Physics for Scientists and Engineers, 4e **(Giancoli)**

Chapter 3 Kinematics in Two or Three Dimensions; Vectors

3.1 Conceptual Questions

1) A student adds two displacement vectors that have the magnitudes of 14.0 m and 6.0 m. What is the range of possible answers for the magnitude of the resultant vector?
Answer: between 8.0 m and 20.0 m
Diff: 1 Page Ref: Sec. 3-4

2) Vector quantities are represented in terms of their magnitude and direction.
Answer: TRUE
Diff: 1 Page Ref: Sec. 3-1

3) The magnitude of a vector can be less than the magnitude of one of its components.
Answer: FALSE
Diff: 1 Page Ref: Sec. 3-4

4) If the magnitude of vector $\vec{\mathbf{A}}$ is less than the magnitude of vector $\vec{\mathbf{B}}$, then the x component of $\vec{\mathbf{A}}$ is less than the x component of $\vec{\mathbf{B}}$.
Answer: FALSE
Diff: 1 Page Ref: Sec. 3-4

5) If $\vec{\mathbf{A}} + \vec{\mathbf{B}} = \vec{\mathbf{C}}$ and A+B=C, then the vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are oriented perpendicular relative to one other.
Answer: FALSE
Diff: 1 Page Ref: Sec. 3-4

6) If $\vec{\mathbf{A}} - \vec{\mathbf{B}} = \vec{\mathbf{C}}$ and A-B=C, then the vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are oriented perpendicular relative to one other.
Answer: FALSE
Diff: 1 Page Ref: Sec. 3-4

7) If $\vec{\mathbf{A}} + \vec{\mathbf{B}} = \vec{\mathbf{C}}$ and $A^2 + B^2 = C^2$, then the vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are oriented perpendicular relative to one other.
Answer: TRUE
Diff: 1 Page Ref: Sec. 3-4

8) If $\vec{\mathbf{A}} + \vec{\mathbf{B}} = 0$, then the vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ have equal magnitudes and are directed in the same direction.
Answer: FALSE
Diff: 1 Page Ref: Sec. 3-4

9) If $\vec{\mathbf{A}} - \vec{\mathbf{B}} = 0$, then the vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ have equal magnitudes and are directed in the same direction.
Answer: TRUE
Diff: 1 Page Ref: Sec. 3-4

10) The magnitude of a unit vector is one.
Answer: TRUE
Diff: 1 Page Ref: Sec. 3-5

11) The horizontal component of the velocity of a projectile remains constant during the entire trajectory of the projectile.
Answer: TRUE
Diff: 1 Page Ref: Sec. 3-7 & 3-8

12) The vertical component of the acceleration of a projectile remains constant during the entire trajectory of the projectile.
Answer: TRUE
Diff: 1 Page Ref: Sec. 3-7 & 3-8

13) A projectile is launched with velocity v at an angle θ above the horizontal. The range of the projectile does not depend upon the acceleration due to gravity at that location.
Answer: FALSE
Diff: 1 Page Ref: Sec. 3-7 & 3-8

14) A projectile is launched from ground level with a certain speed. For any range less than the maximum range there are two possible launch angles that give the same range.
Answer: TRUE
Diff: 2 Page Ref: Sec. 3-7 & 3-8

15) Under what condition is $\left|\vec{\mathbf{A}}+\vec{\mathbf{B}}\right| = \left|\vec{\mathbf{A}}\right| + \left|\vec{\mathbf{B}}\right|$?
A) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in the same direction.
B) The statement is always true.
C) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in opposite directions.
D) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in perpendicular directions.
E) The statement is never true.
Answer: A
Diff: 1 Page Ref: Sec. 3-2

16) Vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$. Under what condition is $\left|\vec{\mathbf{C}}\right|^2 = \left|\vec{\mathbf{A}}\right|^2 + \left|\vec{\mathbf{B}}\right|^2$?
A) The statement is always true.
B) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in perpendicular directions.
C) The statement is never true.
D) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in opposite directions.
E) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in the same direction.
Answer: B
Diff: 1 Page Ref: Sec. 3-2

17) Vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} - \vec{\mathbf{B}}$. Under what condition is $\left|\vec{\mathbf{C}}\right|^2 = \left|\vec{\mathbf{A}}\right|^2 + \left|\vec{\mathbf{B}}\right|^2$?
A) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in the same direction.
B) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in opposite directions.
C) The statement is always true.
D) The statement is never true.
E) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in perpendicular directions.
Answer: E
Diff: 1 Page Ref: Sec. 3-2

18) Under what condition is $\left|\vec{\mathbf{A}}-\vec{\mathbf{B}}\right| = \left|\vec{\mathbf{A}}\right| + \left|\vec{\mathbf{B}}\right|$?
A) The magnitude of vector $\vec{\mathbf{B}}$ is zero.
B) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in opposite directions.
C) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in the same direction.
D) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in perpendicular directions.
E) both A and B
Answer: E
Diff: 1 Page Ref: Sec. 3-3

19) Under what condition is $\left|\vec{\mathbf{A}}+\vec{\mathbf{B}}\right| = \left|\vec{\mathbf{A}}\right| - \left|\vec{\mathbf{B}}\right|$?

A) The statement is always true.
B) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in opposite directions.
C) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in perpendicular directions.
D) The statement is never true.
E) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are in the same direction.

Answer: B
Diff: 1 Page Ref: Sec. 3-3

20) The sum of two vectors has the greatest magnitude when the angle between these two vectors is

A) 90°. B) 180°. C) 60°. D) 0°. E) 270°.

