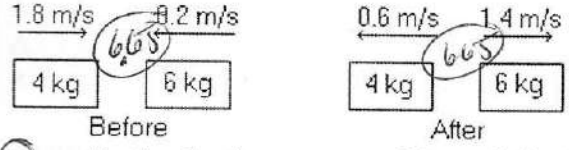
AP Physics

Review 3—Answer Key

1) A 5-kg ball collides inelastically head-on with a 10-kg ball, which is initially stationary. Which of the following statements is true? (There could be more than one correct choice.)
A) The magnitude of the change of velocity the 5-kg ball experiences is greater than that of the 10-kg ball.
B) The magnitude of the change of velocity the 5-kg ball experiences is less than that of the 10-kg ball.
C) The magnitude of the change of velocity the 5-kg ball experiences is equal to that of the 10-kg ball.
D) The magnitude of the change of the momentum of the 5-kg ball is equal to the magnitude of the change of momentum of the 10-kg ball.
E) Both balls lose all their momentum since the collision is inelastic.
Answer: A, D

2) In the figure, determine the character of the collision. The masses of the blocks, and the velocities before and after, are shown. The collision is



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

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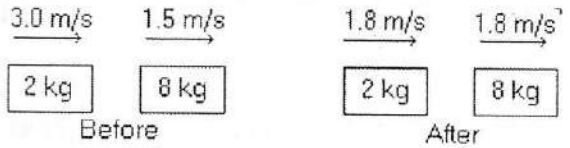


A) perfectly elastic. B) partially inelastic. C) completely inelastic. D) characterized by an increase in kinetic energy. E) not possible because momentum is not conserved.
Answer: C

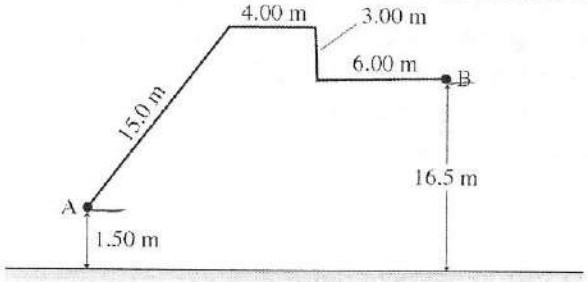
4) If a quantity you calculated had units of kg · m/s, what type of quantity could it be? (There could be more than one correct choice.)
A) momentum B) kinetic energy C) work D) impulse E) force
Answer: A, D

5) A rubber ball bounces off of a wall with an initial speed v and reverses its direction so its speed is v right after the bounce. As a result of this bounce, which of the following quantities of the ball are conserved? (There could be more than one correct choice.)
A) the kinetic energy of the ball
B) the momentum of the ball
C) both the momentum and the kinetic energy of the ball
D) None of the above quantities are conserved.
Answer: A

6) A firecracker explodes in midair and breaks up into many fragments. Which of the following statements are true regarding conditions immediately before and immediately after the explosion:
I. The total momentum of the fragments is equal to the original momentum of the firecracker.
II. The total kinetic energy of the fragments is equal to the original kinetic energy of the firecracker.
A) Statement I only B) Statement II only C) Both Statement I and Statement II

D) Neither statement is true.
Answer: A

7) A person carries a 2.00-N pebble through the path shown in the figure, starting at point A and ending at point B. The total time from A to B is 6.75 min. How much work did gravity do on the rock between A and B?



$W = Fd$
$= 2N(15m)$

A) 30.0 J B) -30.0 J C) -56.0 J D) 56.0 J E) -36.0 J
Answer: B

8) How fast must a 6.0-kg cat run to have a kinetic energy of 150 J? $150 = \frac{1}{2}(6)v^2$
Answer: 7.1 m/s $v = 7.1 m/s$

9) An object hits a wall and bounces back with half of its original speed. What is the ratio of the final kinetic energy to the initial kinetic energy of the object?
A) ½ B) ¼ C) 1/8 D) 1/16
Answer: B

$W = \Delta K = \frac{1}{2}(1000)(26.1)$
$= 340,605$

10) How much work must be done by frictional forces in slowing a 1000-kg car from 26.1 m/s to rest?
A) 3.41×10^5 J B) 2.73×10^5 J C) 4.09×10^5 J D) 4.77×10^5 J
Answer: A

11) A 100-N force has a horizontal component of 80 N and a vertical component of 60 N. The force is applied to a cart on a level frictionless floor. The cart starts from rest and moves 2.0 m horizontally along the floor due to this force. What is the cart's final kinetic energy?
A) 200 J B) 160 J C) 120 J D) zero
Answer: B

$W = \Delta K$
$80N \cdot 2.0m$

12) A stone initially moving at 8.0 m/s on a level surface comes to rest due to friction after it travels 11 m. What is the coefficient of kinetic friction between the stone and the surface?
A) 0.13 B) 0.25 C) 0.30 D) 0.43 E) 0.80
Answer: C

$0^2 = 8^2 + 2a(11)$
$a = 2.9 m/s^2$
$F_f = \mu F_N$
$m(2.9) = \mu \cdot m(9.8)$
$\mu = 0.2959 = 0.30$

13) On an alien planet, an object moving at 4.0 m/s on the horizontal ground comes to rest after traveling a distance of 10 m. If the coefficient of kinetic friction between the object and the surface is 0.20, what is the value of g on that planet?
A) 4.0 m/s^2 B) 6.0 m/s^2 C) 8.0 m/s^2 D) 10 m/s^2 E) 12 m/s^2
Answer: A

$0^2 = 4^2 + 2a(10)$
$a = 0.80$
$F_f = \mu F_N$
$m(.80) = 0.20(m)g$
$g = 4$

14) How high a hill would a 75-kg hiker have to climb to increase her gravitational potential energy by 10,000 J?
Answer: 14 m

