Name: ______________________ **Class:** _________________ **Date:** _________ **ID: A**

Cp physics - Fall final review (part II)

Multiple Choice

Identify the choice that best completes the statement or answers the question.

____ 1. A force does work on an object if a component of the force
- a. is perpendicular to the displacement of the object.
- b. is parallel to the displacement of the object.
- c. perpendicular to the displacement of the object moves the object along a path that returns the object to its starting position.
- d. parallel to the displacement of the object moves the object along a path that returns the object to its starting position.

____ 2. Work is done when
- a. the displacement is not zero.
- b. the displacement is zero.
- c. the force is zero.
- d. the force and displacement are perpendicular.

____ 3. What is the common formula for work? Assume that W is the work, F is a constant force, Δv is the change in velocity, and d is the displacement.
- a. $W = F\Delta v$
- c. $W = Fd^2$
- b. $W = Fd$
- d. $W = F^2d$

____ 4. If the sign of work is negative,
- a. the displacement is perpendicular to the force.
- b. the displacement is in the direction opposite the force.
- c. the displacement is in the same direction as the force.
- d. no work is done.

____ 5. In which of the following scenarios is work done?
- a. A weightlifter holds a barbell overhead for 2.5 s.
- b. A construction worker carries a heavy beam while walking at constant speed along a flat surface.
- c. A car decelerates while traveling on a flat stretch of road.
- d. A student holds a spring in a compressed position.

____ 6. In which of the following scenarios is no net work done?
- a. A car accelerates down a hill.
- b. A car travels at constant speed on a flat road.
- c. A car decelerates on a flat road.
- d. A car decelerates as it travels up a hill.

____ 7. A child moving at constant velocity carries a 2 N ice-cream cone 1 m across a level surface. What is the net work done on the ice-cream cone?
- a. 0 J
- c. 2 J
- b. 0.5 J
- d. 20 J

____ 8. A worker does 25 J of work lifting a bucket, then sets the bucket back down in the same place. What is the total net work done on the bucket?
- a. –25 J
- c. 25 J
- b. 0 J
- d. 50 J

____ 9. A construction worker pushes a wheelbarrow 5.0 m with a horizontal force of 50.0 N. How much work is done by the worker on the wheelbarrow?

a. 10 J
b. 55 J
c. 250 J
d. 1250 J

____ 10. A child pulls a balloon for 12 m with a force of 1.0 N at an angle 60° below horizontal. How much work does the child do on the balloon?

a. –10 J
b. –6.0 J
c. 6.0 J
d. 12 J

____ 11. Which of the following energy forms is associated with an object in motion?

a. potential energy
b. elastic potential energy
c. nonmechanical energy
d. kinetic energy

____ 12. Which of the following energy forms is associated with an object due to its position?

a. potential energy
b. positional energy
c. total energy
d. kinetic energy

____ 13. Which of the following formulas would be used to directly calculate the kinetic energy of an object with mass *m* bouncing up and down on a spring with spring constant *k?*

a. $KE = \frac{1}{2}kx^2$
b. $KE = -\frac{1}{2}kx^2$
c. $KE = \frac{1}{2}mv^2$
d. $KE = -\frac{1}{2}mv^2$

____ 14. Ball A has triple the mass and speed of ball B. What is the ratio of the kinetic energy of ball A to ball B.

a. 3
b. 6
c. 9
d. 27

____ 15. What is the kinetic energy of a 0.135 kg baseball thrown at 40.0 m/s?

a. 54.0 J
b. 87.0 J
c. 108 J
d. 216 J

____ 16. Which of the following equations expresses the work-kinetic energy theorem?

a. $ME_i = ME_f$
b. $W_{net} = \Delta PE$
c. $\Delta W = \Delta KE$
d. $W_{net} = \Delta KE$

____ 17. The equation for determining gravitational potential energy is $PE_g = mgh$. Which factor(s) in this equation is (are) *not* intrinsic to an object?

a. *m*
b. *g*
c. *h*
d. both *g* and *h*

____ 18. What are the units for a spring constant?

a. N
b. m
c. N•m
d. N/m

____ 19. If the displacement of a horizontal mass-spring system was doubled, the elastic potential energy in the system would change by a factor of

a. 1/4.
b. 1/2.
c. 2.
d. 4.

