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

Cp physics fall final review part I

Multiple Choice

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

____ 1. Which of the following is the equation for average velocity?

a. $v_{avg} = \dfrac{\Delta x}{\Delta t}$

b. $v_{avg} = \dfrac{\Delta t}{\Delta x}$

c. $v_{avg} = \Delta x \Delta t$

d. $v_{avg} = \dfrac{v_i - v_f}{2}$

____ 2. Which of the following situations represents a negative displacement? (Assume positive position is measured vertically upward along a *y*-axis.)

a. A cat stands on a tree limb.

b. A cat jumps from the ground onto a tree limb.

c. A cat jumps from a lower tree limb to a higher one.

d. A cat jumps from a tree limb to the ground.

____ 3. Which of the following units is the SI unit of velocity?

a. meter

b. meter•second

c. meter per second

d. second per meter

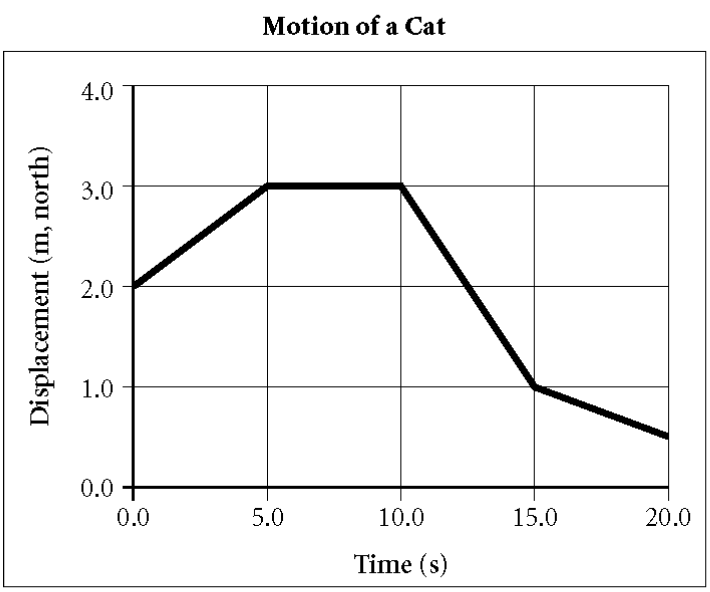
____ 4. Suppose you are given a position versus time graph. The slope of a line drawn tangent to a point on the curve of this graph describes what quantity?

a. acceleration

b. displacement

c. instantaneous velocity

d. position



____ 5. According to the graph above, during which interval is the cat at rest?

a. 0.0–5.0 s

b. 5.0–10.0 s

c. 10.0–15.0 s

d. 15.0–20.0 s

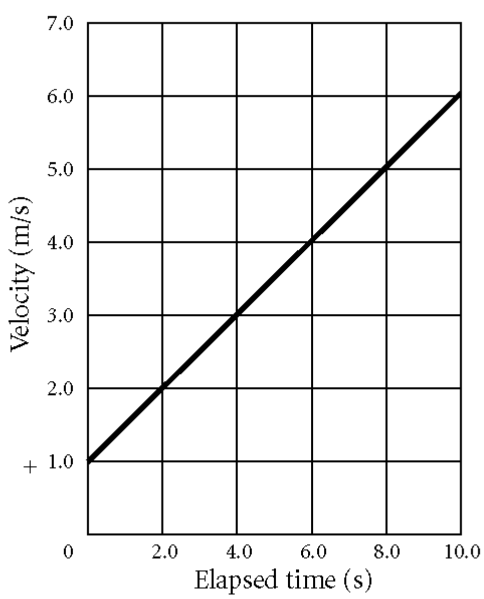
____ 6. According to the graph above, the cat has the fastest speed during which interval?
a. 0.0–5.0 s
b. 5.0–10.0 s
c. 10.0–15.0 s
d. 15.0–20.0 s

____ 7. According to the graph above, during which interval does the cat have the greatest positive velocity?
a. 0.0–5.0 s
b. 5.0–10.0 s
c. 10.0–15.0 s
d. 15.0–20.0 s

____ 8. Acceleration is defined as
a. a rate of displacement.
b. the rate of change of displacement.
c. the change in velocity.
d. the rate of change of velocity.

