 2.05×10^3 N

98. How long will it take a 7.08 hp motor to lift a 250 kg beam directly upward at constant velocity from the ground to a height of 45.0 m? Assume frictional forces are negligible. (1 hp = 746 W)
A) 20.9 s B) 2.18×10^4 s C) 39.7 s D) 1.56×10^4 s

99. Calculate the minimum average power output necessary for a 55.8 kg person to run up a 12.0 m long hillside, which is inclined at 25.0° above the horizontal, in 3.00 s. You can neglect the person's kinetic energy. Express your answer in horsepower. (1 hp = 746 W)

A) 0.740 hp
B) 2.93 hp
C) 1.86 hp
D) 1.24 hp

100. If electricity costs 6.00 ¢/kWh (kilowatt–hour), how much would it cost you to run a 120 W stereo system 4.0 hours per day for 4.0 weeks?

A) $2.27
B) $1.38
C) $0.81
D) $0.12

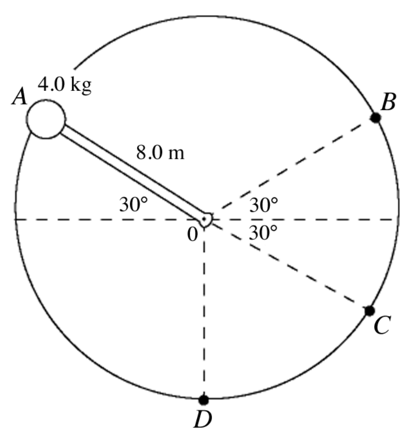
101. The work performed as a function of time for a process is given by $W = at^3$, where $a = 2.4\ \mathrm{J/s^3}$. What is the instantaneous power output at $t = 3.7$ s?

A) 99 W
B) 207 W
C) 69 W
D) 138 W

102. A mass is pressed against (but is not attached to) an ideal horizontal spring on a frictionless horizontal surface. After being released from rest, the mass acquires a maximum speed v and a maximum kinetic energy K. If instead the mass initially compresses the spring twice as far:

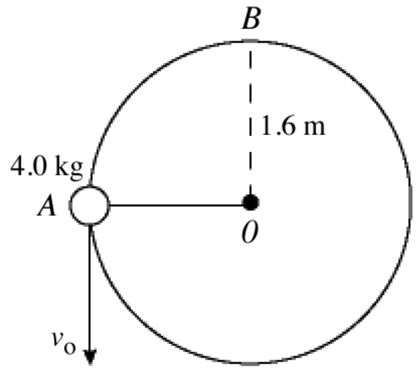
A) Its maximum speed will be $4v$ and its maximum kinetic energy will be $2K$.
B) Its maximum speed will be $2v$ and its maximum kinetic energy will be $\sqrt{2}K$.
C) Its maximum speed will be $2v$ and its maximum kinetic energy will be $2K$.
D) Its maximum speed will be $2v$ and its maximum kinetic energy will be $4K$.
E) Its maximum speed will be $v\sqrt{2}$ and its maximum kinetic energy will be $2K$.

103. An 8.0–m massless rod is loosely pinned to a frictionless pivot at 0, as shown in the figure. A very small 4.0–kg ball is attached to the other end of the rod. The ball is held at A, where the rod makes a 30° angle above the horizontal, and is released. The ball–rod assembly then swings freely with negligible friction in a vertical circle between A and B. The tension in the rod when the ball passes through the lowest point at D is closest to



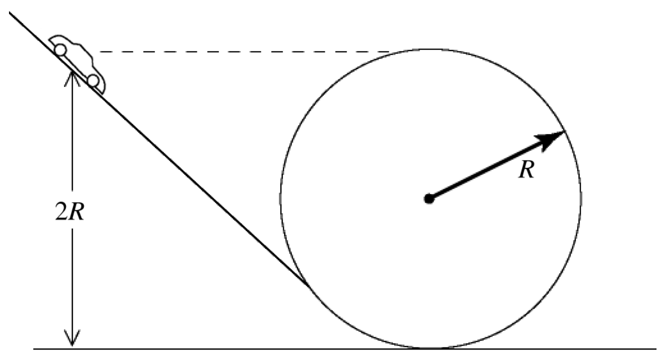
A) 160 N.
B) 40 N.
C) 200 N.
D) 120 N.
E) 80 N.