$10,000J = 75(9.80)h$
$h = 13.6 m$

15) An ideal spring stretches by 21.0 cm when a 135-N object is hung from it. If instead you hang a fish from

this spring, what is the weight of a fish that would stretch the spring by 31.0 cm?
A) 199 N B) 91 N C) 145 N D) 279 N
Answer: A

$135N = k(21\,cm)$
$k = 6.43\,N/cm$
$x = 6.43(31)$
$= 199N$

16) If the work done to stretch an ideal spring by 4.0 cm is 6.0 J, what is the spring constant (force constant) of this spring?
A) 300 N/m B) 3000 N/m C) 3500 N/m D) 7500 N/m E) 6000 N/m
Answer: D

$6.0 = \frac{1}{2}k(.04m)^2$
$k = 7500\,N/m$

17) It takes 87 J of work to stretch an ideal spring from 1.4 m to 2.9 m from equilibrium. What is the value of the spring constant (force constant) of this spring?
A) 27 N/m B) 77 N/m C) 52 N/m D) 39 N/m
Answer: B

$87 = \frac{1}{2}(k)(1.5)^2$
$k = 77\,N/m$

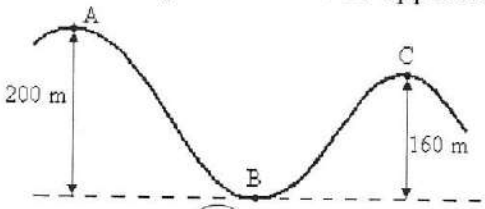
18) A rock falls from a vertical cliff that is 4.0 m tall and experiences no significant air resistance as it falls. At what speed will its gravitational potential energy (relative to the base of the cliff) be equal to its kinetic energy?
A) 3.1 m/s B) 4.4 m/s C) 6.3 m/s D) 8.9 m/s E) 13 m/s
Answer: C

Before = after
$mg(4.0) + 0 = 2 \cdot (\frac{1}{2}mv^2)$
$v = 6.26\,m/s$

19) A prankster drops a water balloon from the top of a building. If the balloon is traveling at 29.1 m/s when it strikes a window ledge that is 1.5 m above the ground, how tall is the building? Neglect air resistance.
A) 45 m B) 43 m C) 46 m D) 47 m
Answer: A

$(29.1)^2$
$m(9.80)h + 0 = m(9.80)(1.5) + \frac{1}{2}mv^2$
$h = 44.7\,m$

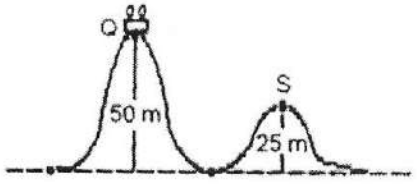
20) A bead is moving with a speed of 20 m/s at position A on the track shown in the figure. This track is friction-free, and there is no appreciable air resistance. What is the speed of the bead at point C?



$m(9.80)(200) + \frac{1}{2}m(20)^2 = mg(160) + \frac{1}{2}mv^2$
$v = 34.4\,m/s$

A) 0 m/s B) 34 m/s C) 69 m/s D) 20 m/s
E) We cannot solve this problem without knowing the mass of the bead.
Answer: B

21) The figure shows a famous roller coaster ride. You can ignore friction. If the roller coaster leaves point Q from rest, what is its speed at the top of the 25-m peak (point S)?



$mg(9.80)(50) + 0 = m(9.80)(25) + \frac{1}{2}mv^2$
$v = 22.1\,m/s$

A) 10 m/s B) 22 m/s C) 44 m/s D) 62 m/s E) 120 m/s
Answer: B

22) A 60-kg skier starts from rest from the top of a 50-m high slope. If the work done by friction is -6.0 kJ, what is the speed of the skier on reaching the bottom of the slope?
A) 17 m/s B) 24 m/s C) 28 m/s D) 31 m/s
Answer: C

$60(9.80)(50) = 6000\,J + \frac{1}{2}mv^2$
$v = 27.9\,m/s^2$

23) How many joules of energy are used by a 2.0 hp motor that runs for 1.0 hour? (1 hp = 746 W)
Answer: 5.4 MJ $1492\ W = \frac{W}{3600s}$ $W = 5,371,200$ $5.4 \times 10^6\ J$

24) At what minimum rate is a 60.0-kg boy using energy when, in 8.00 s, he runs up a flight of stairs that is 10.0-m high?
A) 75.0 W (B) 735 W C) 4.80 kW D) 48.0 W $P = \frac{60.0(9.80)(10.0)}{8.00s} = 735\ W$
Answer: B

25) In a physical fitness program, a woman who weighs 510 N runs up four flights of stairs in 22 s. Each flight rises 3.1 m. (1 hp = 746 W)
(a) What is her total change in potential energy? $U_g = 510(4 \cdot 3.1) = 6300\ J$
(b) What was the minimum average power (in watts) that she expended during the 22 s? $P = \frac{6300\ J}{22\ s} = 290\ W$
(c) What horsepower motor would be required to generate the same power? $290\ W \times \frac{1\ hp}{746\ W} = 0.39\ hp$
Answer: (a) 6.3 kJ (b) 290 W (c) 0.39 hp

26) A 100%-efficient engine is being used to raise a 89-kg crate vertically upward at a steady rate. If the power output of the engine is 1620 W, how long does it take the engine to lift the crate a vertical distance of 18.7 m? Friction in the system is negligible.
Answer: 10 s $1620\ W = \frac{89(9.80)(18.7)}{t}$ $t = 10.1\ s$