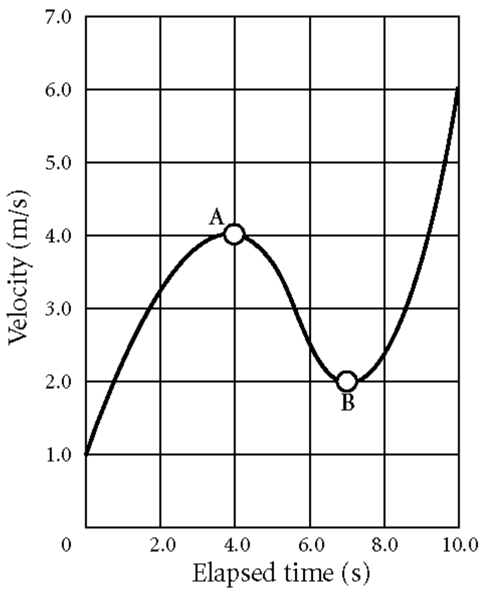
____ 9. Which of the following is the equation for acceleration?
a. $a = \frac{\Delta t}{\Delta v}$
b. $a = \frac{\Delta v}{\Delta t}$
c. $a = \Delta v \Delta t$
d. $\frac{v_i - v_f}{t_i - t_f}$

____ 10. When a car's velocity is positive and its acceleration is negative, what is happening to the car's motion?
a. The car slows down.
b. The car speeds up.
c. The car travels at constant speed.
d. The car remains at rest.



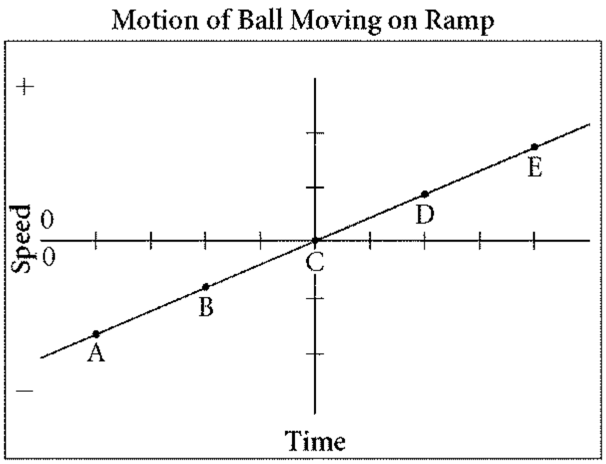
____ 11. The graph above describes the motion of a cyclist. The graph illustrates that the acceleration of the cyclist
a. is constant.
b. decreases.
c. increases.
d. is zero.

____ 12. The graph above describes the motion of a cyclist. During the interval shown, the cyclist is
a. slowing down.
b. speeding up.
c. traveling at the same speed.
d. at rest.



____ 13. What does the graph above illustrate about acceleration?
a. The acceleration varies.
b. The acceleration is zero.
c. The acceleration is constant.
d. The acceleration increases then becomes constant.

____ 14. In the graph above, how does the acceleration at A compare with the acceleration at B?
a. The acceleration at A is positive and less than the acceleration at B.
b. The acceleration at B is positive and less than the acceleration at A.
c. The accelerations at A and B are each zero.
d. The accelerations at A and B cannot be determined.



____ 15. The graph above describes the motion of a ball. At what point does the ball have an instantaneous velocity of zero?
a. A
b. B
c. C
d. D

____ 16. The graph above describes the motion of a ball. At what point is the speed of the ball equal to its speed at B?
a. A
b. C
c. D
d. none of the above

____ 17. The graph above describes the motion of a ball. At what point is the velocity of the ball equal to its velocity at B?
a. A
b. C
c. D
d. none of the above

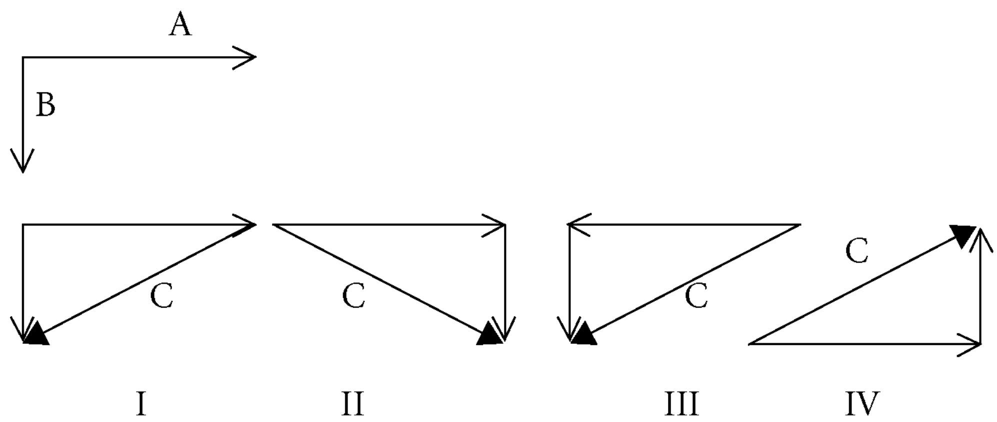
____ 18. Acceleration due to gravity is also called
a. negative velocity.
b. displacement.
c. free-fall acceleration.
d. instantaneous acceleration.