____ 20. What is the potential energy of a 1.0 kg mass 1.0 m above the ground?

a. 1.0 J
b. 9.8 J
c. 10 J
d. 96 J

____ 21. A 3.00 kg toy falls from a height of 1.00 m. What will the kinetic energy of the toy be just before the toy hits the ground? (Assume no air resistance and that g = 9.81 m/s^2.)
a. 0.98 J
b. 9.8 J
c. 29.4 J
d. 294 J

____ 22. Which of the following is the rate at which energy is transferred?
a. potential energy
b. kinetic energy
c. mechanical energy
d. power

____ 23. How much power is required to lift a 2.0 kg mass at a speed of 2.0 m/s?
a. 2.0 J
b. 4.0 J
c. 9.8 J
d. 39 J

____ 24. What is the average power supplied by a 60.0 kg person running up a flight of stairs a vertical distance of 4.0 m in 4.2 s?
a. 57 W
b. 240 W
c. 560 W
d. 670 W

____ 25. Which of the following equations can be used to directly calculate an object's momentum, **p**?
a. $\mathbf{p} = m\mathbf{v}$
b. $\mathbf{p} = \dfrac{m}{\mathbf{v}}$
c. $\mathbf{p} = \mathbf{F}\Delta t$
d. $\Delta\mathbf{p} = \mathbf{F}\Delta t$

____ 26. What are the SI units for momentum?
a. N•m
b. J
c. kg•m/s
d. kg•m/s^2

____ 27. When comparing the momentum of two moving objects, which of the following is correct?
a. The object with the higher velocity will have less momentum if the masses are equal.
b. The more massive object will have less momentum if its velocity is greater.
c. The less massive object will have less momentum if the velocities are the same.
d. The more massive object will have less momentum if the velocities are the same.

____ 28. A child with a mass of 23 kg rides a bike with a mass of 5.5 kg at a velocity of 4.5 m/s to the south. Compare the momentum of the child with the momentum of the bike.
a. Both the child and the bike have the same momentum.
b. The bike has a greater momentum than the child.
c. The child has a greater momentum than the bike.
d. Neither the child nor the bike has momentum.

____ 29. Which of the following has the greatest momentum?
a. a tortoise with a mass of 275 kg moving at a velocity of 0.55 m/s
b. a hare with a mass of 2.7 kg moving at a velocity of 7.5 m/s
c. a turtle with a mass of 91 kg moving at a velocity of 1.4 m/s
d. a roadrunner with a mass of 1.8 kg moving at a velocity of 6.7 m/s

____ 30. A roller coaster climbs up a hill at 4 m/s and then zips down the hill at 30 m/s. The momentum of the roller coaster
a. is greater up the hill than down the hill.
b. is greater down the hill than up the hill.
c. remains the same throughout the ride.
d. is zero throughout the ride.

____ 31. The change in an object's momentum is equal to
a. the product of the mass of the object and the time interval.
b. the product of the force applied to the object and the time interval.
c. the time interval divided by the net external force.
d. the net external force divided by the time interval.

____ 32. A 0.2 kg baseball is pitched with a velocity of 40 m/s and is then batted to the pitcher with a velocity of 60 m/s. What is the magnitude of change in the ball's momentum?
a. 2 kg•m/s
b. 4 kg•m/s
c. 8 kg•m/s
d. 20 kg•m/s

____ 33. The impulse experienced by a body is equivalent to the body's change in
a. velocity.
b. kinetic energy.
c. momentum.
d. force.

____ 34. A 20 kg shopping cart moving at a velocity of 0.5 m/s collides with a store wall and stops. The momentum of the shopping cart
a. increases.
b. decreases.
c. remains the same.
d. is conserved.

____ 35. A soccer ball collides with another soccer ball at rest. The total momentum of the balls
a. is zero.
b. increases.
c. remains constant.
d. decreases.

____ 36. Two skaters stand facing each other. One skater's mass is 60 kg, and the other's mass is 72 kg. If the skaters push away from each other without spinning,
a. the lighter skater has less momentum.
b. their momenta are equal but opposite.
c. their total momentum doubles.
d. their total momentum decreases.

____ 37. In a two-body collision,
a. momentum is always conserved.
b. kinetic energy is always conserved.
c. neither momentum nor kinetic energy is conserved.
d. both momentum and kinetic energy are always conserved.