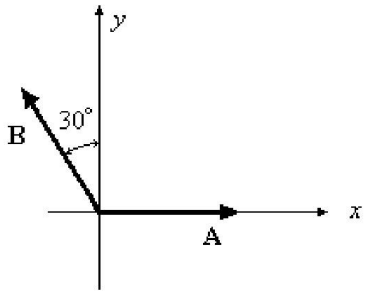
Answer: D
Diff: 1 Page Ref: Sec. 3-4

21) The resultant vector $\vec{\mathbf{C}}$ of two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ will have the minimum value when the angle between these vectors is which one of the following?

A) 0°. B) 90°. C) 270° D) 180° E) 360°

Answer: D
Diff: 1 Page Ref: Sec. 3-4

FIGURE 3-1

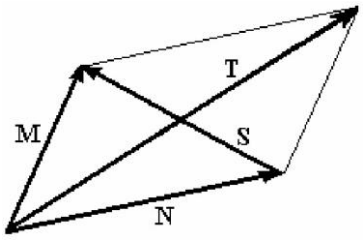


22) Refer to Fig. 3-1. The components of vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are

A) $A_x = 0$ $B_x = B \sin 30°$ $A_y = 0$ $B_y = B \cos 30°$.
B) $A_x = A \sin 90°$ $B_x = B \cos 60°$ $A_y = A \cos 90°$ $B_y = B \sin 60°$.
C) $A_x = A \cos 0°$ $B_x = -B \cos 60°$ $A_y = A \cos 90°$ $B_y = B \cos 30°$.
D) $A_x = A \cos 90°$ $B_x = B \sin 60°$ $A_y = A \sin 90°$ $B_y = B \cos 60°$.
E) $A_x = A \cos 90°$ $B_x = 0$ $A_y = A \sin 90°$ $B_y = 0$

Answer: C
Diff: 1 Page Ref: Sec. 3-4

FIGURE 3-2



23) Refer to Fig. 3-2. Vector $\vec{\mathbf{S}}$ as expressed in terms of vectors $\vec{\mathbf{M}}$ and $\vec{\mathbf{N}}$ is given by
A) $\vec{\mathbf{M}} + \vec{\mathbf{N}}$.
B) $\vec{\mathbf{M}} - \vec{\mathbf{N}}$.
C) $\vec{\mathbf{M}}$.
D) $\vec{\mathbf{N}}$.
E) None of the other choices is correct.
Answer: B
Diff: 1 Page Ref: Sec. 3-4

24) Refer to Fig. 3-2. Vector $\vec{\mathbf{T}}$ as expressed in terms of vectors $\vec{\mathbf{M}}$ and $\vec{\mathbf{N}}$ is given by
A) $\vec{\mathbf{M}} + \vec{\mathbf{N}}$.
B) $\vec{\mathbf{M}} - \vec{\mathbf{N}}$.
C) $\vec{\mathbf{M}}$.
D) $\vec{\mathbf{N}}$.
E) None of the other choices is correct.
Answer: A
Diff: 1 Page Ref: Sec. 3-4

25) The eastward component of vector $\vec{\mathbf{A}}$ is equal to the westward component of vector $\vec{\mathbf{B}}$ and their northward components are equal. Which one of the following statements is correct for these two vectors?
A) Vector $\vec{\mathbf{A}}$ is parallel to vector $\vec{\mathbf{B}}$.
B) Vector $\vec{\mathbf{A}}$ is anti-parallel to vector $\vec{\mathbf{B}}$.
C) Vector $\vec{\mathbf{A}}$ is perpendicular to vector $\vec{\mathbf{B}}$.
D) Magnitude of vector $\vec{\mathbf{A}}$ is equal to the magnitude of vector $\vec{\mathbf{B}}$.
E) Magnitude of vector $\vec{\mathbf{A}}$ is twice the magnitude of vector $\vec{\mathbf{B}}$.
Answer: D
Diff: 2 Page Ref: Sec. 3-4

26) For general projectile motion, the horizontal component of a projectile's velocity
A) is zero.
B) remains a non-zero constant.
C) continuously increases.
D) continuously decreases.
E) any of the above, depending on position.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

27) For general projectile motion, the horizontal component of a projectile's acceleration
A) is zero.
B) remains a non-zero constant.
C) continuously increases.
D) continuously decreases.
E) any of the above, depending on position.
Answer: A
Diff: 1 Page Ref: Sec. 3-7 & 3-8

28) For general projectile motion, the vertical component of a projectile's acceleration
A) is zero.
B) remains a non-zero constant.
C) continuously increases.
D) continuously decreases.
E) any of the above, depending on position.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

29) For general projectile motion, which statement is true when the projectile is at the highest point of its trajectory?
A) Its acceleration is zero.
B) Its velocity is perpendicular to the acceleration.
C) Its velocity and acceleration are both zero.
D) The horizontal component of its velocity is zero.
E) The horizontal and vertical components of its velocity are zero.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

30) For a projectile launched horizontally, the vertical component of its velocity
A) is zero.
B) remains a non-zero constant.
C) continuously increases.
D) continuously decreases.
E) any of the above, depending on position.
Answer: C
Diff: 1 Page Ref: Sec. 3-7 & 3-8

31) For a projectile launched horizontally, the horizontal component of a projectile's velocity
A) is zero.
B) remains a non-zero constant.
C) continuously increases.
D) continuously decreases.
E) any of the above, depending on position.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

32) A ball rolls off the edge of a table. The horizontal component of the ball's velocity remains constant during its entire trajectory because
A) the ball is not acted upon by any force.
B) the net force acting on the ball is zero.
C) the ball is not acted upon by a force in the horizontal direction.
D) the ball is not acted upon by a force in the vertical direction.
E) None of the other choices is correct.
Answer: C
Diff: 1 Page Ref: Sec. 3-7 & 3-8

33) James and John dive from an overhang into the lake below. James simply drops straight down from the edge. John takes a running start and jumps with an initial horizontal velocity of 25 m/s. When they reach the lake below,
A) the splashdown speed of James is larger than that of John.
B) the splashdown speed of John is larger than that of James.
C) they will both have the same splashdown speed.
D) the splashdown speed of James will always be 9.8 m/s larger than that of John.
E) the splashdown speed of John will always be 25 m/s larger than that of John.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