____ 19. Which would hit the ground first if dropped from the same height in a vacuum—a feather or a metal bolt?
a. the feather
b. the metal bolt
c. They would hit the ground at the same time.
d. They would be suspended in a vacuum.

____ 20. Which of the following is a physical quantity that has a magnitude but no direction?
a. vector
b. scalar
c. resultant
d. frame of reference

____ 21. Which of the following is a physical quantity that has both magnitude and direction?
a. vector
b. scalar
c. resultant
d. frame of reference

____ 22. Which of the following is an example of a vector quantity?
a. velocity
b. temperature
c. volume
d. mass

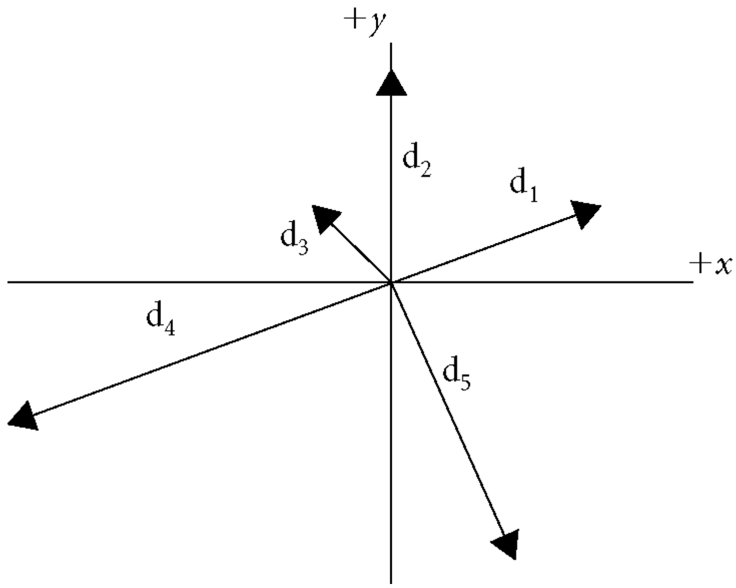


____ 23. In the figure above, which diagram represents the vector addition **C** = **A** + **B**?
a. I
b. II
c. III
d. IV

____ 24. In the figure above, which diagram represents the vector subtraction **C** = **A**–**B**?
a. I
b. II
c. III
d. IV

____ 25. For the winter, a duck flies 10.0 m/s due south against a gust of wind with a speed of 2.5 m/s. What is the resultant velocity of the duck?
a. 12.5 m/s south
b. –12.5 m/s south
c. 7.5 m/s south
d. –7.5 m/s south

____ 26. An ant on a picnic table travels 3.0×10^{1} cm eastward, then 25 cm northward, and finally 15 cm westward. What is the magnitude of the ant's displacement relative to its original position?
a. 70 cm
b. 57 cm
c. 52 cm
d. 29 cm



____ 27. How many displacement vectors shown in the figure above have horizontal components?
a. 2
b. 3
c. 4
d. 5

____ 28. How many displacement vectors shown in the figure above have components that lie along the *y*-axis and are pointed in the –*y* direction?
a. 0
b. 2
c. 3
d. 5