104. In the figure, a 4.0-kg ball is on the end of a 1.6-m rope that is fixed at *0*. The ball is held at point *A*, with the rope horizontal, and is given an initial downward velocity. The ball moves through three quarters of a circle with no friction and arrives at *B*, with the rope barely under tension. The initial velocity of the ball, at point *A*, is closest to



A) 6.3 m/s B) 6.9 m/s C) 4.0 m/s D) 5.6 m/s E) 7.9 m/s

105. In the figure, a very small toy race car of mass *m* is released from rest on the loop-the-loop track. If it is released at a height 2*R* above the floor, how high is it above the floor when it leaves the track, neglecting friction?



A) 1.67 *R* B) 1.33 *R* C) 1.25 *R* D) 1.50 *R* E) 2.00 *R*

106. A 60.0-kg person drops from rest a distance of 1.20 m to a platform of negligible mass supported by an ideal stiff spring of negligible mass. The platform drops 6.00 cm before the person comes to rest. What is the spring constant of the spring?
A) 4.12×10^5 N/m
B) 8.83×10^4 N/m
C) 3.92×10^5 N/m
D) 2.56×10^5 N/m
E) 5.45×10^4 N/m

107. A spring-loaded dart gun is used to shoot a dart straight up into the air, and the dart reaches a maximum height of 24 meters above its point of release. The same dart is shot up a second time from the same gun, but this time the spring is compressed only half as far (compared to the first shot). How far up does the dart go this time? (Neglect friction and assume the spring is ideal and massless.)
A) 12 m B) 48 m C) 6.0 m D) 3.0 m

108. A block slides down a frictionless inclined ramp. If the ramp angle is 17.0 ° and its length is 30.0 m, find the speed of the block as it reaches the bottom of the ramp, assuming it started sliding from rest at the top.

A) 13.1 m/s B) 9.26 m/s C) 172 m/s D) 24.0 m/s

109. Consider the motion of a 1.00-kg particle that moves with potential energy given by $U(x) = (-2.00\ \text{J·m})/x + (4.00\ \text{J·m}^2)/x^2$. Suppose the particle is moving with a speed of 3.00 m/s when it is located at $x = 1.00$ m. What is the speed of the object when it is located at $x = 5.00$ m?

A) 2.13 m/s B) 3.67 m/s C) 4.68 m/s D) 3.00 m/s

110. A car on a roller coaster starts at zero speed at an elevation above the ground of 26 m. It coasts down a slope, and then climbs a hill. The top of the hill is at an elevation of 16 m. What is the speed of the car at the top of the hill? Neglect any frictional effects.

A) 18 m/s B) 6.0 m/s C) 10 m/s D) 9.0 m/s E) 14 m/s

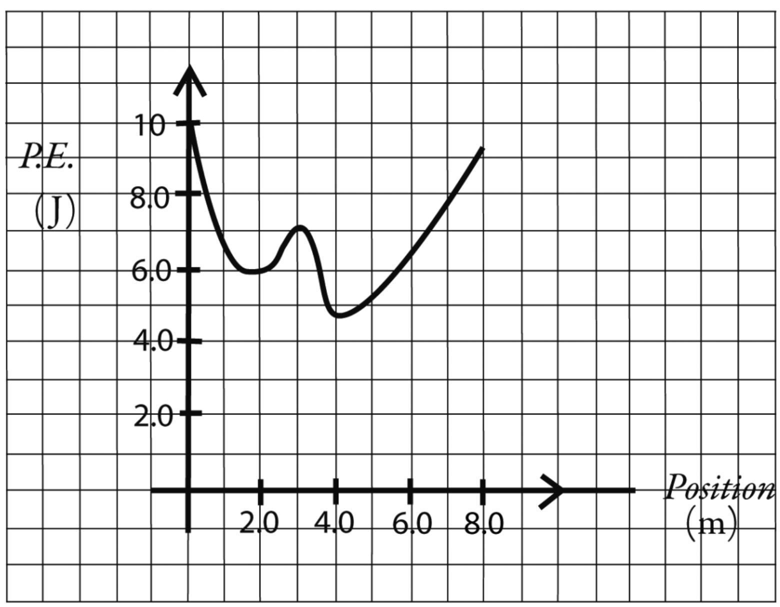
111. A projectile is fired from ground level at an angle of 40.0° above horizontal at a speed of 30.0 m/s. What is the speed of the projectile when it has reached a height equal to 50.0% of its maximum height?

