

Exam

Name\_\_\_\_\_

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Graphical Addition: Two displacement vectors have magnitudes of 5.0 m and 7.0 m, respectively. If these two vectors are added together, the magnitude of the sum
- A) could be as small as 2.0 m or as large as 12 m.
  - B) is equal to 12 m.
  - C) is equal to 8.6 m.
  - D) is equal to 2.0 m.

Answer: A

- 2) Graphical Addition: Two vectors, of magnitudes 20 mm and 50 mm, are added together. Which one of the following is a possible value for the magnitude of the resultant?
- A) 80 mm
  - B) 20 mm
  - C) 10 mm
  - D) 40 mm

Answer: D

- 3) Graphical Addition: The magnitude of the resultant of two vectors cannot be less than the magnitude of either of those two vectors.
- A) True
  - B) False

Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 4) Graphical Addition: A student adds two displacement vectors that have the magnitudes of 12.0 m and 5.0 m. What is the range of possible answers for the magnitude of the resultant vector?

Answer: Between 7.0 m and 17.0 m

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 5) Graphical Addition: If  $\vec{A} + \vec{B} = \vec{C}$  and their magnitudes are given by  $A + B = C$ , then the vectors  $\vec{A}$  and  $\vec{B}$  are oriented
- A) parallel to each other (in the same direction).
  - B) perpendicular relative to one other.
  - C) antiparallel to each other (in opposite directions).
  - D) It is impossible to know from the given information.

Answer: A

- 6) Graphical Addition: If  $\vec{A} - \vec{B} = 0$ , then the vectors  $\vec{A}$  and  $\vec{B}$  have equal magnitudes and are directed in the same direction.
- A) True
  - B) False

Answer: A

7) Graphical Addition: If three vectors add to zero, they must all have equal magnitudes.

A) True

B) False

Answer: B

8) Graphical Addition: The sum of two vectors of fixed magnitudes has the greatest magnitude when the angle between these two vectors is

A)  $270^\circ$ .

B)  $180^\circ$ .

C)  $60^\circ$ .

D)  $0^\circ$ .

E)  $90^\circ$ .

Answer: D

9) Graphical Addition: The sum of two vectors of fixed magnitudes has its minimum magnitude when the angle between these vectors is

A)  $90^\circ$ .

B)  $270^\circ$ .

C)  $0^\circ$ .

D)  $180^\circ$ .

E)  $360^\circ$ .

Answer: D

10) Graphical Addition: Vectors  $\vec{M}$  and  $\vec{N}$  obey the equation  $\vec{M} + \vec{N} = 0$ . These vectors satisfy which one of the following statements?

A) Vectors  $\vec{M}$  and  $\vec{N}$  have the same magnitudes.

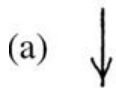
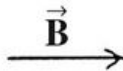
B) Vectors  $\vec{M}$  and  $\vec{N}$  are at right angles to each other.

C) Vectors  $\vec{M}$  and  $\vec{N}$  point in the same direction.

D) The magnitude of  $\vec{M}$  is the negative of the magnitude of  $\vec{N}$ .

Answer: A

11) Graphical Addition: Consider two vectors  $\vec{A}$  and  $\vec{B}$  shown in the figure. The difference  $\vec{A} - \vec{B}$  is best illustrated by



A) choice (a)

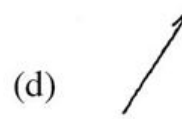
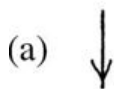
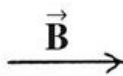
B) choice (b)

C) choice (c)

D) choice (d)

Answer: C

- 12) Graphical Addition: Consider two vectors  $\vec{A}$  and  $\vec{B}$  shown in the figure. The difference  $\vec{A} - \vec{B}$  is best illustrated by



A) choice (a)

B) choice (b)

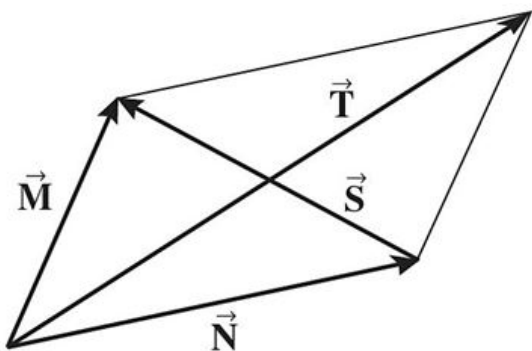
C) choice (c)

D) choice (d)

Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 13) Graphical Addition: Refer to the figure, which shows four vectors  $\vec{M}$ ,  $\vec{N}$ ,  $\vec{S}$ , and  $\vec{T}$ .