____ 38. A billiard ball collides with a second identical ball in an elastic head-on collision. What is the kinetic energy of the system after the collision compared with the kinetic energy before the collision?
a. unchanged
b. one-fourth as great
c. two times as great
d. four times as great

____ 39. When an object is moving with uniform circular motion, the object's tangential speed
a. is circular.
b. is perpendicular to the plane of motion.
c. is constant.
d. is directed toward the center of motion.

____ 40. When an object is moving with uniform circular motion, the centripetal acceleration of the object
a. is circular.
b. is perpendicular to the plane of motion.
c. is zero.
d. is directed toward the center of motion.

____ 41. What term describes a change in the speed of an object in circular motion?
a. tangential speed
b. tangential acceleration
c. centripetal acceleration
d. centripetal force

____ 42. What is the term for the net force directed toward the center of an object's circular path?

a. circular force
b. centrifugal force
c. centripetal force
d. orbital force

A child rides a bicycle in a circular path with a radius of 2.0 m. The tangential speed of the bicycle is 2.0 m/s. The combined mass of the bicycle and the child is 43 kg.

____ 43. What is the magnitude of the bicycle's centripetal acceleration?

a. 1.0 m/s^2
b. 2.0 m/s^2
c. 4.0 m/s^2
d. 8.0 m/s^2

____ 44. What is the magnitude of the centripetal force on the bicycle?

a. 4.0 N
b. 43 N
c. 86 N
d. 3.7 kN

____ 45. What kind of force provides the centripetal force on the bicycle?

a. gravitational force
b. friction
c. air resistance
d. normal force

____ 46. A ball is whirled on a string, then the string breaks. What causes the ball to move off in a straight line?

a. centripetal acceleration
b. centripetal force
c. centrifugal force
d. inertia

____ 47. Which of the following equations expresses Newton's law of universal gravitation?

a. $F_c = \frac{mv_t^2}{r}$
b. $F_g = \frac{m_1 m_2}{r}$
c. $g = G\frac{m_E}{r^2}$
d. $F_g = G\frac{m_1 m_2}{r^2}$

____ 48. When calculating the gravitational force between two extended bodies, you should measure the distance

a. from the closest points on each body.
b. from the most distant points on each body.
c. from the center of each body.
d. from the center of one body to the closest point on the other body.

____ 49. The gravitational force between two masses is 36 N. What is the gravitational force if the distance between them is tripled? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

a. 4.0 N
b. 9.0 N
c. 18 N
d. 27 N

____ 50. Two small masses that are 10.0 cm apart attract each other with a force of 10.0 N. When they are 5.0 cm apart, these masses will attract each other with what force?
($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

a. 5.0 N
b. 2.5 N
c. 20.0 N
d. 40.0 N

____ 51. Which of the following is a direct cause of a substance's temperature increase?
a. Energy is removed from the particles of the substance.
b. Kinetic energy is added to the particles of the substance.
c. The number of atoms and molecules in a substance changes.
d. The volume of the substance decreases.

____ 52. What happens to the internal energy of an ideal gas when it is heated from 0°C to 4°C?
a. It increases.
b. It decreases.
c. It remains constant.
d. It is impossible to determine.

____ 53. Which of the following best describes the relationship between two systems in thermal equilibrium?
a. No net energy is exchanged.
b. The volumes are equal.
c. The masses are equal.
d. The velocity is zero.

____ 54. If two small beakers of water, one at 70°C and one at 80°C, are emptied into a large beaker, what is the final temperature of the water?
a. The final temperature is less than 70°C.
b. The final temperature is greater than 80°C.
c. The final temperature is between 70°C and 80°C.
d. The water temperature will fluctuate.