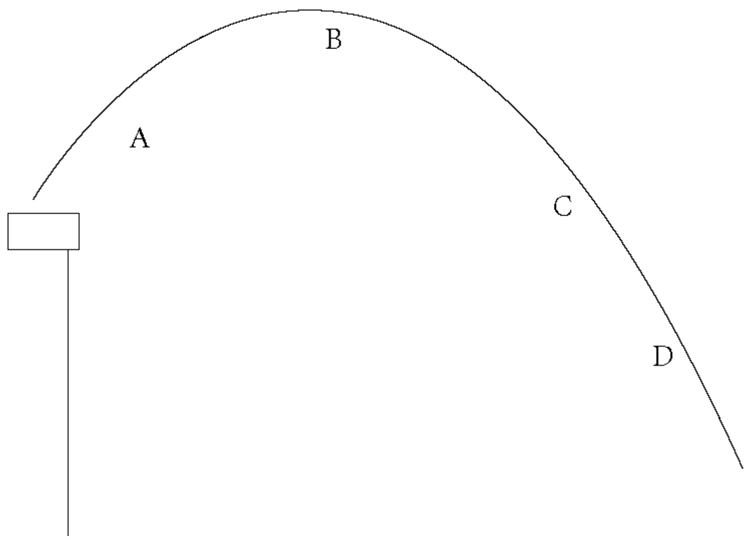
____ 29. Which displacement vectors shown in the figure above have vertical components that are equal?
a. $\mathbf{d}_1$ and $\mathbf{d}_2$
b. $\mathbf{d}_1$ and $\mathbf{d}_3$
c. $\mathbf{d}_2$ and $\mathbf{d}_5$
d. $\mathbf{d}_4$ and $\mathbf{d}_5$

____ 30. Which of the following is the motion of objects moving in two dimensions under the influence of gravity?
a. horizontal velocity
b. directrix
c. vertical velocity
d. projectile motion

____ 31. Which of the following is an example of projectile motion?
a. a jet lifting off a runway
b. a thrown baseball
c. an aluminum can dropped straight down into the recycling bin
d. a space shuttle being launched

____ 32. Which of the following is *not* an example of projectile motion?
a. a volleyball served over a net
b. a baseball hit by a bat
c. a hot-air balloon drifting toward Earth
d. a long jumper in action

____ 33. What is the path of a projectile (in the absence of friction)?
a. a wavy line
b. a parabola
c. a hyperbola
d. Projectiles do not follow a predictable path.



The figure above shows the path of a ball tossed from a building. Air resistance is ignored.

____ 34. At what point of the ball's path shown in the figure above is the vertical component of the ball's velocity zero?
a. A
b. B
c. C
d. D

____ 35. In the figure above, the magnitude of the ball's velocity is least at location
a. A.
b. B.
c. C.
d. D.

____ 36. In the figure above, the magnitude of the ball's velocity is greatest at location
a. A.
b. B.
c. C.
d. D.

____ 37. In the figure above, the horizontal component of the ball's velocity at A is
a. zero.
b. equal to the vertical component of the ball's velocity at C.
c. equal in magnitude but opposite in direction to the horizontal component of the ball's velocity at D.
d. equal to the horizontal component of its initial velocity.

____ 38. In the figure above, at which point is the ball's speed about equal to the speed at which it was tossed?
a. A
b. B
c. C
d. D

____ 39. A track star in the long jump goes into the jump at 12 m/s and launches herself at 20.0° above the horizontal. What is the magnitude of her horizontal displacement? (Assume no air resistance and that $a_y = -g = -9.81 \text{ m/s}^2$.)
a. 4.6 m
b. 9.2 m
c. 13 m
d. 15 m

____ 40. A piece of chalk is dropped by a teacher walking at a speed of 1.5 m/s. From the teacher's perspective, the chalk appears to fall

a. straight down.
b. straight down and backward.
c. straight down and forward.
d. straight backward.

____ 41. Which of the following is the cause of an acceleration?

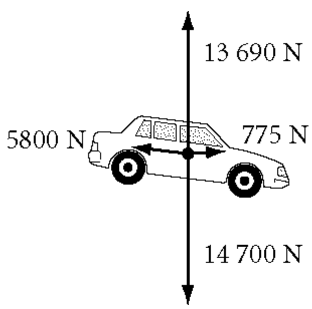
a. speed
b. inertia
c. force
d. velocity

____ 42. What causes a moving object to change direction?

a. acceleration
b. velocity
c. inertia
d. force

____ 43. A newton is equivalent to which of the following quantities?

a. kg
b. kg•m/s
c. $kg \bullet m/s^2$
d. $kg \bullet (m/s)^2$

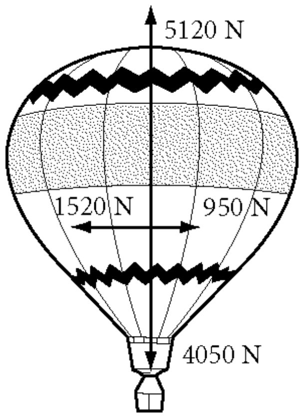


____ 44. The free-body diagram shown above represents a car being pulled by a towing cable. In the diagram, which of the following is the gravitational force acting on the car?