- (a) Vector  $\vec{S}$  as expressed in terms of vectors  $\vec{M}$  and  $\vec{N}$  is given by

A)  $\vec{M} + \vec{N}$ .

B)  $\vec{M} - \vec{N}$ .

C)  $\vec{N} - \vec{M}$ .

- (b) Vector  $\vec{T}$  as expressed in terms of vectors  $\vec{M}$  and  $\vec{N}$  is given by

A)  $\vec{M} + \vec{N}$ .

B)  $\vec{M} - \vec{N}$ .

C)  $\vec{N} - \vec{M}$ .

Answer: (a) B (b) A

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 14) Components: If a vector pointing upward has a positive magnitude, a vector pointing downward has a negative magnitude.

A) True

B) False

Answer: B

- 15) Components: If a vector's components are all negative, then the magnitude of the vector is negative.

A) True

B) False

Answer: B

- 16) Components: The magnitude of a vector can *never* be less than the magnitude of any of its components.

A) True

B) False

Answer: A

- 17) Components: The magnitude of a vector is only zero if *all* of its components are zero.

A) True

B) False

Answer: A

- 18) Components: If a vector  $\vec{A}$  has components  $A_x < 0$ , and  $A_y > 0$ , then the angle that this vector makes with the positive  $x$ -axis must be in the range

A)  $0^\circ$  to  $90^\circ$ .

B)  $90^\circ$  to  $180^\circ$ .

C)  $180^\circ$  to  $270^\circ$ .

D)  $270^\circ$  to  $360^\circ$ .

E) It cannot be determined without additional information.

Answer: B

- 19) Components: If a vector  $\vec{A}$  has components  $A_x < 0$ , and  $A_y < 0$ , then the angle that this vector makes with the positive  $x$ -axis must be in the range

A)  $0^\circ$  to  $90^\circ$ .

B)  $90^\circ$  to  $180^\circ$ .

C)  $180^\circ$  to  $270^\circ$ .

D)  $270^\circ$  to  $360^\circ$ .

E) It cannot be determined without additional information.

Answer: C

20) Components: If a vector  $\vec{A}$  has components  $A_x > 0$ , and  $A_y < 0$ , then the angle that this vector makes with the positive  $x$ -axis must be in the range

- A)  $0^\circ$  to  $90^\circ$ .
- B)  $90^\circ$  to  $180^\circ$ .
- C)  $180^\circ$  to  $270^\circ$ .
- D)  $270^\circ$  to  $360^\circ$ .
- E) It cannot be determined without additional information.

Answer: D

21) Components: The eastward component of vector  $\vec{A}$  is equal to the westward component of vector  $\vec{B}$  and their northward components are equal. Which one of the following statements must be correct for these two vectors?

- A) The angle between vector  $\vec{A}$  and vector  $\vec{B}$  must be  $90^\circ$ .
- B) Vector  $\vec{A}$  is parallel to vector  $\vec{B}$ .
- C) The magnitude of vector  $\vec{A}$  must be equal to the magnitude of vector  $\vec{B}$ .
- D) Vector  $\vec{A}$  is antiparallel (in the opposite direction) to vector  $\vec{B}$ .
- E) Vector  $\vec{A}$  must be perpendicular to vector  $\vec{B}$ .

Answer: C

22) Components: Vector  $\vec{A}$  is along the  $+x$ -axis and vector  $\vec{B}$  is along the  $+y$ -axis. Which one of the following statements is correct with respect to these vectors?

- A) The  $y$  component of vector  $\vec{A}$  is equal to the  $y$  component of vector  $\vec{B}$ .
- B) The  $x$  component of vector  $\vec{A}$  is equal to the  $x$  component of vector  $\vec{B}$ .
- C) The  $x$  component of vector  $\vec{A}$  is equal to the  $y$  component of vector  $\vec{B}$ .
- D) The  $y$  component of vector  $\vec{A}$  is equal to the  $x$  component of vector  $\vec{B}$ .

Answer: D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

23) Components: A velocity vector has components 36 m/s westward and 22 m/s northward. What are the magnitude and direction of this vector?