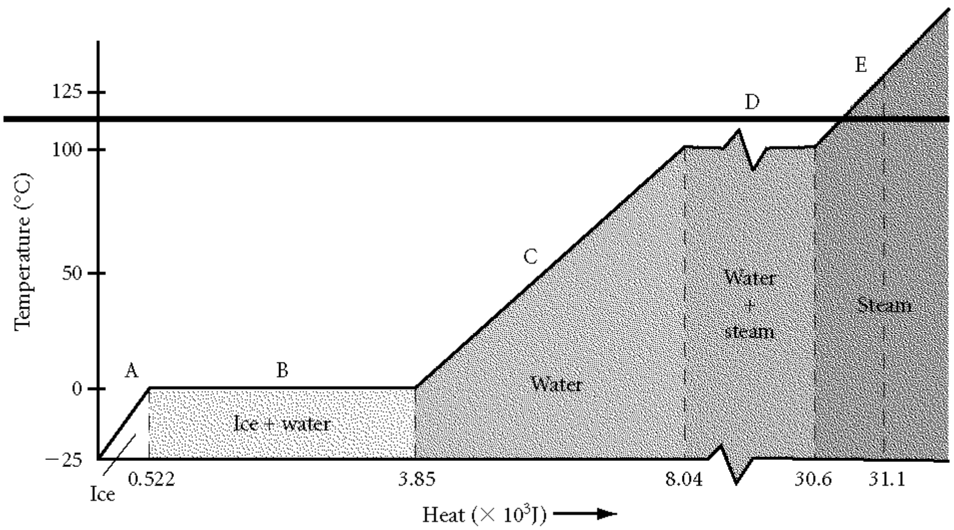
____ 55. Energy transferred as heat occurs between two bodies in thermal contact when they differ in which of the following properties?
a. mass
b. specific heat
c. density
d. temperature

____ 56. Which of the following terms describes a transfer of energy?
a. heat
b. internal energy
c. temperature
d. kinetic energy

____ 57. To which of the following is high temperature related?
a. low particle kinetic energy
b. high particle kinetic energy
c. large volume
d. zero net energy transfer

____ 58. Energy transfer as heat between two objects depends on which of the following?
a. The difference in mass of the two objects.
b. The difference in volume of the two objects.
c. The difference in temperature of the two objects.
d. The difference in composition of the two objects.

____ 59. Which of the following is true during a phase change?
a. Temperature increases.
b. Temperature remains constant.
c. Temperature decreases.
d. There is no transfer of energy as heat.



____ 60. The figure above shows how the temperature of 10.0 g of ice changes as energy is added. Which of the following statements is correct?
a. The water absorbed energy continuously, but the temperature increased only when all of the water was in one phase.
b. The water absorbed energy sporadically, and the temperature increased only when all of the water was in one phase.
c. The water absorbed energy continuously, and the temperature increased continuously.
d. The water did not absorb energy.

____ 61. At what point on the figure above does the substance undergo a phase change?
a. A
b. B
c. C
d. E

____ 62. Using the figure above, determine which value equals the latent heat required to change the liquid water into steam.
a. 8.04×10^3 J
b. 22.6×10^3 J
c. 30.6×10^3 J
d. 31.1×10^3 J

____ 63. At what point on the figure above is the amount of energy transferred as heat approximately 4.19×10^3 J?
a. A
b. B
c. C
d. D

____ 64. What accounts for an increase in the temperature of a gas that is kept at constant volume?
a. Energy has been removed as heat from the gas.
b. Energy has been added as heat to the gas.
c. Energy has been removed as work done by the gas.
d. Energy has been added as work done on the gas.

____ 65. When an ideal gas does positive work on its surroundings, which of the gas's quantities increases?
a. temperature
b. volume
c. pressure
d. internal energy

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____ 66. An ideal gas system is maintained at a constant volume of 4 L. If the pressure is constant, how much work is done by the system?
a. 0 J
b. 5 J
c. 8 J
d. 30 J

____ 67. Air cools as it escapes from a diver's compressed air tank. What kind of process is this?
a. isovolumetric
b. isobaric
c. adiabatic
d. isothermal

____ 68. What thermodynamic process for an ideal gas system has an unchanging internal energy and a heat intake that corresponds to the value of the work done by the system?
a. isovolumetric
b. isobaric
c. adiabatic
d. isothermal

____ 69. Which thermodynamic process takes place when work is done on or by the system but no energy is transferred to or from the system as heat?
a. isovolumetric
b. isobaric
c. adiabatic
d. isothermal

____ 70. Which thermodynamic process takes place at a constant temperature so that the internal energy of a system remains unchanged?
a. isovolumetric
b. isobaric
c. adiabatic
d. isothermal