a. 5800 N
b. 775 N
c. 14 700 N
d. 13 690 N

____ 45. The free-body diagram shown above represents a car being pulled by a towing cable. In the diagram, the 5800 N force is

a. the gravitational force acting on the car.
b. the backward force the road exerts on the car.
c. the upward force the road exerts on the car.
d. the force exerted by the towing cable on the car.



____ 46. In the free-body diagram shown above, which of the following is the gravitational force acting on the balloon?
a. 1520 N
b. 950 N
c. 4050 N
d. 5120 N

____ 47. Which of the following is the tendency of an object to maintain its state of motion?
a. acceleration
b. inertia
c. force
d. velocity

____ 48. A waitperson carrying a tray with a platter on it tips the tray at an angle of 12° below the horizontal. If the gravitational force on the platter is 5.0 N, what is the magnitude of the force parallel to the tray that tends to cause the platter to slide down the tray? (Disregard friction.)
a. 0.42 N
b. 1.0 N
c. 4.9 N
d. 5.0 N

____ 49. As an object falls toward Earth,
a. the object does not exert a force on Earth.
b. the object exerts a downward force on Earth.
c. Newton's third law does not apply.
d. the upward acceleration of Earth is negligible because of its large mass.

____ 50. If a nonzero net force is acting on an object, then the object is definitely
a. at rest.
b. moving with a constant velocity.
c. being accelerated.
d. losing mass.

____ 51. According to Newton's second law, when the same force is applied to two objects of different masses,
a. the object with greater mass will experience a great acceleration, and the object with less mass will experience an even greater acceleration.
b. the object with greater mass will experience a smaller acceleration, and the object with less mass will experience a greater acceleration.
c. the object with greater mass will experience a greater acceleration, and the object with less mass will experience a smaller acceleration.
d. the object with greater mass will experience a small acceleration, and the object with less mass will experience an even smaller acceleration.

____ 52. A net force of 6.8 N accelerates a 31 kg scooter across a level parking lot. What is the magnitude of the scooter's acceleration?

a. $0.22\ m/s^2$ c. $3.2\ m/s^2$
b. $0.69\ m/s^2$ d. $4.6\ m/s^2$

____ 53. A sled traveling at a speed of 3.0 m/s slows to a stop 4.0 m from the point where its passenger rolled off. What is the magnitude of the horizontal net force that slows the 110 N sled? (Assume $a_g = 9.81\ m/s^2$.)

a. 130 N c. 37 N
b. 34 N d. 13 N

____ 54. Two perpendicular forces, one of 45.0 N directed upward and the other of 60.0 N directed to the right, act simultaneously on an object with a mass of 35.0 kg. What is the magnitude of the resultant acceleration of the object?

a. $2.14\ m/s^2$ c. $5.25\ m/s^2$
b. $3.00\ m/s^2$ d. $1.41\ m/s^2$

____ 55. The statement by Newton that for every action there is an equal but opposite reaction is which of his laws of motion?

a. first c. third
b. second d. fourth

____ 56. A hammer drives a nail into a piece of wood. Identify an action-reaction pair in this situation.

a. The nail exerts a force on the hammer; the hammer exerts a force on the wood.
b. The hammer exerts a force on the nail; the wood exerts a force on the nail.
c. The hammer exerts a force on the nail; the nail exerts a force on the hammer.
d. The hammer exerts a force on the nail; the hammer exerts a force on the wood.

____ 57. A ball is dropped from a person's hand and falls to Earth. Identify an action-reaction pair in this situation.

a. The hand exerts a force on the ball; Earth exerts a force on the hand.
b. Earth exerts a force on the ball; the hand exerts a force on Earth.
c. Earth exerts a force on the hand; the hand exerts a force on the ball.
d. Earth exerts a force on the ball; the ball exerts a force on Earth.

____ 58. The magnitude of the gravitational force acting on an object is

a. frictional force. c. inertia.
b. weight. d. mass.

____ 59. A measure of the quantity of matter is

a. density. c. force.
b. weight. d. mass.

____ 60. A change in the gravitational force acting on an object will affect the object's

a. mass. c. weight.
b. coefficient of static friction. d. inertia.