34) James and John dive from an overhang into the lake below. James simply drops straight down from the edge. John takes a running start and jumps with an initial horizontal velocity of 25 m/s. Compare the time it takes each to reach the lake below.
A) James reaches the surface of the lake first.
B) John reaches the surface of the lake first.
C) James and John will reach the surface of the lake at the same time.
D) Cannot be determined without knowing the mass of both James and John.
E) Cannot be determined without knowing the weight of both James and John.
Answer: C
Diff: 1 Page Ref: Sec. 3-7 & 3-8

35) A student kicks a soccer ball in a high arc toward the opponent's goal. At the highest point in its trajectory:
A) both velocity and acceleration of the soccer ball are zero.
B) neither the ball's velocity nor its acceleration is zero.
C) the ball's acceleration is zero but not its velocity.
D) the ball's acceleration points upwards.
E) the ball's velocity points downwards.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

36) When a football in a field goal attempt reaches its maximum height, how does its speed compare to its initial speed?
A) It is zero.
B) It is less than its initial speed.
C) It is equal to its initial speed.
D) It is greater than its initial speed.
E) Cannot be determined without additional information.
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

37) A monkey is sitting at the top of a tree 20 m above ground level. A person standing on the ground wants to feed the monkey. He uses a bow and arrow to launch the food to the monkey. If the monkey remains seated at the top of the tree, how should the person aim the arrow containing the food so that the monkey gets the food?

A) He should aim it at the monkey.
B) He should aim it below the monkey.
C) He should aim it above the monkey.
D) None of the other choices is correct.

Answer: C
Diff: 1 Page Ref: Sec. 3-7 & 3-8

38) A monkey is sitting at the top of a tree 20 m above ground level. A person standing on the ground wants to feed the monkey. He uses a bow and arrow to launch the food to the monkey. If the person knows that the monkey is going to drop from the tree at the same instant that the person launches the food, how should the person aim the arrow containing the food?

A) He should aim it at the monkey.
B) He should aim it below the monkey.
C) He should aim it above the monkey.
D) None of the other choices is correct.

Answer: A
Diff: 1 Page Ref: Sec. 3-7 & 3-8

39) An Olympic athlete throws a javelin at four different angles above the horizontal, each with the same speed: 30°, 40°, 60°, and 80°. Which two throws cause the javelin to land the same distance away?

A) 30° and 80° B) 40° and 60° C) 30° and 40° D) 40° and 80° E) 30° and 60°

Answer: E
Diff: 2 Page Ref: Sec. 3-7 & 3-8

40) A pilot drops a bomb from a plane flying horizontally at a constant speed. Neglecting air resistance, when the bomb hits the ground the horizontal location of the plane will

A) be behind the bomb.
B) be over the bomb.
C) be in front of the bomb.
D) depend of the speed of the plane when the bomb was released.
E) depend of the mass of the bomb when it was released.

Answer: B
Diff: 2 Page Ref: Sec. 3-7 & 3-8

41) A package of supplies is dropped from a plane, and one second later a second package is dropped. Neglecting air resistance, the distance between the falling packages will

A) be constant.
B) decrease.
C) increase.
D) depend on their weight.
E) depend on the speed of the plane.

Answer: C
Diff: 2 Page Ref: Sec. 3-7 & 3-8

42) You are trying to cross a river that flows due south with a strong current. You start out in your motorboat on the west bank desiring to reach the east bank directly east from your starting point. You should head your motorboat

A) due east.
B) due north.
C) due south.
D) in a southeasterly direction.
E) in a northeasterly direction.

Answer: E
Diff: 2 Page Ref: Sec. 3-9

3.2 Quantitative Problems

1) Vector $\vec{\mathbf{A}}$ is 5.5 cm long and points along the x axis. Vector $\vec{\mathbf{B}}$ is 7.5 cm long and points at +30° above the negative x axis.
(a) Determine the x and y components of Vector $\vec{\mathbf{A}}$.
(b) Determine the x and y components of Vector $\vec{\mathbf{B}}$
(c) Determine the sum of these two vectors in terms of components.
(d) Determine the sum of these two vectors in terms of magnitude and direction.
Answer: (a) A_X = 5.5 cm, A_Y = 0
(b) B_X = -6.5 cm, B_Y = 3.8 cm
(c) R_X = -1.0 cm, R_Y = 3.8 cm
(d) 3.9 cm at 75° above -x axis
Diff: 2 Page Ref: Sec. 3-4 & 3-5

2) Vector $\vec{\mathbf{A}}$ is 75.0 cm long and points at 30° above the positive x axis. Vector $\vec{\mathbf{B}}$ is 25.0 cm long and points along the negative x axis. Vector $\vec{\mathbf{C}}$ is 40.0 cm long and points at 45° below the negative x axis.
(a) Determine the x and y components of Vector $\vec{\mathbf{A}}$.
(b) Determine the x and y components of Vector $\vec{\mathbf{B}}$.
(c) Determine the x and y components of Vector $\vec{\mathbf{C}}$.
(d) Determine the sum of these three vectors in terms of components.
(e) Determine the sum of these three vectors in terms of magnitude and direction.
Answer: (a) A_X = 65 cm, A_Y = 38 cm
(b) B_X = -25 cm, B_Y = 0
(c) C_X = -28 cm, C_Y = -28 cm
(d) R_X = 12 cm, R_Y = -10 cm
(e) 16 cm at 40° below x axis
Diff: 2 Page Ref: Sec. 3-4 & 3-5