____ 71. Which thermodynamic process takes place at constant volume so that no work is done on or by the system?
a. isovolumetric
b. isobaric
c. adiabatic
d. isothermal

____ 72. In an isovolumetric process for an ideal gas, the system's change in the energy as heat is equivalent to a change in which of the following?
a. temperature
b. volume
c. pressure
d. internal energy

____ 73. During an isovolumetric process, which of the following does not change?
a. temperature
b. volume
c. pressure
d. internal energy

____ 74. According to the first law of thermodynamics, the difference between energy transferred to or from a system as heat and energy transferred to or from a system by work is equivalent to which of the following?
a. entropy change
b. internal energy change
c. volume change
d. pressure change

____ 75. How is conservation of internal energy expressed for a system during an adiabatic process?
a. $Q = W = 0$, so $\Delta U = 0$ and $U_i = U_f$
b. $Q = 0$, so $\Delta U = -W$
c. $\Delta T = 0$, so $\Delta U = 0$; therefore, $\Delta U = Q - W = 0$, or $Q = W$
d. $\Delta V = 0$, so $P\Delta V = 0$ and $W = 0$; therefore, $\Delta U = Q$

____ 76. How is conservation of internal energy expressed for a system during an isovolumetric process?
a. $Q = W = 0$, so $\Delta U = 0$ and $U_i = U_f$
b. $Q = 0$, so $\Delta U = -W$
c. $\Delta T = 0$, so $\Delta U = 0$; therefore, $\Delta U = Q - W = 0$, or $Q = W$
d. $\Delta V = 0$, so $P\Delta V = 0$ and $W = 0$; therefore, $\Delta U = Q$

____ 77. How is conservation of internal energy expressed for a system during an isothermal process?
a. $Q = W = 0$, so $\Delta U = 0$ and $U_i = U_f$
b. $Q = 0$, so $\Delta U = -W$
c. $\Delta T = 0$, so $\Delta U = 0$; therefore, $\Delta U = Q - W = 0$, or $Q = W$
d. $\Delta V = 0$, so $P\Delta V = 0$ and $W = 0$; therefore, $\Delta U = Q$

____ 78. How is conservation of internal energy expressed for an isolated system?
a. $Q = W = 0$, so $\Delta U = 0$ and $U_i = U_f$
b. $Q = 0$, so $\Delta U = -W$
c. $\Delta T = 0$, so $\Delta U = 0$; therefore, $\Delta U = Q - W = 0$, or $Q = W$
d. $\Delta V = 0$, so $P\Delta V = 0$ and $W = 0$; therefore, $\Delta U = Q$

____ 79. An ideal gas system undergoes an adiabatic process in which it expands and does 20 J of work on its environment. How much energy is transferred to the system as heat?
a. –20 J
b. 0 J
c. 5 J
d. 20 J

____ 80. An ideal gas system undergoes an isovolumetric process in which 20 J of energy is added as heat to the gas. What is the change in the system's internal energy?
a. –20 J
b. 0 J
c. 5 J
d. 20 J

Problem

81. How much work is done on a bookshelf being pulled 5.00 m at an angle of 37.0° from the horizontal? The magnitude of the component of the force that does the work is 43.0 N.

82. A worker pushes a box with a horizontal force of 50.0 N over a level distance of 5.0 m. If a frictional force of 43 N acts on the box in a direction opposite to that of the worker, what net work is done on the box?

83. A 15.0 kg crate, initially at rest, slides down a ramp 2.0 m long and inclined at an angle of 20.0° with the horizontal. Using the work-kinetic energy theorem and disregarding friction, find the velocity of the crate at the bottom of the ramp. ($g = 9.81\ \text{m/s}^2$)

84. A skier with a mass of 88 kg hits a ramp of snow at 16 m/s and becomes airborne. At the highest point of flight, the skier is 3.7 m above the ground. What is the skier's gravitational potential energy at this point?

85. An 80.0 kg climber climbs to the top of Mount Everest, which has a peak height of 8848 m above sea level. What is the climber's potential energy with respect to sea level?

86. A scale contains a spring with a spring constant of 275 N/m. Placing a mass on the scale causes the spring to be compressed by 3.25 cm. Calculate the elastic potential energy stored in the spring.