____ 61. A book with a mass of 2.0 kg is held in equilibrium on a board with a slope of 60.0° by a horizontal force. What is the normal force exerted on the book?

a. 39 N c. 15 N
b. 61 N d. 34 N

____ 62. There are six books in a stack, and each book weighs 5 N. The coefficient of static friction between the books is 0.2. With what horizontal force must one push to start sliding the top five books off the bottom one?

a. 1 N
b. 5 N
c. 3 N
d. 7 N

____ 63. An ice skater moving at 10.0 m/s coasts to a halt in 1.0×10^2 m on a smooth ice surface. What is the coefficient of friction between the ice and the skates?

a. 0.025
b. 0.051
c. 0.102
d. 0.205

Problem

64. A horse trots past a fencepost located 12 m to the left of a gatepost. It then passes another fencepost located 24 m to the right of the gatepost 11 s later. What is the average velocity of the horse?

65. A shopping cart is given an initial velocity of 2.0 m/s and undergoes a constant acceleration of 3.0 m/s^2. What is the magnitude of the cart's displacement after the first 4.0 s of its motion?

66. A skater glides off a frozen pond onto a patch of ground at a speed of 1.8 m/s. Here she is slowed at a constant rate of 3.00 m/s^2. How fast is the skater moving when she has slid 0.37 m across the ground?

67. A sports car traveling at 27.8 m/s slows at a constant rate to a stop in 8.00 s. What is the displacement of the sports car in this time interval?

68. A toy car is given an initial velocity of 5.0 m/s and experiences a constant acceleration of 2.0 m/s^2. What is the final velocity after 6.0 s?

69. A rock is thrown downward from the top of a cliff with an initial speed of 12 m/s. If the rock hits the ground after 2.0 s, what is the height of the cliff? (Disregard air resistance. $a = -g = -9.81$ m/s^2.)

70. A rock is thrown straight upward with an initial velocity of 24.5 m/s where the acceleration due to gravity has a magnitude of 9.81 m/s^2. What is the rock's displacement after 1.00 s?

71. A jogger runs 10.0 blocks due east, 5.0 blocks due south, and another 2.0 blocks due east. Assume all blocks are of equal size. Use the graphical method to find the magnitude of the jogger's net displacement.

72. While following directions on a treasure map, a person walks 45.0 m south, then turns and walks 7.50 m east. Which single straight-line displacement could the person have walked to reach the same spot?

73. An athlete runs 110 m across a level field at an angle of 30.0° north of east. What is the north component of this displacement?

74. A skateboarder rolls 25.0 m down a hill that descends at an angle of 20.0° with the horizontal. Find the horizontal and vertical components of the skateboarder's displacement.

75. Two ice-hockey players simultaneously strike a puck with their sticks. The stick of one player exerts an eastward force on the puck of 12 N. The other player's stick exerts a northward force of 15 N on the puck. Assuming that there is no frictional force between the puck and the ice, what is the magnitude of the net horizontal force on the puck?

76. A sled is pulled at a constant velocity across a horizontal snow surface. If a force of 8.0×10^1 N is being applied to the sled rope at an angle of 53° to the ground, what is the magnitude of the force of friction of the snow acting on the sled?

77. A wagon having a mass of 32 kg is accelerated across a level road at 0.50 m/s^2. What net force acts on the wagon horizontally?

78. An elevator weighing 2.00×10^5 N is supported by a steel cable. What is the tension in the cable when the elevator is accelerated upward at a rate of 3.00 m/s^2? (g = 9.81 m/s^2)

79. A three-tiered birthday cake rests on a table. From bottom to top, the cake tiers weigh 16 N, 9 N, and 5 N, respectively. What is the magnitude and direction of the normal force acting on the second tier?

80. A stagehand starts sliding a large piece of stage scenery originally at rest by pulling it horizontally with a force of 176 N. What is the coefficient of static friction between the stage floor and the 490 N piece of scenery?