Answer: 42 m/s at  $31^\circ$  north of west

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

24) Components: The  $x$  component of vector  $\vec{A}$  is 8.7 units, and its  $y$  component is -6.5 units. The magnitude of  $\vec{A}$  is closest to

- A) 9.9 units.
- B) 12 units.
- C) 8.9 units.
- D) 7.9 units.
- E) 11 units.

Answer: E

- 25) Components: When rolled down a mountainside at 7.0 m/s, the horizontal component of its velocity vector was 1.8 m/s. What was the angle of the mountain surface above the horizontal?
- A)  $75^\circ$                       B)  $33^\circ$                       C)  $57^\circ$                       D)  $15^\circ$

Answer: A

- 26) Components: When Jeff ran up a hill at 7.0 m/s, the horizontal component of his velocity vector was 5.1 m/s. What was the vertical component of Jeff's velocity?
- A) 3.4 m/s                      B) 4.8 m/s                      C) 4.3 m/s                      D) 3.8 m/s

Answer: B

- 27) Components: The  $x$  component of vector  $\vec{A}$  is 5.3 units, and its  $y$  component is -2.3 units. The angle that vector  $\vec{A}$  makes with the  $+x$ -axis is closest to
- A)  $250^\circ$ .                      B)  $340^\circ$ .                      C)  $110^\circ$ .                      D)  $23^\circ$ .                      E)  $160^\circ$ .

Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 28) Components: A vector in the  $xy$ -plane has an  $x$  component of -7.50 units. What must be the  $y$  component of this vector so that its magnitude is 10.0 units. (*Note: There are two possible answers.*)

Answer: +6.6 units and -6.6 units

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 29) Components: A displacement vector is 34.0 m in length and is directed  $60.0^\circ$  east of north. Selecting choices in the table below, what are the components of this vector?

choice	Northward component	Eastward component
1	29.4 m	17.0 m
2	18.2 m	28.1 m
3	22.4 m	11.5 m
4	17.0 m	29.4 m
5	25.2 m	18.2 m

- A) choice 1                      B) choice 2                      C) choice 3                      D) choice 4                      E) choice 5

Answer: D

- 30) Components: A player throws a football 50.0 m at  $61.0^\circ$  north of west. What is the westward component of the displacement of the football?
- A) 55.0 m                      B) 64.7m                      C) 24.2 m                      D) 74.0 m                      E) 0.00 m

Answer: C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

31) Components: A vector  $\vec{A}$  has components  $A_x = 12.0$  m and  $A_y = 5.00$  m.

(a) What is the angle that vector  $\vec{A}$  makes with the  $+x$ -axis?

(b) What is the magnitude of vector  $\vec{A}$ ?

Answer: (a)  $22.6^\circ$  (b) 13.0 m

32) Components: The  $x$  and  $y$  components of a vector in a horizontal plane are 4.00 m and 3.00 m, respectively.

(a) What is the magnitude of this vector?

(b) What angle does this vector make with the positive  $+y$ -axis.

Answer: (a) 5.00 m (b)  $53.1^\circ$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

33) Components: A boy jumps with a velocity of magnitude 20.0 m/s at an angle of  $25.0^\circ$  above the horizontal. What is the horizontal component of the boy's velocity?

A) 8.45 m/s

B) 18.1 m/s

C) 9.33 m/s

D) 12.6 m/s

E) 15.6 m/s

Answer: B

34) Components: The magnitude of  $\vec{A}$  is 5.5 m, and this vector lies in the second quadrant and makes an angle of  $34^\circ$  with the  $+y$ -axis. The components of  $\vec{A}$  are closest to:

A)  $A_x = -4.6$  m,  $A_y = -3.1$  m.

B)  $A_x = -3.1$  m,  $A_y = 4.6$  m.

C)  $A_x = -4.6$  m,  $A_y = 3.1$  m.

D)  $A_x = 4.6$  m,  $A_y = -3.1$  m.

E)  $A_x = 3.1$  m,  $A_y = -4.6$  m.

Answer: B

35) Components: The components of vectors  $\vec{B}$  and  $\vec{C}$  are given as follows:

$$B_x = -9.2 \quad C_x = -4.5$$

$$B_y = -6.1 \quad C_y = 4.3$$

The angle (less than  $180^\circ$ ) between vectors  $\vec{B}$  and  $\vec{C}$  is closest to

A)  $10^\circ$ .

B)  $77^\circ$ .

C)  $84^\circ$ .

D)  $103^\circ$ .

E)  $170^\circ$ .

