CHAPTER REVIEW

Concept Items

5.1 Vector Addition and Subtraction: Graphical Methods

1. There is a vector $\vec{A}$, with magnitude 5 units pointing towards west and vector $\vec{B}$, with magnitude 3 units, pointing towards south. Using vector addition, calculate the magnitude of the resultant vector.
   a. 4.0
   b. 5.8
   c. 6.3
   d. 8.0

2. If you draw two vectors using the head-to-tail method, how can you then draw the resultant vector?
   a. By joining the head of the first vector to the head of the last
   b. By joining the head of the first vector with the tail of the last
   c. By joining the tail of the first vector to the head of the last
   d. By joining the tail of the first vector with the tail of the last

3. What is the global angle of 20° south of west?
   a. 110°
   b. 160°
   c. 200°
   d. 290°

5.2 Vector Addition and Subtraction: Analytical Methods

4. What is the angle between the x and y components of a vector?
   a. 0°
   b. 45°
   c. 90°
   d. 180°

5. Two vectors are equal in magnitude and opposite in direction. What is the magnitude of their resultant vector?
   a. The magnitude of the resultant vector will be zero.
   b. The magnitude of resultant vector will be twice the magnitude of the original vector.
   c. The magnitude of resultant vector will be same as magnitude of the original vector.
   d. The magnitude of resultant vector will be half the magnitude of the original vector.

6. How can we express the x and y-components of a vector in terms of its magnitude, A, and direction, global angle θ?
   a. $A_x = A\cos\theta\, A_y = A\sin\theta$
   b. $A_x = A\cos\theta\, A_y = A\cos\theta$
   c. $A_x = A\sin\theta\, A_y = A\cos\theta$
   d. $A_x = A\sin\theta\, A_y = A\sin\theta$

7. True or False—Every 2-D vector can be expressed as the product of its x and y-components.
   a. True
   b. False

5.4 Inclined Planes

10. True or False—Kinetic friction is less than the limiting static friction because once an object is moving, there are fewer points of contact, and the friction is reduced. For this reason, more force is needed to start moving an object than to keep it in motion.

a. True
b. False

11. When there is no motion between objects, what is the relationship between the magnitude of the static friction f_s and the normal force N?

a. $f_s \leq N$
b. $f_s \leq \mu_s N$
c. $f_s \geq N$
d. $f_s \geq \mu_s N$

12. What equation gives the magnitude of kinetic friction?

a. $f_k = \mu_s N$
b. $f_k = \mu_k N$
c. $f_k \leq \mu_s N$
d. $f_k \leq \mu_k N$

Critical Thinking Items

5.1 Vector Addition and Subtraction: Graphical Methods

16. True or False—A person is following a set of directions. He has to walk 2 km east and then 1 km north. He takes a wrong turn and walks in the opposite direction for the second leg of the trip. The magnitude of his total displacement will be the same as it would have been had he followed directions correctly.

a. True
b. False

5.2 Vector Addition and Subtraction: Analytical Methods

17. What is the magnitude of a vector whose x-component is 2 units and whose angle is $60°$?

a. 1.0 units
b. 2.0 units
c. 2.3 units
d. 4.0 units

18. Vectors $\vec{A}$ and $\vec{B}$ are equal in magnitude and opposite in direction. Does $\vec{A} - \vec{B}$ have the same direction as vector $\vec{A}$ or $\vec{B}$?

a. $\vec{A}$
b. $\vec{B}$

5.4 Inclined Planes

21. A box weighing 500 N is at rest on the floor. A person pushes against it and it starts moving when 100 N force is applied to it. What can be said about the coefficient of kinetic friction between the box and the floor?

a. $\mu_k = 0$
b. $\mu_k = 0.2$
c. $\mu_k < 0.2$
d. $\mu_k > 0.2$

22. The component of the weight parallel to an inclined plane of an object resting on an incline that makes an angle of $70.0°$ with the horizontal is 100.0 N. What is the object's mass?

a. 10.9 kg
b. 29.8 kg
c. 106 kg
d. 292 kg

Problems

5.1 Vector Addition and Subtraction: Graphical Methods

25. A person attempts to cross a river in a straight line by navigating a boat at $15\ \text{m/s}$. If the river flows at $5.0\ \text{m/s}$ from his left to right, what would be the magnitude of the boat's resultant velocity? In what direction would the boat go, relative to the straight line across it?

a. The resultant velocity of the boat will be $10.0\ \text{m/s}$. The boat will go toward his right at an angle of 26.6° to a line drawn across the river.
b. The resultant velocity of the boat will be $10.0\ \text{m/s}$. The boat will go toward his left at an angle of 26.6° to a line drawn across the river.
c. The resultant velocity of the boat will be $15.8\ \text{m/s}$. The boat will go toward his right at an angle of 18.4° to a line drawn across the river.
d. The resultant velocity of the boat will be $15.8\ \text{m/s}$. The boat will go toward his left at an angle of 18.4° to a line drawn across the river.