87. A pole vaulter clears 6.00 m. With what velocity does the vaulter strike the mat in the landing area? (Assume no air resistance and that $g = 9.81\ \text{m/s}^2$.)

88. What velocity must a 1340 kg car have in order to have the same momentum as a 2680 kg truck traveling at a velocity of 15 m/s to the west?

89. A 6.0×10^{-2} kg tennis ball moves at a speed of 12 m/s. The ball is struck by a racket, causing it to rebound in the opposite direction at a speed of 18 m/s. What is the change in the ball's momentum?

90. A rubber ball with a mass of 0.30 kg is dropped onto a steel plate. The ball's speed just before impact is 4.5 m/s and just after impact is 4.2 m/s. What is the change in the ball's momentum?

91. A pool cue strikes a 0.16 kg billiard ball with a force of 15 N. The cue remains in contact with the ball for 0.085 s. The ball was initially at rest. What is the final speed of the ball?

A 68.0 kg diver jumps off a diving platform, rises about 1 m above the platform, then falls to the pool.

92. The diver strikes the water at a speed of 14.7 m/s, then slows to a stop underwater in 0.35 s. What force does the water exert on the diver?

93. An astronaut with a mass of 85 kg is outside a space capsule when the tether line breaks. To return to the capsule, the astronaut throws a 2.0 kg wrench away from the capsule at a speed of 14 m/s. At what speed does the astronaut move toward the capsule?

94. A swimmer with a mass of 75 kg dives off a raft with a mass of 500 kg. If the swimmer's speed is 4 m/s immediately after leaving the raft, what is the speed of the raft?

A 35 kg child moves with uniform circular motion while riding a horse on a carousel. The horse is 3.2 m from the carousel's axis of rotation and has a tangential speed of 2.6 m/s.

95. What is the child's centripetal acceleration?

96. What is the centripetal force on the child?

97. A 61.5 kg student sits at a desk 1.25 m away from a 70.0 kg student. What is the magnitude of the gravitational force between the two students? ($G = 6.673 \times 10^{-11}\ \text{N}\bullet\text{m}^2/\text{kg}^2$)

98. A planet has twice the mass of Earth. How much larger would the radius of the planet have to be for the gravitational field strength, *g*, at the planet's surface to be the same as on Earth's surface?

Cp physics - Fall final review (part II)
Answer Section

MULTIPLE CHOICE

1. B
2. A
3. B
4. B
5. C
6. B
7. A
8. B
9. C
10. C
11. D
12. A
13. C
14. D
15. C
16. D
17. D
18. D
19. D
20. B
21. C
22. D
23. D
24. C
25. A
26. C
27. C
28. C
29. A
30. B
31. B
32. D
33. C
34. B
35. C
36. B
37. A
38. A

39. C
40. D
41. B
42. C
43. B
44. C
45. B
46. D
47. D
48. C
49. A
50. D
51. B
52. A
53. A
54. C
55. D
56. A
57. B
58. C
59. B
60. A
61. B
62. B
63. C
64. B
65. B
66. A
67. C
68. D
69. C
70. D
71. A
72. D
73. B
74. B
75. B
76. D
77. C
78. A
79. B
80. D

PROBLEM

81. 215 J

Given
$F = 43.0\ \text{N}$

$d = 5.00\ \text{m}$

Solution
$W = Fd = (43.0\ \text{N})(5.00\ \text{m}) = 215\ \text{J}$

82. 35 J

Given
$F_w = 50.0\ \text{N}$

$F_k = -43\ \text{N}$

$d = 5.0\ \text{m}$

Solution
$W_{net} = F_{net}d = \left(F_w + F_k\right)d = \left[\,(50.0\ \text{N}) + (-43\ \text{N})\,\right](5.0\ \text{m}) = 35\ \text{J}$

83. 3.7 m/s

Given
$v_i = 0 \text{ m/s}$

$m = 15.0 \text{ kg}$

$d = 2.0 \text{ m}$

$\theta = 20.0°$

$g = 9.81 \text{ m/s}^2$

Solution
$W_{net} = \Delta KE$

$W_{net} = F_{net}d = \left(F_g \sin\theta\right)d = mgd\sin\theta$

$\Delta KE = KE_f - KE_i = \frac{1}{2}mv_f^{\,2} - 0 = \frac{1}{2}mv_f^{\,2}$

$mgd\sin\theta = \frac{1}{2}mv_f^{\,2}$

$v_f = \sqrt{2gd\sin\theta}$

$v_f = \sqrt{(2)\left(9.81 \text{ m/s}^2\right)(2.0 \text{ m})(\sin 20.0°)} = 3.7 \text{ m/s}$