Answer: B

36) Addition by Components: A car travels 20 km west and then 20 km south. Use components to find the magnitude of its displacement vector?

A) 20 km

B) 40 km

C) 0 km

D) 28 km

Answer: D

37) Addition by Components: You walk 33 m to the north, then turn  $60^\circ$  to your right and walk another 45 m. Use components to find how far you end up from your starting point.

A) 35 m

B) 75 m

C) 39 m

D) 68 m

Answer: D

38) Addition by Components: You walk 53 m to the north, then you turn  $60^\circ$  to your right and walk another 45 m. Use components to determine the direction of your displacement vector. Express your answer as an angle relative to east.

A)  $69^\circ$  N of E

B)  $50^\circ$  N of E

C)  $63^\circ$  N of E

D)  $57^\circ$  N of E

Answer: C

39) Addition by Components: The components of vectors  $\vec{A}$  and  $\vec{B}$  are given as follows:

$$A_x = 7.6 \quad B_x = -5.1$$

$$A_y = -9.2 \quad B_y = -6.8$$

What is the magnitude of the vector difference  $\vec{B} - \vec{A}$  ?

A) 170

B) 3.4

C) 16

D) 3.5

E) 13

Answer: E

40) Addition by Components: If vector  $\vec{A}$  has components  $A_x = -3.0$  lb and  $A_y = -4.0$  lb, and vector  $\vec{B}$  has components  $B_x = 3.0$  lb and  $B_y = -8.0$  lb, what is the magnitude of vector  $\vec{C} = \vec{A} - \vec{B}$  ?

A) 16 lb

B) 7.2 lb

C) 140 lb

D) 13 lb

Answer: B

41) Addition by Components: Vector  $\vec{A}$  has magnitude 2 units and is directed to the north. Vector  $\vec{B}$  has magnitude 5 units and is directed to the south. Calculate the magnitude and direction of  $\vec{A} - \vec{B}$ .

A) 7 units, north

B) 7 units, south

C) 3 units, south

D) 3 units, north

Answer: A

42) Addition by Components: Two perpendicular vectors,  $\vec{A}$  and  $\vec{B}$ , are added together giving vector  $\vec{C}$ . If the magnitudes of both vectors  $\vec{A}$  and  $\vec{B}$  are doubled without changing their directions, the magnitude of vector  $\vec{C}$  will

A) increase by a factor of 4.

B) increase by a factor of 8.

C) increase by a factor of  $\sqrt{2}$ .

D) increase by a factor of 2.

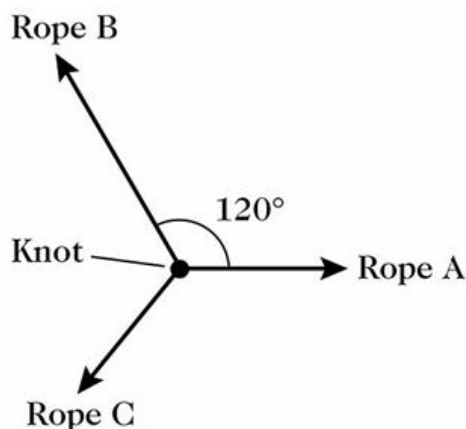
E) not change.

Answer: D



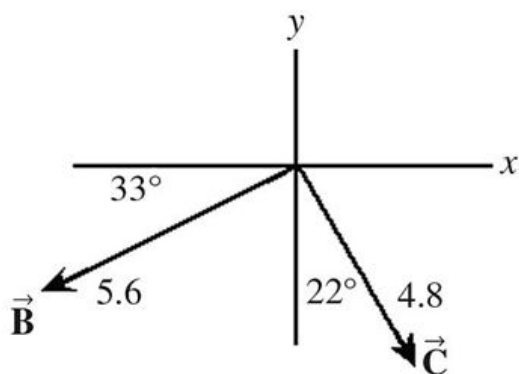
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 43) Addition by Components: Three ropes are tied in a knot as shown in the figure. One student pulls on rope A with 1.0 pound of force, and another student pulls on rope B with 7.0 pounds of force. How *hard* and in what *direction* must you pull on rope C to *balance* the first two pulls? Give the direction by specifying the angle (clockwise or counterclockwise) of the pull with the direction of rope A.