3) A projectile is shot horizontally at 23.4 m/s from the roof of a building 55.0 m tall.
(a) Determine the time necessary for the projectile to reach the ground below.
(b) Determine the distance from the base of the building that the projectile lands.
(c) Determine the horizontal and vertical components of the velocity just before the projectile reaches the ground.
Answer: (a) 3.35 s
(b) 78.4 m
(c) $v_{horizontal}$ = 23.4 m/s, $v_{vertical}$ = 32.8 m/s
Diff: 2 Page Ref: Sec. 3-7 & 3-8

4) A projectile is fired from ground level with an initial speed of 55.6 m/s at an angle of 41.2° above the horizontal.
(a) Determine the time necessary for the projectile to reach its maximum height.
(b) Determine the maximum height reached by the projectile.
(c) Determine the horizontal and vertical components of the velocity vector at the maximum height.
(d) Determine the horizontal and vertical components of the acceleration vector at the maximum height.
Answer: (a) 3.73 s
(b) 68.3 m
(c) $v_{horizontal}$ = 41.8 m/s, $v_{vertical}$ = 0
(d) $a_{horizontal}$ = 0, $a_{vertical}$ = -9.8 m/s^2
Diff: 2 Page Ref: Sec. 3-7 & 3-8

5) A boat, whose speed in still water is 1.75 m/s, must aim upstream at an angle of 26.3° (with respect to a line perpendicular to the shore) in order to travel directly across the stream.
(a) Determine the speed of the current.
(b) Determine the resultant speed of the boat with respect to the shore.
Answer: (a) 0.775 m/s
(b) 1.57 m/s
Diff: 2 Page Ref: Sec. 3-9

6) A vector $\vec{\mathbf{A}}$ has components A_X = 12 m and A_Y = 5.0 m. What is the magnitude of vector $\vec{\mathbf{A}}$?
A) 7.0 m B) 13 m C) 17 m D) 60 m E) 169 m
Answer: B
Diff: 1 Page Ref: Sec. 3-4 & 3-5

7) A vector $\vec{\mathbf{A}}$ has components A_X = 12.0 m and A_Y = 5.00 m. What is the angle that vector $\vec{\mathbf{A}}$ makes with the *x*-axis?
A) 12.6° B) 22.6° C) 32.6° D) 67.4° E) 6.6°
Answer: B
Diff: 1 Page Ref: Sec. 3-4 & 3-5

8) Vector $\vec{\mathbf{A}}$ = -2.00 $\hat{i}$ + 3.00 j . Determine the magnitude and direction of vector $\vec{\mathbf{A}}$.
A) 3.61 in a direction 304° counterclockwise from the positive *x* axis
B) 3.61 in a direction 56.3° counterclockwise from the positive *x* axis
C) -1.00 in a direction 56.3° counterclockwise from the positive *x* axis
D) 3.61 in a direction 124° counterclockwise from the positive *x* axis
E) 5.00 in a direction 56.3° counterclockwise from the positive *x* axis
Answer: D
Diff: 1 Page Ref: Sec. 3-4 & 3-5

9) Vector $\vec{\mathbf{A}}$ has a magnitude 5.00 and points in a direction 50.0° counterclockwise from the positive *x* axis. What are the *x* and *y* components of vector $\vec{\mathbf{A}}$.
A) A_X = 0.643 and A_Y = 0.766
B) A_X = -3.83 and A_Y = -3.21
C) A_X = 3.21 and A_Y = 3.83
D) A_X = 3.83 and A_Y = 3.21
E) A_X = 0.766 and A_Y = 0.643
Answer: C
Diff: 1 Page Ref: Sec. 3-4 & 3-5

10) Vector $\vec{\mathbf{A}}$ has a magnitude 5.00 and points in a direction 60.0° clockwise from the negative *y* axis. What are the *x* and *y* components of vector $\vec{\mathbf{A}}$.
A) A_X = 2.50 and A_Y = 4.33
B) A_X = 2.50 and A_Y = -4.33
C) A_X = -4.33 and A_Y = -2.50
D) A_X = -4.33 and A_Y = 2.50
E) A_X = 1.78 and A_Y = -2.14
Answer: C
Diff: 1 Page Ref: Sec. 3-4 & 3-5

11) Vector $\vec{\mathbf{M}}$ = 4.00 m points eastward and vector $\vec{\mathbf{N}}$ = 3.00 m points northward. The resultant vector $\vec{\mathbf{M}} + \vec{\mathbf{N}}$ is given by

A) 5.00 m at an angle 71.6° north of east.
B) 5.00 m at an angle 36.9° north of east.
C) 5.00 m at an angle 53.1° north of east.
D) 5.00 m at an angle 18.4° north of east.
E) 5.00 m at an angle 26.6° north of east.

Answer: B
Diff: 1 Page Ref: Sec. 3-4 & 3-5

12) Vector $\vec{\mathbf{M}}$ = 4.00 m points eastward and vector $\vec{\mathbf{N}}$ = 3.00 m points southward. The resultant vector $\vec{\mathbf{M}} + \vec{\mathbf{N}}$ is given by

A) 5.00 m at an angle 36.9° south of east.
B) 5.00 m at an angle 53.1° south of east.
C) 5.00 m at an angle 71.6° south of east.
D) 5.00 m at an angle 18.4° south of east.
E) 5.00 m at an angle 26.6° south of east.

Answer: A
Diff: 1 Page Ref: Sec. 3-4 & 3-5

13) Vector $\vec{\mathbf{M}}$ = 4.0 m points eastward and vector $\vec{\mathbf{N}}$ = 3.0 m points westward. The resultant vector $\vec{\mathbf{M}} + \vec{\mathbf{N}}$ is given by

A) 7.0 m east. B) 7.0 m west. C) 1.0 m east. D) 1.0 m west. E) 3.5 m west.

Answer: C
Diff: 1 Page Ref: Sec. 3-4 & 3-5

14) Vector $\vec{\mathbf{A}} = -3.00\,\hat{i} + 3.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What is vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$?