84. 3.2×10^3 J

Given
$m = 88 \text{ kg}$

$h = 3.7 \text{ m}$

$g = 9.81 \text{ m/s}^2$

Solution
$PE = mgh = \left(88 \text{ kg}\right)\left(9.81 \text{ m/s}^2\right)(3.7 \text{ m}) = 3.2 \times 10^3 \text{ J}$

85. 6.94×10^6 J

Given
$m = 80.0\,\text{kg}$

$h = 8848\,\text{m}$

$g = 9.81\,\text{m/s}^2$

Solution
$PE = mgh = \left(80.0\,\text{kg}\right)\left(9.81\,\text{m/s}^2\right)(8848\,\text{m}) = 6.94 \times 10^6\,\text{J}$

86. 0.145 J

Given
$k = 275\,\text{N/m}$

$x = 3.25\,\text{cm} = 3.25 \times 10^{-2}\,\text{m}$

Solution
$PE = \frac{1}{2}kx^2 = \frac{1}{2}(275\,\text{N/m})\left(3.25 \times 10^{-2}\,\text{m}\right)^2 = 0.145\,\text{J}$

87. 10.8 m/s

Given
$h = 6.00\,\text{m}$

$g = 9.81\,\text{m/s}^2$

Solution
$KE_f = PE_{g,i}$

$\frac{1}{2}mv_f{}^2 = mgh$

$v_f = \sqrt{2gh} = \sqrt{(2)\left(9.81\,\text{m/s}^2\right)(6.00\,\text{m})} = 10.8\,\text{m/s}$

88. 30 m/s to the west

Given
$m_1 = 2680\ \text{kg}$
$\mathbf{v_1} = 15\ \text{m/s to the west}$
$m_2 = 1340\ \text{kg}$

Solution
$m_1\mathbf{v_1} = m_2\mathbf{v_2}$

$$\mathbf{v_2} = \frac{m_1\mathbf{v_1}}{m_2} = \frac{\left(2.68\times 10^{3}\ \text{kg}\right)(15\ \text{m/s west})}{\left(1.34\times 10^{3}\ \text{kg}\right)} = 3.0\times 10^{1}\ \text{m/s west}$$

89. –1.8 kg•m/s

Given
$m = 6.0\times 10^{-2}\ \text{kg}$

$v_i = 12\ \text{m/s}$

$v_f = -18\ \text{m/s}$

Solution
$$\Delta p = m\left(v_f - v_i\right) = \left(6.0\times 10^{-2}\ \text{kg}\right)(-18\ \text{m/s} - 12\ \text{m/s}) = -1.8\ \text{kgm/s}$$

90. 2.6 kg•m/s

Given
$m = 0.30\ \text{kg}$

$v_i = -4.5\ \text{m/s}$

$v_f = 4.2\ \text{m/s}$

Solution
$$\Delta p = m\left(v_f - v_i\right) = \left(0.30\ \text{kg}\right)\left[4.2\ \text{m/s} - (-4.5\ \text{m/s})\right] = 2.6\ \text{kgm/s}$$

91. 8.0 m/s

Given
$m = 0.16\text{ kg}$

$F = 15\text{ N}$

$\Delta t = 0.085\text{ s}$

$v_i = 0\text{ m/s}$

Solution
$F\Delta t = \Delta p = mv_f - mv_i$

$$v_f = \frac{F\Delta t + mv_i}{m} = \frac{(15\text{ N})(0.085\text{ s}) - \left(0.16\text{ kg}\right)(0\text{ m/s})}{0.16\text{ kg}} = 8.0\text{ m/s}$$

92. 2.9×10^3 N upward

Given
$m = 68.0\text{ kg}$

$\mathbf{v_i} = 14.7\text{ m/s downward}; v_i = -14.7\text{ m/s}$

$\mathbf{v_f} = 0\text{ m/s}$

$\Delta t = 0.35\text{ s}$

Solution

$$F = \frac{\Delta p}{\Delta t} = \frac{m\left(v_f - v_i\right)}{\Delta t} = \frac{\left(68.0\text{ kg}\right)\left[(0\text{ m/s}) - (-14.7\text{ m/s})\right]}{0.35\text{ s}} = 2.9 \times 10^3\text{ N}$$