Answer: 6.6 lb at  $68^\circ$  clockwise from rope A

- 44) Addition by Components: The figure shows two vectors  $\vec{B}$  and  $\vec{C}$ , along with their magnitudes and directions. The vector  $\vec{D}$  is given by  $\vec{D} = \vec{B} - \vec{C}$ .



- (a) What is the magnitude of vector  $\vec{D}$  ?  
(b) What angle does vector  $\vec{D}$  make with the  $+x$ -axis?

Answer: (a) 6.6 (b)  $170^\circ$

45) Addition by 1. Components: Displacement vector  $\vec{A}$  is 5.5 cm long and points along the  $+x$ -axis.

Displacement vector  $\vec{B}$  is 7.5 cm long and points at  $+30^\circ$  to the  $-x$ -axis.

(a) Determine the  $x$  and  $y$  components of vector  $\vec{A}$ .

(b) Determine the  $x$  and  $y$  components of vector  $\vec{B}$ .

(c) Determine the  $x$  and  $y$  components of the resultant of these two vectors.

(d) Determine the magnitude and direction of the resultant of these two vectors.

Answer: (a)  $A_x = 5.5$  cm,  $A_y = 0$  cm (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  $75^\circ$  above the  $-x$  axis

46) Addition by 1. Components: Displacement vector  $\vec{A}$  is 75 cm long and points at  $30^\circ$  above the  $+x$ -axis. Displacement vector  $\vec{B}$  is 25 cm long and points along the  $-x$ -axis. Displacement vector  $\vec{C}$  is 40 cm long and points at  $45^\circ$  below the  $-x$ -axis.

(a) Determine the  $x$  and  $y$  components of vector  $\vec{A}$ .

(b) Determine the  $x$  and  $y$  components of vector  $\vec{B}$ .

(c) Determine the  $x$  and  $y$  components of vector  $\vec{C}$ .

(d) Determine the  $x$  and  $y$  components of the resultant of these three vectors.

(e) Determine the magnitude and direction of the resultant of these three vectors.

Answer: (a)  $A_x = 65$  cm,  $A_y = 38$  cm (b)  $B_x = -25$  cm,  $B_y = 0$  cm

(c)  $C_x = -28$  cm,  $C_y = -28$  cm (d)  $R_x = 12$  cm,  $R_y = 9$  cm

(e) 15 cm at  $38^\circ$  above the  $+x$ -axis

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

47) Addition by 1. Components: Vector  $\vec{M} = 4.00$  m points eastward and vector  $\vec{N} = 3.00$  m points southward. The resultant vector  $\vec{M} + \vec{N}$  is given by

A) 5.00 m at an angle of  $18.4^\circ$  south of east.

B) 5.00 m at an angle of  $71.6^\circ$  south of east.

C) 5.00 m at an angle of  $53.1^\circ$  south of east.

D) 5.00 m at an angle of  $36.9^\circ$  south of east.

E) 5.00 m at an angle of  $26.6^\circ$  south of east.

Answer: D

- 48) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 6.0 m and points  $30^\circ$  north of east. Vector  $\vec{B}$  has a magnitude of 4.0 m and points  $30^\circ$  east of north. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 2.0 m at an angle of  $42^\circ$  north of east.
  - B) 9.7 m at an angle of  $42^\circ$  north of east.
  - C) 0.70 m at an angle of  $42^\circ$  north of east.
  - D) 14 m at an angle of  $42^\circ$  north of east.
  - E) 1.1 m at an angle of  $42^\circ$  north of east.

Answer: B

- 49) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 6.0 m and points  $30^\circ$  north of east. Vector  $\vec{B}$  has a magnitude of 4.0 m and points  $30^\circ$  west of north. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 9.8 m at an angle of  $26^\circ$  north of east.
  - B) 7.2 m at an angle of  $26^\circ$  east of north.
  - C) 3.3 m at an angle of  $64^\circ$  east of north.
  - D) 3.3 m at an angle of  $26^\circ$  north of east.
  - E) 9.8 m at an angle of  $64^\circ$  east of north.

Answer: B

- 50) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 6.0 m and points  $30^\circ$  north of east. Vector  $\vec{B}$  has a magnitude of 4.0 m and points  $30^\circ$  west of south. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 3.2 m at an angle of  $8.3^\circ$  east of south.
  - B) 2.7 m at an angle of  $8.3^\circ$  east of south.
  - C) 2.3 m at an angle of  $8.3^\circ$  south of east.
  - D) 2.7 m at an angle of  $8.3^\circ$  south of east.
  - E) 3.2 m at an angle of  $8.3^\circ$  south of east.