A) 28.7 m/s B) 28.1 m/s C) 26.7 m/s D) 26.0 m/s E) 27.4 m/s

112. A very small 100-g object is attached to one end of a massless 10-cm rod that is pivoted without friction about the opposite end. The rod is held vertical, with the object at the top, and released, allowing the rod to swing. What is the speed of the object at the instant that the rod is horizontal?

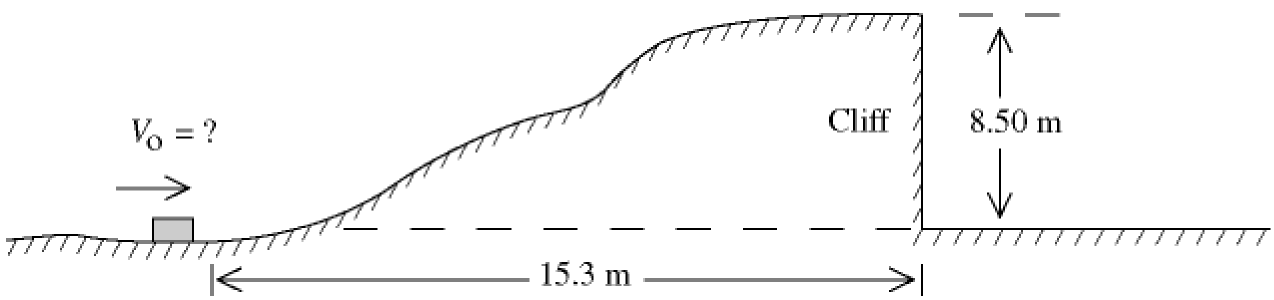
A) 1.4 m/s B) 2.8 m/s C) 2.8 m/s D) 0.71 m/s E) 4.0 m/s

113. A 2.0-kg object is moving without friction along the x-axis. The potential energy curve as a function of position is shown in the figure, and the system is conservative. If the speed of the object at the origin is 4.0 m/s, what will be its speed at 7.0 m along the $+x$-axis?



A) 4.2 m/s B) 9.8 m/s C) 4.6 m/s D) 4.0 m/s E) 4.4 m/s

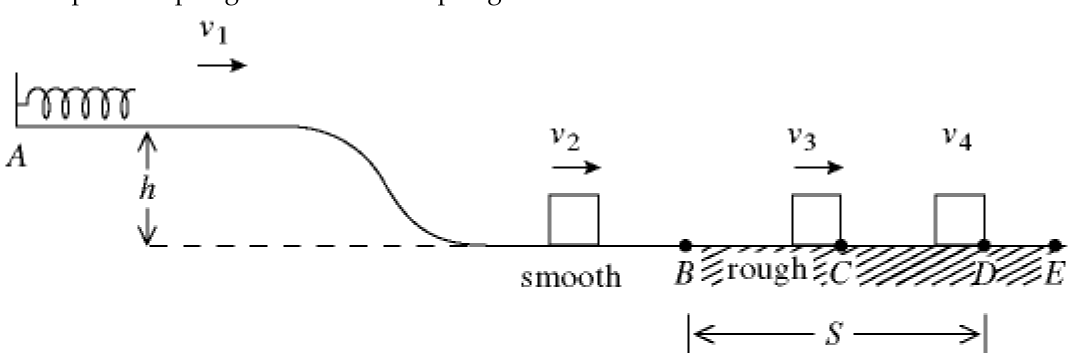
114. A small hockey puck slides without friction over the icy hill shown in the figure and lands 6.20 m from the foot of the cliff with no air resistance. What was its speed v_0 at the bottom of the hill?