26. A river flows in a direction from south west to north east at a velocity of $7.1\ \text{m/s}$. A boat captain wants to cross this river to reach a point on the opposite shore due east of the boat's current position. The boat moves at $13\ \text{m/s}$. Which direction should it head towards if the resultant velocity is $19.74\ \text{m/s}$?

a. It should head in a direction 22.6° east of south.
b. It should head in a direction 22.6° south of east.
c. It should head in a direction 45.0° east of south.
d. It should head in a direction 45.0° south of east.

5.2 Vector Addition and Subtraction: Analytical Methods

27. A person walks 10.0 m north and then 2.00 m east. Solving analytically, what is the resultant displacement of the person?

a. $\vec{R} = 10.2$ m, $\theta = 78.7°$ east of north
b. $\vec{R} = 10.2$ m, $\theta = 78.7°$ north of east
c. $\vec{R} = 12.0$ m, $\theta = 78.7°$ east of north
d. $\vec{R} = 12.0$ m, $\theta = 78.7°$ north of east

28. A person walks 12.0° north of west for $55.0\ \text{m}$ and 63.0° south of west for $25.0\ \text{m}$. What is the magnitude of his displacement? Solve analytically.

a. $10.84\ \text{m}$
b. $65.1\ \text{m}$
c. $66.04\ \text{m}$
d. $80.00\ \text{m}$

5.4 Inclined Planes

31. A coin is sliding down an inclined plane at constant velocity. If the angle of the plane is 10° to the horizontal, what is the coefficient of kinetic friction?

a. $\mu_k = 0$
b. $\mu_k = 0.18$
c. $\mu_k = 5.88$
d. $\mu_k = \infty$

32. A skier with a mass of 55 kg is skiing down a snowy slope that has an incline of 30°. Find the coefficient of kinetic friction for the skier if friction is known to be 25 N .

a. $\mu k = 0$
b. $\mu k = 0.05$
c. $\mu k = 0.09$
d. $\mu k = \infty$

TEST PREP

Multiple Choice

5.1 Vector Addition and Subtraction: Graphical Methods

36. True or False—We can use Pythagorean theorem to calculate the length of the resultant vector obtained from the addition of two vectors which are at right angles to each other.

a. True
b. False

37. True or False—The direction of the resultant vector depends on both the magnitude and direction of added vectors.

a. True
b. False

38. A plane flies north at $200\ \text{m/s}$ with a headwind blowing from the north at $70\ \text{m/s}$. What is the resultant velocity of the plane?

a. $130\ \text{m/s}$ north
b. $130\ \text{m/s}$ south
c. $270\ \text{m/s}$ north
d. $270\ \text{m/s}$ south

39. Two hikers take different routes to reach the same spot. The first one goes $255\ \text{m}$ southeast, then turns and goes $82\ \text{m}$ at 14° south of east. The second hiker goes $200\ \text{m}$ south. How far and in which direction must the second hiker travel now, in order to reach the first hiker's location destination?

a. $200\ \text{m}$ east
b. $200\ \text{m}$ south
c. $260\ \text{m}$ east
d. $260\ \text{m}$ south

5.2 Vector Addition and Subtraction: Analytical Methods

40. When will the x-component of a vector with angle θ be greater than its y-component?

a. $0^\circ < \theta < 45^\circ$
b. $\theta = 45^\circ$
c. $45^\circ < \theta < 60^\circ$
d. $60^\circ < \theta < 90^\circ$

41. The resultant vector of the addition of vectors $\vec{a}$ and $\vec{b}$ is $\vec{r}$. The magnitudes of $\vec{a}$, $\vec{b}$, and $\vec{r}$ are A, B, and R, respectively. Which of the following is true?

a. $R_x + R_y = 0$
b. $A_x + A_y = \vec{A}$
c. $A_x + B_y = B_x + A_y$
d. $A_x + B_x = R_x$

5.4 Inclined Planes

47. If an object sits on an inclined plane and no other object makes contact with the object, what is typically equal in magnitude to the component of the weight perpendicular to the plane?

a. The normal force
b. The total weight
c. The parallel force of weight

48. A 5 kg box is at rest on the floor. The coefficient of static friction between the box and the floor is 0.4. A horizontal force of 50 N is applied to the box. Will it move?

a. No, because the applied force is less than the maximum limiting static friction.
b. No, because the applied force is more than the maximum limiting static friction.
c. Yes, because the applied force is less than the maximum limiting static friction.
d. Yes, because the applied force is more than the maximum limiting static friction.