Answer: E

- 51) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 6.0 m and points  $30^\circ$  south of east. Vector  $\vec{B}$  has a magnitude of 4.0 m and points  $30^\circ$  west of south. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 9.8 m at an angle of  $64^\circ$  south of east.
  - B) 3.3 m at an angle of  $64^\circ$  south of east.
  - C) 3.3 m at an angle of  $26^\circ$  south of east.
  - D) 7.2 m at an angle of  $64^\circ$  south of east.
  - E) 9.8 m at an angle of  $26^\circ$  south of east.

Answer: D

- 52) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 4.0 m and points  $30^\circ$  south of east. Vector  $\vec{B}$  has a magnitude of 2.0 m and points  $30^\circ$  north of west. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 1.0 m at an angle  $30^\circ$  east of south.
  - B) 2.0 m at an angle  $60^\circ$  south of east.
  - C) 10.0 m at an angle  $60^\circ$  east of south.
  - D) 10.0 m at an angle  $30^\circ$  south of east.
  - E) 2.0 m at an angle  $30^\circ$  south of east.

Answer: E

- 53) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 7.0 m and points  $30^\circ$  east of north. Vector  $\vec{B}$  has a magnitude of 5.0 m and points  $30^\circ$  west of south. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 10.0 m at an angle  $60^\circ$  north of east.
  - B) 1.0 m at an angle  $60^\circ$  east of north
  - C) 10.0 m at an angle  $30^\circ$  east of north.
  - D) 2.0 m at an angle  $30^\circ$  north of east.
  - E) 2.0 m at an angle  $60^\circ$  north of east.

Answer: E

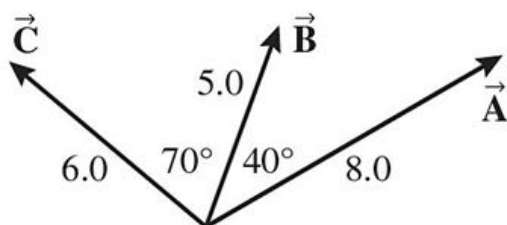
- 54) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 6.0 m and points  $30^\circ$  east of south. Vector  $\vec{B}$  has a magnitude of 4.0 m and points  $30^\circ$  west of north. The resultant vector  $\vec{A} + \vec{B}$  is given by
- A) 2.0 m at an angle of  $30^\circ$  north of west.
  - B) 1.0 m at an angle of  $60^\circ$  north of west.
  - C) 2.0 m at an angle of  $30^\circ$  east of south.
  - D) 10.0 m at an angle of  $60^\circ$  north of west.
  - E) 10.0 m at an angle of  $60^\circ$  east of south.

Answer: C

- 55) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 8.0 m and points east, vector  $\vec{B}$  has a magnitude of 6.0 m and points north, and vector  $\vec{C}$  has a magnitude of 5.0 m and points west. The resultant vector  $\vec{A} + \vec{B} + \vec{C}$  is given by
- A) 6.7 m at an angle  $63^\circ$  north of east.
  - B) 2.0 m at an angle  $63^\circ$  north of east.
  - C) 2.0 m at an angle  $63^\circ$  east of north.
  - D) 3.8 m at an angle  $67^\circ$  north of east
  - E) 6.7 m at an angle  $63^\circ$  east of north.

Answer: A

- 56) Addition by 1. Components: The figure shows three vectors and their magnitudes and relative directions. The magnitude of the resultant of the three vectors is closest to

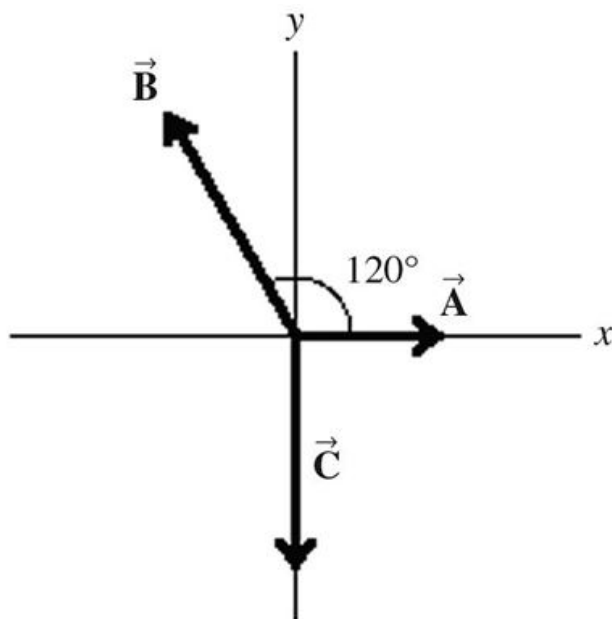


- A) 7.0.                      B) 16.                      C) 13.                      D) 10.                      E) 19.