A) $0.00\,\hat{i} + 3.00\,j$
B) $7.00\,\hat{i} + 7.00\,j$
C) $-3.00\,\hat{i} + 7.00\,j$
D) $0.00\,\hat{i} + 7.00\,j$
E) $-3.00\,\hat{i} + -3.00\,j$

Answer: D
Diff: 1 Page Ref: Sec. 3-4 & 3-5

15) Vector $\vec{\mathbf{A}} = 1.00\,\hat{i} + -2.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What are the magnitude and direction of vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$?

A) 7.21 in a direction 33.7° counterclockwise from the positive *x* axis
B) 6.00 in a direction 63.4° counterclockwise from the positive *x* axis
C) 4.47 in a direction 6.34° counterclockwise from the positive *x* axis
D) 4.47 in a direction 26.6° counterclockwise from the positive *x* axis
E) 7.21 in a direction 56.3° counterclockwise from the positive *x* axis

Answer: D
Diff: 1 Page Ref: Sec. 3-4 & 3-5

16) Vector $\vec{\mathbf{A}} = -1.00\,\hat{i} + 2.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What are the magnitude and direction of vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$?

A) 6.32 in a direction 71.6° counterclockwise from the positive x axis
B) 8.00 in a direction 71.6° counterclockwise from the positive x axis
C) 8.00 in a direction 18.4° counterclockwise from the positive x axis
D) 6.32 in a direction 18.4° counterclockwise from the positive x axis
E) 40 in a direction 18.4° counterclockwise from the positive x axis

Answer: A
Diff: 1 Page Ref: Sec. 3-4 & 3-5

17) Vector $\vec{\mathbf{A}} = 2.00\,\hat{i} + -1.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What is vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} - \vec{\mathbf{B}}$?

A) $1.00\,\hat{i} + 5.00\,j$
B) $1.00\,\hat{i} + 3.00\,j$
C) $-1.00\,\hat{i} + -3.00\,j$
D) $-1.00\,\hat{i} + 3.00\,j$
E) $-1.00\,\hat{i} + -5.00\,j$

Answer: E
Diff: 1 Page Ref: Sec. 3-4 & 3-5

18) Vector $\vec{\mathbf{A}} = 3.00\,\hat{i} + -1.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What is vector $\vec{\mathbf{C}} = 2.00\vec{\mathbf{A}} + 3.00\vec{\mathbf{B}}$?

A) $3.00\,\hat{i} + 6.00\,j$
B) $5.00\,\hat{i} + 1.00\,j$
C) $-3.00\,\hat{i} + 9.00\,j$
D) $15.0\,\hat{i} + 10.0\,j$
E) $2.00\,\hat{i} + 3.00\,j$

Answer: D
Diff: 1 Page Ref: Sec. 3-4 & 3-5

19) Vector $\vec{\mathbf{A}} = -1.00\,\hat{i} + -2.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What are the magnitude and direction of vector $\vec{\mathbf{C}} = 3.00\vec{\mathbf{A}} + 2.00\vec{\mathbf{B}}$?

A) 3.61 in a direction -56.3° counterclockwise from the positive x axis
B) 3.61 in a direction 56.3° counterclockwise from the positive x axis
C) 3.61 in a direction 33.7° counterclockwise from the positive x axis
D) 5.00 in a direction 56.3° counterclockwise from the positive x axis
E) 6.72 in a direction 34.4° counterclockwise from the positive x axis

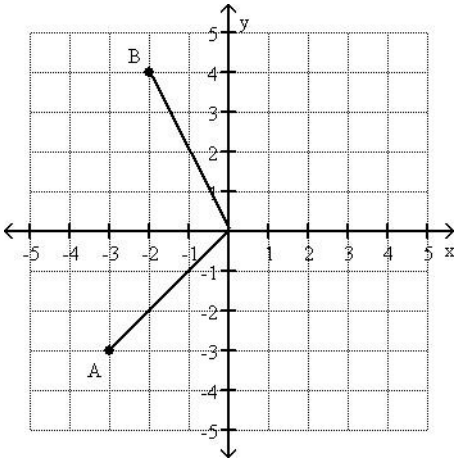
Answer: C
Diff: 1 Page Ref: Sec. 3-4 & 3-5

20) Vector $\vec{\mathbf{A}} = 2.00\,\hat{i} + 2.00\,j$ and vector $\vec{\mathbf{B}} = 3.00\,\hat{i} + 4.00\,j$. What is vector $\vec{\mathbf{C}} = 3.00\vec{\mathbf{A}} - \vec{\mathbf{B}}$?

A) $-3.00\,\hat{i} + -18.0\,j$
B) $9.00\,\hat{i} + 10.0\,j$
C) $3.00\,\hat{i} + 2.00\,j$
D) $-3.00\,\hat{i} + -2.00\,j$
E) $3.00\,\hat{i} + 18.0\,j$

Answer: C
Diff: 1 Page Ref: Sec. 3-4 & 3-5

FIGURE 3-3



21) Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are shown in Fig. 3-3. What is $\left|-5.00\vec{\mathbf{A}}+4.00\vec{\mathbf{B}}\right|$?

A) 31.8
B) -32.0 $\hat{i}$ + -2.00 j
C) 1028
D) 34.0
E) -2.00 $\hat{i}$ + -32.0 j

Answer: A
Diff: 1 Page Ref: Sec. 3-4 & 3-5

22) Vector $\vec{\mathbf{A}}$ = 6.0 m and points 30° north of east. Vector $\vec{\mathbf{B}}$ = 4.0 m and points 30° west of south. The resultant vector $\vec{\mathbf{A}}$ + $\vec{\mathbf{B}}$ is given by

A) 2.7 m at an angle 8.3° south of east.
B) 2.7 m at an angle 8.3° east of south.
C) 3.2 m at an angle 8.3° east of south.
D) 3.2 m at an angle 8.3° south of east.
E) 2.3 m at an angle 8.3° south of east.