A) 13.7 m/s B) 14.4 m/s C) 17.4 m/s D) 4.71 m/s E) 20.8 m/s

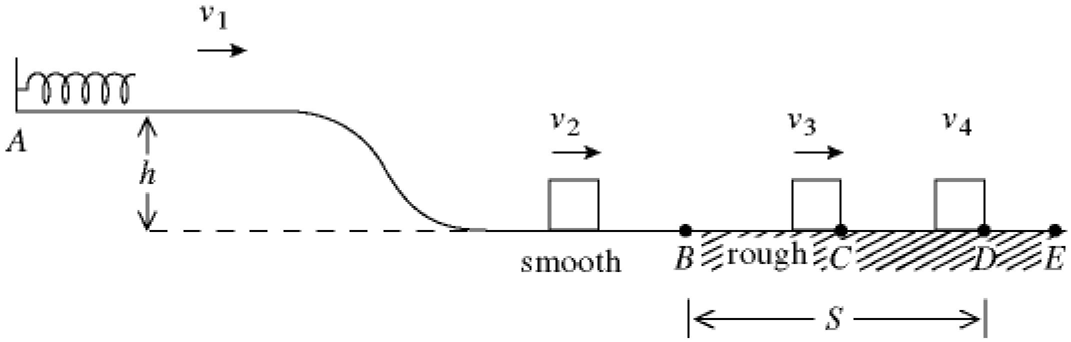
115. An object is attached to a hanging unstretched ideal and massless spring and slowly lowered to its equilibrium position, a distance of 6.4 cm below the starting point. If instead of having been lowered slowly the object was dropped from rest, how far then would it then stretch the spring at maximum elongation?
A) 18 cm B) 26 cm C) 13 cm D) 6.4 cm E) 9.1 cm

116. An 0.80 -kg block is held in place against the spring by a 67-N horizontal external force (see the figure). The external force is removed, and the block is projected with a velocity v_1 = 1.2 m/s upon separation from the spring. The block descends a ramp and has a velocity v_2 = 1.9 m/s at the bottom. The track is frictionless between points A and B. The block enters a rough section at B, extending to E. The coefficient of kinetic friction over this section is 0.39. The velocity of the block is v_3 = 1.4 m/s at C. The block moves on to D, where it stops. The spring constant of the spring is closest to



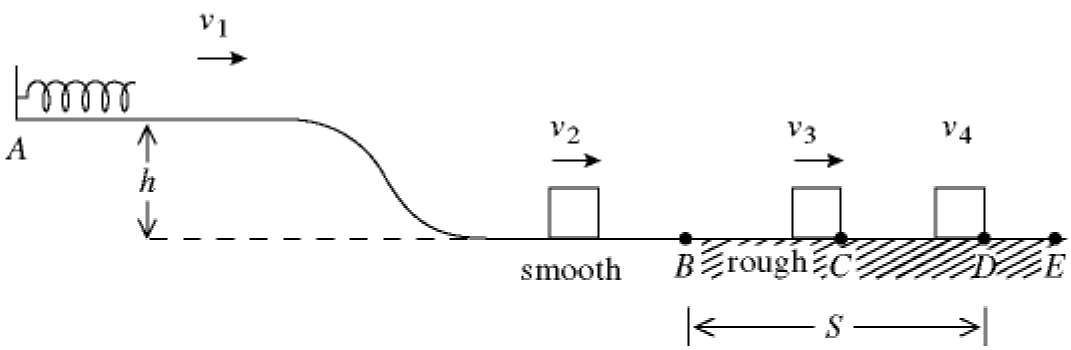
A) 2000 N/m. B) 1600 N/m. C) 3900 N/m. D) 2600 N/m. E) 1100 N/m.