Answer: C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 57) Addition by 1. Components: Find the magnitude and direction of the resultant of the three force vectors,  $\vec{A}$ ,  $\vec{B}$ , and  $\vec{C}$ , shown in the figure. These vectors have the following magnitudes:  $A = 5.0$  lb,  $B = 7.9$  lb, and  $C = 8.0$  lb. Express the direction of the resultant by specifying the angle it makes with the  $+x$ -axis, with counterclockwise angles taken to be positive.



Answer: 1.6 lb,  $312^\circ$

- 58) Addition by 1. Components: Two boys, Joe and Sam, who are searching for buried treasure start underneath the same tree. Joe walks 12 m east and then 12 m north, while Sam walks 15 m west and then 10 m south. Both boys then stop. Find the magnitude and direction of the vector from Sam to Joe. Express the direction of this vector by specifying the angle it makes with the west-to-east direction.

Answer: 35 m at  $39^\circ$  north of east

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

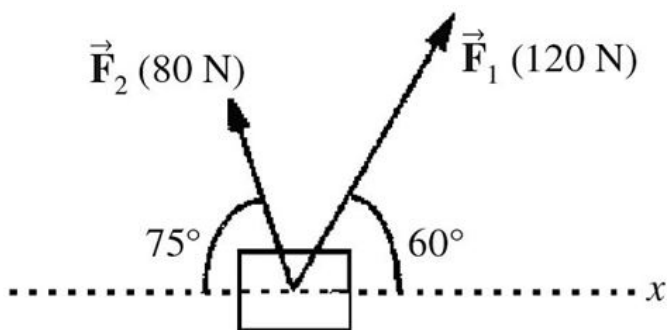
- 59) Addition by 1. Components: An airplane undergoes the following displacements, all at the same altitude: First, it flies 59.0 km in a direction  $30.0^\circ$  east of north. Next, it flies 58.0 km due south. Finally, it flies 100 km  $30.0^\circ$  north of west. Use components to determine how far the airplane ends up from its starting point.

A) 73.0 km      B) 71.5 km      C) 70.1 km      D) 74.4 km      E) 68.7 km

Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 60) Addition by 1. Components: Two forces are acting on an object as shown in the figure. Assume that all the quantities shown are accurate to three significant figures.

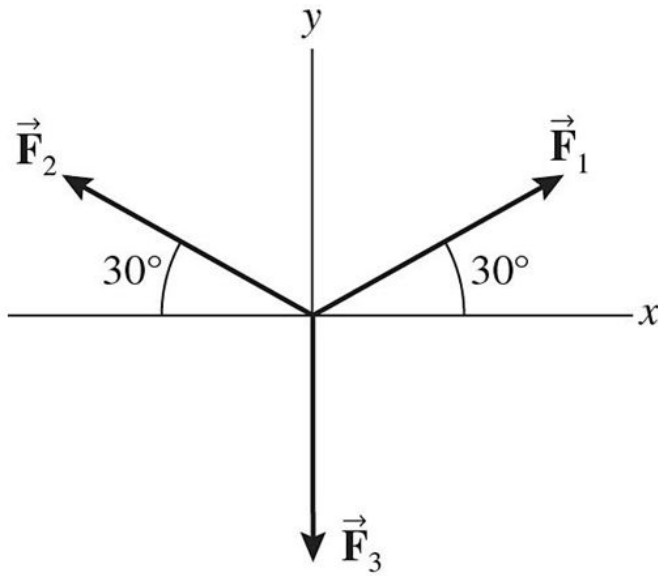


- (a) What is the magnitude of the resultant force on the object?  
(b) What is the direction of the resultant force?