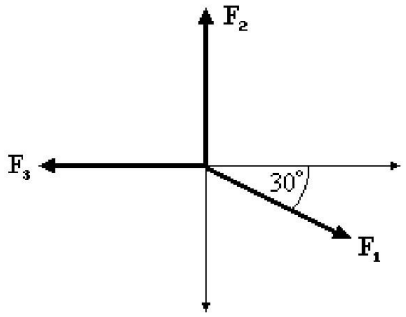
Answer: D
Diff: 2 Page Ref: Sec. 3-4 & 3-5

23) Vector $\vec{\mathbf{A}}$ = 6.0 m and points 30° north of east. Vector $\vec{\mathbf{B}}$ = 4.0 m and points 30° south of west. The resultant vector $\vec{\mathbf{A}}$ + $\vec{\mathbf{B}}$ is given by

A) 2.0 m at an angle 30° north of east.
B) 2.0 m at an angle 60° north of east.
C) 10.0 m at an angle 60° east of north.
D) 10.0 m at an angle 30° north of east.
E) 10.0 m at an angle 60° north of east.

Answer: A
Diff: 2 Page Ref: Sec. 3-4 & 3-5

FIGURE 3-4

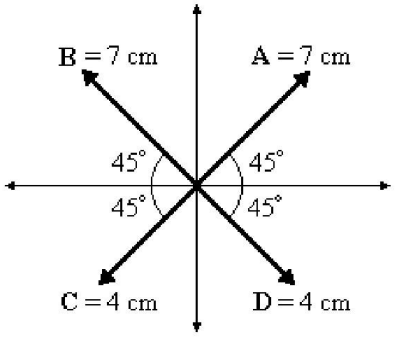


24) Refer to Fig. 3-4 The magnitudes of the forces as shown in the figure are:
F_1 = 80.0 N, F_2 = 60.0 N, and F_3 = 40.0 N. The resultant force acting on the particle O is given by

A) 180 N at an angle 60.0° with respect to +*x*-axis.
B) 60.0 N at an angle 90.0° with respect to +*x*-axis.
C) 20.0 N at an angle 34.3° with respect to +*x*-axis.
D) 35.5 N at an angle 34.3° with respect to +*x*-axis.
E) 40.0 N at an angle 60.0° with respect to +*x*-axis.

Answer: D
Diff: 2 Page Ref: Sec. 3-4 & 3-5

FIGURE 3-5



25) Refer to Fig. 3-5. The components of the sum of these vectors are given by

choice	*x*-component	*y*-component
1	4.9 cm	2.8 cm
2	2.8 cm	4.9 cm
3	0 cm	4.2 cm
4	-4.2 cm	0 cm
5	0 cm	2.8 cm

A) Choice 1 B) Choice 2 C) Choice 3 D) Choice 4 E) Choice 5

Answer: C
Diff: 3 Page Ref: Sec. 3-4 & 3-5

26) Refer to Fig. 3-5. The sum of these vectors is given by
A) 4.2 cm at an angle 180° with respect to +x-axis.
B) 4.2 cm along the y-axis.
C) 4.2 cm at an angle 270° with respect to +x-axis.
D) 4.2 cm along the x-axis.
E) 4.2 cm along the negative y-axis.
Answer: B
Diff: 3 Page Ref: Sec. 3-4 & 3-5

27) A teacher sends her students on a treasure hunt. She gives the following instructions:
1. Walk 300 m north
2. Walk 400 m northwest
3. Walk 700 m east-southeast and the treasure is buried there.
As all the other students walk off following the instructions, Joe physics student quickly adds the displacements and walks in a straight line to find the treasure. How far and in what direction does Joe need to walk?
A) 187 m in a direction 67.3° north of east
B) 481 m in a direction 40.9° north of east
C) 399 m in a direction 52.5° north of east
D) 284 m in a direction 28.2° west of north
E) The treasure position cannot be reached in one straight walk.
Answer: B
Diff: 1 Page Ref: Sec. 3-5 & 3-6

28) Object A has a position as a function of time given by $\vec{r}_A(t) = (3.00 \text{ m/s})t\,\vec{i} + (1.00 \text{ m/s}^2)t^2\,\vec{j}$. Object B has a position as a function of time given by $\vec{r}_B(t) = (4.00 \text{ m/s})t\,\vec{i} + (-1.00 \text{ m/s}^2)t^2\,\vec{j}$. What is the distance between object A and object B at time $t = 5.00$ s?
A) 34.6 m B) 45.0 m C) 50.2 m D) 3.46 m E) 29.8 m
Answer: C
Diff: 1 Page Ref: Sec. 3-6

29) An object has a position given by $\vec{r} = [2.0 \text{ m} + (5.0 \text{ m/s})t]\,\vec{i} + [3.0 \text{ m} - (1.0 \text{ m/s}^2)t^2]\,\vec{j}$. Determine the velocity of the object as a function of time.
A) 5.4 m/s
B) 5.1 m/s
C) $(5.0 \text{ m/s})\,\vec{i} - [(1.0 \text{ m/s}^2)t]\,\vec{j}$
D) $(5.0 \text{ m/s})\,\vec{i} - [(2.0 \text{ m/s}^2)t]\,\vec{j}$
E) $(5.0 \text{ m/s})\,\vec{i} - (1.0 \text{ m/s}^2)\,\vec{j}$
Answer: D
Diff: 1 Page Ref: Sec. 3-6

30) An object has a position given by $\vec{r} = [2.0 \text{ m} + (3.00 \text{ m/s})t]\,\vec{i} + [3.0 \text{ m} - (2.00 \text{ m/s}^2)t^2]\,\vec{j}$. What is the speed of the object at time $t = 2.00$ s?
A) 5.00 m/s B) 8.54 m/s C) 5.50 m/s D) 4.65 m/s E) 11.0 m/s
Answer: B
Diff: 1 Page Ref: Sec. 3-6

31) An object has a position given by $\vec{r}$ = [2.0 m + (5.00 m/s)t] $\vec{i}$ + [3.0 m - (2.00 m/s^2)t^2] $\vec{j}$. What is the magnitude of the acceleration of the object at time t = 2.00 s?