$\mathbf{F} = 2.9 \times 10^3\text{ N upward}$

93. 0.33 m/s

Given

$m_1 = 85\,\text{kg}$

$m_2 = 2.0\,\text{kg}$

$v_{1,i} = v_{2,i} = 0\,\text{m/s}$

$v_{2,f} = -14\,\text{m/s}$

Solution

$m_1\mathbf{v}_{\mathbf{1,i}} + m_2\mathbf{v}_{\mathbf{2,i}} = m_1\mathbf{v}_{\mathbf{1,f}} + m_2\mathbf{v}_{\mathbf{2,f}} = 0$

$m_1\mathbf{v}_{\mathbf{1,f}} = -m_2\mathbf{v}_{\mathbf{2,f}}$

$$v_{1,f} = -\frac{m_2 v_{2,f}}{m_1} = -\frac{(2.0\,\text{kg})(-14\,\text{m/s})}{85\,\text{kg}} = 0.33\,\text{m/s}$$

94. 0.6 m/s

Given

$m_1 = 75\,\text{kg}$

$m_2 = 500\,\text{kg}$

$v_{1,i} = v_{2,i} = 0\,\text{m/s}$

$v_{1,f} = -4\,\text{m/s}$

Solution

$m_1\mathbf{v}_{\mathbf{1,i}} + m_2\mathbf{v}_{\mathbf{2,i}} = m_1\mathbf{v}_{\mathbf{1,f}} + m_2\mathbf{v}_{\mathbf{2,f}} = 0$

$m_2\mathbf{v}_{\mathbf{2,f}} = -m_1\mathbf{v}_{\mathbf{1,f}}$

$$v_{2,f} = -\frac{m_1 v_{1,f}}{m_2} = -\frac{(75\,\text{kg})(-4\,\text{m/s})}{500\,\text{kg}} = 0.6\,\text{m/s}$$

95. 2.1 m/s^2

Given

$v_t = 2.6\,\text{m/s}$

$r = 3.2\,\text{m}$

Solution

$$a_c = \frac{v_t^{\,2}}{r} = \frac{(2.6\,\text{m/s})^2}{3.2\,\text{m}} = 2.1\,\text{m/s}^2$$

96. 74 N

Given
$m = 35\,\text{kg}$

$v_t = 2.6\,\text{m/s}$

$r = 3.2\,\text{m}$

Solution
$$F_c = \frac{m{v_t}^2}{r} = \frac{\left(35\,\text{kg}\right)(2.6\,\text{m/s})^2}{3.2\,\text{m}} = 74\,\text{N}$$

97. 1.84×10^{-7} N

Given
$m_1 = 61.5\,\text{kg}$

$m_2 = 70.0\,\text{kg}$

$r = 1.25\,\text{m}$

$G = 6.673 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$

Solution
$$F_g = G\frac{m_1 m_2}{r^2} = \left(6.673 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2\right)\frac{\left(61.5\,\text{kg}\right)\left(70.0\,\text{kg}\right)}{(1.25\,\text{m})^2} = 1.84 \times 10^{-7}\ \text{N}$$

98. The planet's radius would have to be larger by a factor of $\sqrt{2}$.

Given

$r_p = 2r_E$

$g_p = g_E$

Solution

$$g_p = G\frac{m_p}{r_p^{\ 2}}$$

$$g_E = G\frac{m_E}{r_E^{\ 2}}$$

$$g_p = g_E$$

$$G\frac{m_p}{r_p^{\ 2}} = G\frac{m_E}{r_E^{\ 2}}$$

$$m_p = 2m_E$$

$$G\frac{2m_E}{r_p^{\ 2}} = G\frac{m_E}{r_E^{\ 2}}$$

$$\frac{2}{r_p^{\ 2}} = \frac{1}{r_E^{\ 2}}$$

$$r_p^{\ 2} = 2r_E^{\ 2}$$

$$r_p = \sqrt{2r_E^{\ 2}} = \sqrt{2}\,r_E$$