81. An Olympic skier moving at 20.0 m/s down a 30.0° slope encounters a region of wet snow and slides 145 m before coming to a halt. What is the coefficient of friction between the skis and the snow? (g = 9.81 m/s^2)

Cp physics fall final review part I
Answer Section

MULTIPLE CHOICE

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

39. B
40. A
41. C
42. D
43. C
44. C
45. D
46. C
47. B
48. B
49. D
50. C
51. B
52. A
53. D
54. A
55. C
56. C
57. D
58. B
59. D
60. C
61. A
62. B
63. B

PROBLEM

64. 3.3 m/s, to the right

Given
$x_i = -12$ m
$x_f = 24$ m
$\Delta t = 11$ s

Solution

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t} = \frac{(24\text{ m}) - (-12\text{ m})}{11\text{ s}} = 3.3\text{ m/s, to the right}$$

65. 32 m

Given
$v_i = 2.0$ m/s

$a = 3.0$ m/s^2
$\Delta t = 4.0$ s

Solution
$\Delta x = v_i \Delta t + \frac{1}{2} a(\Delta t)^2$

$\Delta x = (2.0\text{ m/s})(4.0\text{ s}) + \frac{1}{2}(3.0\text{ m/s}^2)(4.0\text{ s})^2 = 8.0\text{ m} + 24\text{ m}$

$\Delta x = 32\text{ m}$

66. 1.0 m/s

Given
$v_i = 1.8$ m/s

$a = -3.00$ m/s^2
$\Delta x = 0.37$ m

Solution
$v_f^{\,2} = v_i^{\,2} + 2a\Delta x$

$v_f = \sqrt{v_i^{\,2} + 2a\Delta x} = \sqrt{(1.8\text{ m/s})^2 + 2(-3.00\text{ m/s}^2)(0.37\text{ m})}$

$v_f = \sqrt{3.2\text{ m}^2/\text{s}^2 - 2.2\text{ m}^2/\text{s}^2} = \sqrt{1.0\text{ m}^2/\text{s}^2}$

$v_f = 1.0\text{ m/s}$

67. 111 m

Given
$v_i = 27.8$ m/s
$v_f = 0.0$ m/s
$\Delta t = 8.00$ s

Solution
$\Delta x = \frac{1}{2}(v_i + v_f)\Delta t = \frac{1}{2}(27.8\text{ m/s} + 0.0\text{ m/s})(8.00\text{ s}) = 111\text{ m}$

68. 17 m/s

Given
$v_i = 5.0$ m/s
$a = 2.0$ m/s^2
$\Delta t = 6.0$ s

Solution
$v_f = v_i + a\Delta t = 5.0 \text{ m/s} + (2.0 \text{ m/s}^2)(6.0 \text{ s}) = 17 \text{ m/s}$

69. 44 m

Given
$a = -g = -9.81$ m/s^2
$\Delta t = 2.0$ s
$v_i = -12$ m/s

Solution
$\Delta x = v_i \Delta t + \frac{1}{2} a(\Delta t)^2$

$\Delta x = (-12 \text{ m/s})(2.0 \text{ s}) + \frac{1}{2}(-9.81 \text{ m/s}^2)(2.0 \text{ s})^2 = -44 \text{ m}$

height of cliff = 44 m

70. 19.6 m

Given
$a = -g = -9.81$ m/s^2
$v_i = 24.5$ m/s
$\Delta t = 1.00$ s

Solution

$\Delta x = v_i \Delta t + \frac{1}{2} a(\Delta t)^2$

$\Delta x = (24.5 \text{ m/s})(1.00 \text{ s}) + \frac{1}{2}(-9.81 \text{ m/s}^2)(1.00 \text{ s})^2 = 19.6 \text{ m}$

71. 13.0 blocks

Solution
Students should use graphical techniques. Their answers can be checked using the techniques presented in Section 2.

$d = \sqrt{(12.0 \text{ blocks})^2 + (5.0 \text{ blocks})^2} = 13.0 \text{ blocks}$

72. 45.6 m at 80.5° south of east

Given
$\mathbf{d}_1$ = 45.0 m south
$\mathbf{d}_2$ = 7.50 m east

Solution
$\Delta x = d_2 = 7.50\text{ m}$

$\Delta y = d_1 = 45.0\text{ m}$

$d^2 = \Delta x^2 + \Delta y^2$

$d = \sqrt{\Delta x^2 + \Delta y^2} = \sqrt{(7.50\text{ m})^2 + (45.0\text{ m})^2} = 45.6\text{ m}$

$\theta = \tan^{-1}\left(\frac{\Delta y}{\Delta x}\right) = \tan^{-1}\left(\frac{45.0\text{ m}}{7.50\text{ m}}\right) = 80.5°$