A) 1.00 m/s^2 B) 0.00 m/s^2 C) 0.722 m/s^2 D) 4.00 m/s^2 E) 2.00 m/s^2

Answer: D
Diff: 1 Page Ref: Sec. 3-6

32) An object has a velocity $\vec{v}_0(t)$ = (3.00 m/s) $\vec{i}$ + (1.00 m/s) $\vec{j}$ at time t = 0.00 s. The acceleration of the object is $\vec{a}$ (t) = (2.00 m/s^3)t $\vec{i}$ + (1.00 m/s^4)t^2 $\vec{j}$. If the object is located at $\vec{r}_0(t)$ = (1.00 m) $\vec{i}$ + (-1.00 m) $\vec{j}$ at time t = 0.00 s., what is the position of the object at time t = 1.00 s?

A) (2.72 m) $\vec{i}$ + (6.14 m) $\vec{j}$

B) (4.33 m) $\vec{i}$ + (0.0833 m) $\vec{j}$

C) (2.00 m) $\vec{i}$ + (1.00 m) $\vec{j}$

D) (5.32 m) $\vec{i}$ + (1.34 m) $\vec{j}$

E) (0.333 m) $\vec{i}$ + (0.0833 m) $\vec{j}$

Answer: B
Diff: 1 Page Ref: Sec. 3-6

33) A car moves from the point (3.0 m)^x + (5.0 m)^y to the point (8.0 m)^x - (7.0 m)^y in 2.0 s. What is the magnitude of the average velocity of the car?

A) 6.5 m/s B) 13 m/s C) 9.0 m/s D) 4.5 m/s E) 3.3 m/s

Answer: A
Diff: 2 Page Ref: Sec. 3-6

34) A car moves from the point (3.0 m)^x + (5.0 m)^y to the point (8.0 m)^x - (7.0 m)^y in 2.0 s. What is the direction of the average velocity of the car?

A) 67° from the x-axis
B) -67° from the x-axis
C) 33° from the x-axis
D) -33° from the x-axis
E) 52° from the x-axis

Answer: B
Diff: 2 Page Ref: Sec. 3-6

35) A car is moving with a velocity (3.0 m/s)^x + (1.0 m/s)^y and 2.5 seconds later its velocity is (6.0 m/s)^x - (3.0 m/s)^y. What is the magnitude of the average acceleration of the car?

A) 0.82 m/s^2 B) 1.6 m/s^2 C) 2.0 m/s^2 D) 4.5 m/s^2 E) 6.2 m/s^2

Answer: C
Diff: 2 Page Ref: Sec. 3-6

36) A car is moving with a velocity (3.0 m/s)^x + (1.0 m/s)^y and 3.0 seconds later its velocity is (6.0 m/s)^x - (3.0 m/s)^y. What is the direction of the average acceleration of the car?

A) 67° from the x-axis
B) -67° from the x-axis
C) 53° from the x-axis
D) -53° from the x-axis
E) 60° from the x-axis

Answer: D
Diff: 2 Page Ref: Sec. 3-6

37) A projectile is launched from ground level at an angle of 50.0° above horizontal with a speed of 30.0 m/s. If the projectile is moving over level ground, how long is it in the air before it again contacts the ground?
A) 8.12 s B) 2.35 s C) 4.69 s D) 6.44 s E) 11.3 s
Answer: C
Diff: 1 Page Ref: Sec. 3-7 & 3-8

38) A projectile is launched from ground level at an angle of 70.0° above horizontal with a speed of 50.0 m/s. If the projectile is moving over level ground, how far way from the launch position does it contact the ground?
A) 164 m B) 54.2 m C) 203 m D) 102 m E) 12.4 m
Answer: A
Diff: 1 Page Ref: Sec. 3-7 & 3-8

39) A projectile is launched from ground level at an angle of 30.0° above horizontal with a speed of 10.0 m/s. If the projectile is moving over level ground, what is the maximum height above the ground that the projectile reaches?
A) 2.54 m B) 1.27 m C) 5.00 m D) 3.54 m E) 20.0 m
Answer: B
Diff: 1 Page Ref: Sec. 3-7 & 3-8

40) A ball rolls horizontally off the edge of a cliff at 4.00 m/s. If the ball lands a distance of 30.0 m from the base of the vertical cliff, what is the height of the cliff?
A) 276 m B) 138 m C) 9.20 m D) 552 m E) 92.0 m
Answer: A
Diff: 1 Page Ref: Sec. 3-7 & 3-8

41) A hockey puck slides off the edge of a table with an initial velocity of 20.0 m/s. The height of the table above the ground is 2.0 m. What is the magnitude of the velocity of the puck just before it touches the ground?
A) 21 m/s B) 22 m/s C) 24 m/s D) 25 m/s E) 6.3 m/s
Answer: A
Diff: 1 Page Ref: Sec. 3-7 & 3-8

42) A hockey puck slides off the edge of a table with an initial velocity of 20.0 m/s. The height of the table above the ground is 2.00 m. How far from the edge of the table, measured along the floor, does the puck hit the floor?
A) 20.0 m B) 40.0 m C) 12.8 m D) 19.6 m E) 6.4 m
Answer: C
Diff: 2 Page Ref: Sec. 3-7 & 3-8

43) A hockey puck slides off the edge of a table with an initial velocity of 20.0 m/s. The height of the table above the ground is 2.0 m. What is the magnitude of the vertical component of the velocity of the puck just before it hits the ground?
A) 20.0 m/s B) 6.26 m/s C) 12.5 m/s D) 19.6 m/s E) 21 m/s
Answer: B
Diff: 2 Page Ref: Sec. 3-7 & 3-8

44) A hockey puck slides off the edge of a table with an initial velocity of 26.0 m/s. The height of the table above the ground is 2.00 m. What is the angle below the horizontal of the velocity of the puck just before it hits the ground?
A) 77.2° B) 72.6° C) 12.8° D) 13.5° E) 31.8°
Answer: D
Diff: 2 Page Ref: Sec. 3-7 & 3-8

45) A ball is thrown at a 30.0° angle above the horizontal across level ground. It is released from a height of 2.00 m above the ground with a speed of 18.0 m/s. How far does the ball travel horizontally before it strikes the ground?