117. A 1.37-kg block is held in place against the spring by a 74-N horizontal external force (see the figure). The external force is removed, and the block is projected with a velocity $v_1 = 1.2$ m/s upon separation from the spring. The block descends a ramp and has a velocity $v_2 = 1.4$ m/s at the bottom. The track is frictionless between points A and B. The block enters a rough section at B, extending to E. The coefficient of kinetic friction over this section is 0.24. The velocity of the block is $v_3 = 1.4$ m/s at C. The block moves on to D, where it stops. The initial compression of the spring is closest to:



A) 0.96 cm. B) 2.7 cm. C) 5.3 cm. D) 1.4 cm. E) 3.6 cm.

118. A 1.86-kg block is held in place against the spring by a 81-N horizontal external force (see the figure). The external force is removed, and the block is projected with a velocity $v_1 = 1.2$ m/s upon separation from the spring. The block descends a ramp and has a velocity $v_2 = 1.9$ m/s at the bottom. The track is frictionless between points A and B. The block enters a rough section at B, extending to E. The coefficient of kinetic friction over this section is 0.28. The velocity of the block is $v_3 = 1.4$ m/s at C. The block moves on to D, where it stops. The height h of the ramp is closest to



A) 11 B) 15 C) 18 D) 17 E) 7.3

119. A force on an object is given by $F(x) = (-4.00 \text{ N/m})x + (2.00 \text{ N/m}^3)x^3$. What is the change in potential energy in moving from $x = 1.00$ m to $x = 2.00$ m?
A) −1.50 J B) 10.0 J C) 12.0 J D) −10.0 J E) 1.50 J

120. A potential energy function is given by $U(x) = (3.00\ \text{N/m})x - (1.00\ \text{N/m}^3)x^3$. At what position or positions is the force equal to zero?

A) 3.00 m and –3.00 m
B) $\sqrt{6.00}$ m and $-\sqrt{6.00}$ m
C) 0.00 m, $\sqrt{3.00}$ m and $-\sqrt{3.00}$ m
D) 1.00 m and –1.00 m
E) The force is not zero at any location.

121. The potential energy for a certain mass moving in one dimension is given by $U(x) = (2.0\ \text{J/m}^3)x^3 - (15\ \text{J/m}^2)x^2 + (36\ \text{J/m})x - 23\ \text{J}$. Find the location(s) where the force on the mass is zero.

A) 3.0 m, 5.0 m
B) 2.0 m, 3.0 m
C) 4.0 m, 5.0 m
D) 1.0 m

122. A particle experiences a force given by $F(x) = \alpha - \beta x^3$. Find the potential field $U(x)$ the particle is in. (Assume that the zero of potential energy is located at $x = 0$.)

A) $U(x) = -\alpha x + \frac{\beta}{4}x^4$
B) $U(x) = -3\beta x^2$
C) $U(x) = 3\beta x^2$
D) $U(x) = \alpha x - \frac{\beta}{4}x^4$

Answer Key
Testname: AP CH 10 & 11 TEST BANK

1. C
2. B
3. D
4. B
5. D
6. A
7. D
8. C
9. C
10. B
11. C
12. C
13. B
14. E
15. A
16. D
17. E
18. C
19. A
20. B
21. D
22. D
23. D
24. D
25. D
26. D
27. D
28. A
29. A
30. B
31. A
32. A
33. A
34. B
35. A
36. C
37. B
38. C
39. B
40. C
41. A
42. C
43. B
44. A
45. B
46. B
47. E
48. C
49. A
50. C
51. A
52. B
53. B
54. A
55. A
56. C
57. A
58. D
59. A
60. B
61. A
62. A
63. E
64. D
65. E
66. A
67. D
68. E
69. E
70. D
71. B
72. B
73. D
74. B
75. E
76. D
77. B
78. A
79. B
80. E
81. D
82. B
83. E
84. C
85. E
86. A
87. C
88. D
89. C
90. B
91. A
92. A
93. A
94. B
95. D
96. D
97. D
98. A
99. D
100. C
101. A
102. E
103. A
104. B
105. A
106. A
107. C
108. A
109. B
110. E
111. C
112. B
113. A
114. A
115. C
116. C
117. B
118. A
119. A
120. D
121. B
122. A