$\mathbf{d}$ = 45.6 m at 80.5° south of east

73. 55 m

Given
$d = 110$ m $\theta = 30.0°$

Solution
$d_y = d\sin\theta = (110\text{ m})(\sin 30.0°) = 55\text{ m}$

74. $d_x = 23.5$ m; $d_y = -8.55$ m

Given
$d = 25.0$ m, $\theta = 20.0°$

Solution
$d_x = d\cos\theta = (25.0\text{ m})(\cos 20.0°) = 23.5\text{ m}$

$d_y = d\sin\theta = (25.0\text{ m})(\sin 20.0°) = 8.55\text{ m}$

75. 19 N

Given
$\mathbf{F_x}$ = 12 N, east
$\mathbf{F_y}$ = 15 N, north

Solution
$F_{net} = \sqrt{F_x^{\ 2} + F_y^{\ 2}} = \sqrt{(12\text{ N})^2 + (15\text{ N})^2} = 19\text{ N}$

76. 48 N

Given
$F = 8.0 \times 10^1$ N
$\theta = 53°$

Solution
$$\Sigma F_x = F_f - F_{applied,x} = 0$$

$$F_f = F_{applied,x} = F\cos\theta = (8.0 \times 10^1\ \text{N})(\cos 53°) = 48\ \text{N}$$

77. 16 N

Given
$m = 32$ kg
$a_x = 0.50$ m/s^2

Solution
$$\Sigma F_x = ma_x = (32\ \text{kg})(0.50\ \text{m/s}^2) = 16\ \text{N}$$

78. 2.61×10^5 N

Given
$F_g = 2.00 \times 10^5$ N
$g = 9.81$ m/s^2
$a = +3.00$ m/s^2

Solution
$$F_{net} = F_T - F_g = ma = \frac{F_g}{g}a$$

$$F_T = F_g + \frac{F_g}{g}a$$

$$F_T = 2.00 \times 10^5\ \text{N} + \frac{(2.00 \times 10^5\ \text{N})(3.00\ \text{m/s}^2)}{9.81\ \text{m/s}^2} = 2.61 \times 10^5\ \text{N}$$

79. 14 N, upward

Given
$F_{g,1} = 5\text{ N}$
$F_{g,2} = 9\text{ N}$
$F_{g,3} = 16\text{ N}$

Solution
$F_{net,y} = \Sigma F_y = F_n - F_{g,1} - F_{g,2} = 0$
$F_n = F_{g,1} + F_{g,2} = 5\text{ N} + 9\text{ N} = 14\text{ N}$
$\mathbf{F_n} = 14$ N, upward

80. 0.36

Given
$F_{applied} = 176\text{ N}$
$F_g = 490\text{ N}$

Solution
$\Sigma F_y = F_n - F_g = 0$

$F_n = F_g$

$F_{s,max} = F_{applied}$

$$\mu_k = \frac{F_{s,max}}{F_n} = \frac{F_{applied}}{F_g} = \frac{176\text{ N}}{490\text{ N}} = 0.36$$

81. 0.415

Given:
$v_{x,i}$ = 20.0 m/s
Δx = 145 m
θ = 30.0°
g = 9.81 m/s^2

Solution
Choose a coordinate system such that the positive x-direction is down the ski slope. The force of friction will be in the negative x-direction.
Because $\Sigma F_y = 0, F_n = F_{g,y} = mg\cos\theta$

$$F_f = \mu_k F_n = \mu_k mg\cos\theta$$

Because $v_{x,f} = 0, a_x = \left(\dfrac{(v_{x,i})^2}{2\Delta x}\right)$

$$F_{net,x} = ma_x = m\left(\frac{(v_{x,i})^2}{2\Delta x}\right)$$

$$F_{g,x} = F_g \sin\theta = mg\sin\theta$$

$$F_{net,x} = F_{g,x} - F_f$$

$$F_f = F_{g,x} - F_{net,x}$$

$$\mu_k mg\cos\theta = mg\sin\theta - m\left(\frac{(v_{x,i})^2}{2\Delta x}\right)$$

$$\mu_k = \frac{\sin\theta}{\cos\theta} - \frac{(v_{x,i})^2}{2g\Delta x\cos\theta}$$

$$\mu_k = \frac{\sin 30.0°}{\cos 30.0°} - \frac{(20.0\text{ m/s})^2}{2(9.81\text{ m/s}^2)(145\text{ m})(\cos 30.0°)}$$

$$\mu_k = 0.577 - 0.162 = 0.415$$