A) 28.6 m B) 24.0 m C) 26.5 m D) 10.5 m E) 31.7 m

Answer: E

Diff: 2 Page Ref: Sec. 3-7 & 3-8

46) A ball is thrown at a 40.0° angle above the horizontal across level ground. It is released from a height of 2.00 m above the ground with a speed of 18.0 m/s. What is the maximum height above the ground that the ball reaches?

A) 24.0 m B) 26.5 m C) 16.2 m D) 8.82 m E) 6.82 m

Answer: D

Diff: 2 Page Ref: Sec. 3-7 & 3-8

47) A ball is thrown at a 60.0° angle above the horizontal across level ground. It is released from a height of 2.00 m above the ground with a speed of 16.0 m/s. How long does the ball remain in the air before striking the ground?

A) 16.2 s B) 1.80 s C) 2.05 s D) 2.82 s E) 2.96 s

Answer: E

Diff: 2 Page Ref: Sec. 3-7 & 3-8

48) A rock is thrown at a window that is located 18.0 m above the ground. The rock is thrown at an angle of 40.0° above horizontal. The rock is released from a height of 2.00 m above the ground with a speed of 30.0 m/s. If the rock strikes the window on its upward trajectory, from what horizontal distance from the window was it released?

A) 53.2 m B) 48.7 m C) 71.6 m D) 29.8 m E) 27.3 m

Answer: E

Diff: 2 Page Ref: Sec. 3-7 & 3-8

49) An airplane is flying at a speed of 200 m/s in level flight at an altitude of 800 m. A package is to be dropped from the airplane to land on a target on the ground. At what horizontal distance away from the target should the package be released so that it lands on the target?

A) 2.55 km B) 125 m C) 326 m D) 786 m E) 1.22 km

Answer: A

Diff: 2 Page Ref: Sec. 3-7 & 3-8

50) An airplane is flying at a speed of 200 m/s in level flight at an altitude of 800 m. A package is to be dropped from the airplane to land on a target on the ground. In what direction will the package be traveling when it hits the ground?

A) 49.3° below horizontal
B) 62.7° below horizontal
C) 54.8° below horizontal
D) 84.2° below horizontal
E) 32.1° below horizontal

Answer: E

Diff: 2 Page Ref: Sec. 3-7 & 3-8

51) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground. How far from where the child is standing does the ball hit the ground?

A) 1.22 m B) 5.14 m C) 6.79 m D) 7.46 m E) 1.58 m

Answer: D

Diff: 3 Page Ref: Sec. 3-7 & 3-8

52) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground. How long is the ball in flight before it hits the ground?
A) 1.22 s B) 6.79 s C) 7.45 s D) 9.14 s E) 2.44 s
Answer: A
Diff: 3 Page Ref: Sec. 3-7 & 3-8

53) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground. What is the magnitude of the ball's velocity just before it hits the ground?
A) 1.22 m/s B) 6.79 m/s C) 7.45 m/s D) 9.14 m/s E) 4.58 m/s
Answer: D
Diff: 3 Page Ref: Sec. 3-7 & 3-8

54) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground. At what angle below the horizontal does the ball approach the ground?
A) 35.1° B) 38.6° C) 48.0° D) 40.0° E) 65.2°
Answer: C
Diff: 3 Page Ref: Sec. 3-7 & 3-8

55) An airplane flies between two points on the ground that are 500 km apart. The destination is directly north of the origination of the flight. The plane flies with an air speed of 120 m/s. If a constant wind blows at 10.0 m/s due west during the flight, what direction must the plane fly relative to the air to arrive at the destination?
A) 4.78° east of north
B) 4.76° east of north
C) 85.2° west of north
D) 4.78° west of north
E) 4.76° west of north
Answer: A
Diff: 2 Page Ref: Sec. 3-9

56) A plane is headed eastward at a speed of 156 m/s. A 20.0 m/s wind is blowing southward at the same time as the plane is flying. The velocity of the plane relative to the ground is
A) 157 m/s at an angle 7.31° south of east.
B) 157 m/s at an angle 7.31° east of south.
C) 155 m/s at an angle 7.36° south of east.
D) 155 m/s at an angle 7.36° east of south.
E) 157 m/s at an angle 7.36° south of east.
Answer: A
Diff: 2 Page Ref: Sec. 3-9

57) A swimmer heading directly across a river 200 m wide reaches the opposite bank in 6 min 40 s. She is swept downstream 480 m. How fast can she swim in still water?
A) 0.50 m/s B) 0.80 m/s C) 1.2 m/s D) 1.4 m/s E) 1.8 m/s
Answer: A
Diff: 3 Page Ref: Sec. 3-9

58) A swimmer heading directly across a river 200 m wide reaches the opposite bank in 6 min 40 s. She is swept downstream 480 m. What is the speed of the current?
A) 0.50 m/s B) 0.80 m/s C) 1.2 m/s D) 1.4 m/s E) 1.8 m/s
Answer: C
Diff: 3 Page Ref: Sec. 3-9