49. A skier with a mass of 67 kg is skiing down a snowy slope with an incline of 37°. Find the friction if the coefficient of kinetic friction is 0.07.

a. 27.66 N
b. 34.70 N
c. 36.71 N
d. 45.96 N

Short Answer

5.1 Vector Addition and Subtraction: Graphical Methods

56. Find $\vec{A} - \vec{B}$ for the following vectors:
$\vec{A} = (122\,\text{cm}, \angle 145^\circ)\ \vec{B} = (110\,\text{cm}, \angle 270^\circ)$
a. 108 cm, $\theta = 119.0^\circ$
b. 108 cm, $\theta = 125.0^\circ$
c. 206 cm, $\theta = 119.0^\circ$
d. 206 cm, $\theta = 125.0^\circ$

57. Find $\vec{A} + \vec{B}$ for the following vectors:
$\vec{A} = (122\,\text{cm}, \angle 145^\circ)\ \vec{B} = (110\,\text{cm}, \angle 270^\circ)$
a. 108 cm, $\theta = 119.1^\circ$
b. 108 cm, $\theta = 201.8^\circ$
c. 232 cm, $\theta = 119.1^\circ$
d. 232 cm, $\theta = 201.8^\circ$

58. Consider six vectors of 2 cm each, joined from head to tail making a hexagon. What would be the magnitude of the addition of these vectors?
a. Zero
b. Six
c. Eight
d. Twelve

59. Two people pull on ropes tied to a trolley, each applying 44 N of force. The angle the ropes form with each other is 39.5°. What is the magnitude of the net force exerted on the trolley?
a. 0.0 N
b. 79.6 N
c. 82.8 N
d. 88.0 N

5.2 Vector Addition and Subtraction: Analytical Methods

60. True or False—A vector can form the shape of a right angle triangle with its x and y components.
a. True
b. False

61. True or False—All vectors have positive x and y components.
a. True
b. False

62. Consider $\vec{A} - \vec{B} = \vec{R}$. What is R_x in terms of A_x and B_x?
a. $R_x = \frac{A_x}{B_x}$
b. $R_x = \frac{B_x}{A_x}$
c. $R_x = A_x + B_x$
d. $R_x = A_x - B_x$

63. Consider $\vec{A} - \vec{B} = \vec{R}$. What is R_y in terms of A_y and B_y?
a. $R_y = \frac{A_y}{B_y}$
b. $R_y = \frac{B_y}{A_y}$
c. $R_y = A_y + B_y$
d. $R_y = A_y - B_y$

5.4 Inclined Planes

70. What are the units of the coefficient of friction?

a. N
b. $\mathrm{m/s}$
c. $\mathrm{m/s^2}$
d. unitless

71. Two surfaces in contact are moving slowly past each other. As the relative speed between the two surfaces in contact increases, what happens to the magnitude of their coefficient of kinetic friction?

a. It increases with the increase in the relative motion.
b. It decreases with the increase in the relative motion.
c. It remains constant and is independent of the relative motion.

72. When will an object slide down an inclined plane at constant velocity?

a. When the magnitude of the component of the weight along the slope is equal to the magnitude of the frictional force.
b. When the magnitude of the component of the weight along the slope is greater than the magnitude of the frictional force.
c. When the magnitude of the component of the weight perpendicular to the slope is less than the magnitude of the frictional force.
d. When the magnitude of the component of the weight perpendicular to the slope is equal to the magnitude of the frictional force.

73. A box is sitting on an inclined plane. At what angle of incline is the perpendicular component of the box's weight at its maximum?

a. 0°
b. 30°
c. 60°
d. 90°

Extended Response

5.1 Vector Addition and Subtraction: Graphical Methods

80. True or False—For vectors the order of addition is important.

a. True
b. False

81. Consider five vectors *a, b, c, d,* and *e.* Is it true or false that their addition always results in a vector with a greater magnitude than if only two of the vectors were added?

a. True
b. False

5.2 Vector Addition and Subtraction: Analytical Methods

82. For what angle of a vector is it possible that its magnitude will be equal to its y-component?

a. $\theta = 0^\circ$
b. $\theta = 45^\circ$
c. $\theta = 60^\circ$
d. $\theta = 90^\circ$

83. True or False—If only the angles of two vectors are known, we can find the angle of their resultant addition vector.

a. True
b. False

84. True or false—We can find the magnitude and direction of the resultant vector if we know the angles of two vectors and the magnitude of one.

a. True
b. False

5.4 Inclined Planes

87. True or False—Friction varies from surface to surface because different substances have different degrees of roughness or smoothness.

a. True
b. False

88. As the angle of the incline gets larger, what happens to the magnitudes of the perpendicular and parallel components of gravitational force?

a. Both the perpendicular and the parallel component will decrease.
b. The perpendicular component will decrease and the parallel component will increase.
c. The perpendicular component will increase and the parallel component will decrease.
d. Both the perpendicular and the parallel component will increase.