Answer: (a) 185 N (b)  $77.8^\circ$  above the  $+x$ -axis

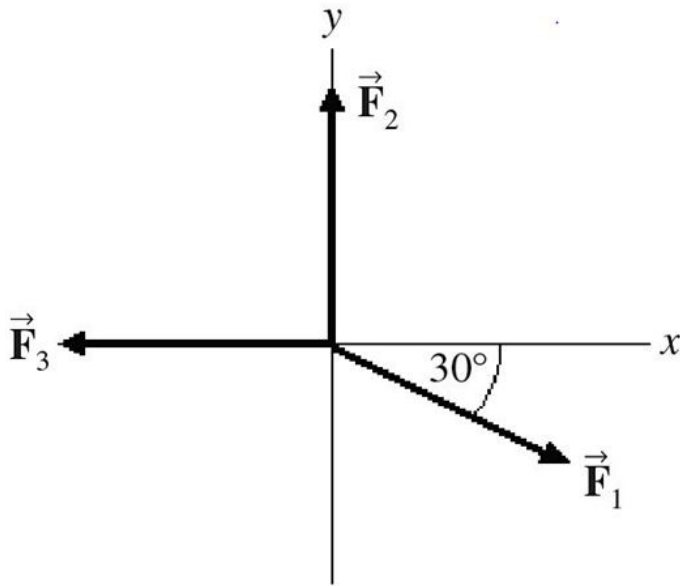
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 61) Addition by 1. Components: Three forces,  $\vec{F}_1$ ,  $\vec{F}_2$ , and  $\vec{F}_3$ , each of magnitude 70 N, all act on an object as shown in the figure. The magnitude of the resultant force acting on the object is



- A) 70 N.      B) 140 N.      C) 210 N.      D) 0 N.      E) 35 N.
- Answer: D

- 62) Addition by 1. Components: Three forces,  $\vec{F}_1$ ,  $\vec{F}_2$ , and  $\vec{F}_3$ , all act on an object, as shown in the figure. The magnitudes of the forces are:  $F_1 = 80.0$  N,  $F_2 = 60.0$  N, and  $F_3 = 40.0$  N. The resultant force acting on the object is given by

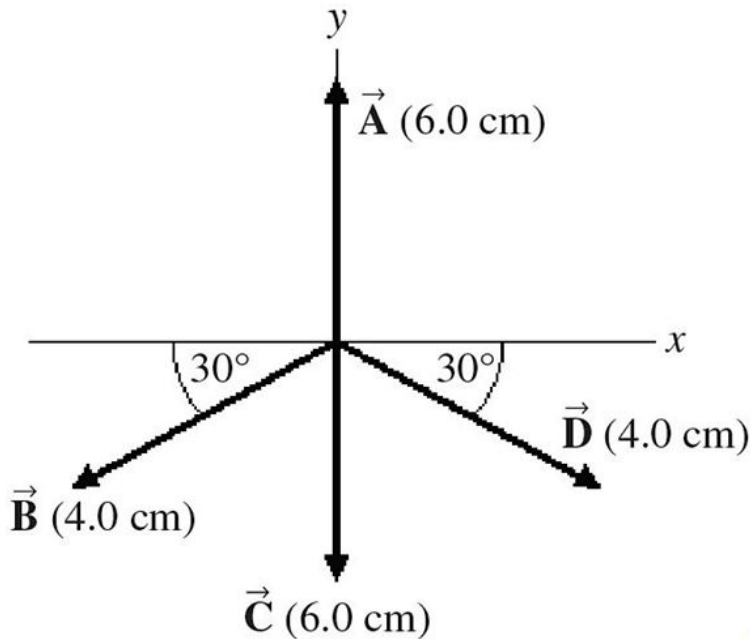


- A) 60.0 N at an angle of  $90.0^\circ$  with respect to  $+x$ -axis.
- B) 35.5 N at an angle of  $34.3^\circ$  with respect to  $+x$ -axis.
- C) 20.0 N at an angle of  $34.3^\circ$  with respect to  $+x$ -axis.
- D) 40.0 N at an angle of  $60.0^\circ$  with respect to  $+x$ -axis.
- E) 180 N at an angle of  $60.0^\circ$  with respect to  $+x$ -axis.

Answer: B



- 63) Addition by 1. Components: Four vectors,  $\vec{A}$ ,  $\vec{B}$ ,  $\vec{C}$ , and  $\vec{D}$ , are shown in the figure. The sum of these four vectors is a vector having magnitude and direction



- A) 4.0 cm, along +y-axis.
- B) 4.0 cm,  $45^\circ$  above +x-axis.
- C) 4.0 cm, along +x-axis.
- D) 4.0 cm, along -y-axis.
- E) 4.0 cm, along -x-axis.

Answer: D

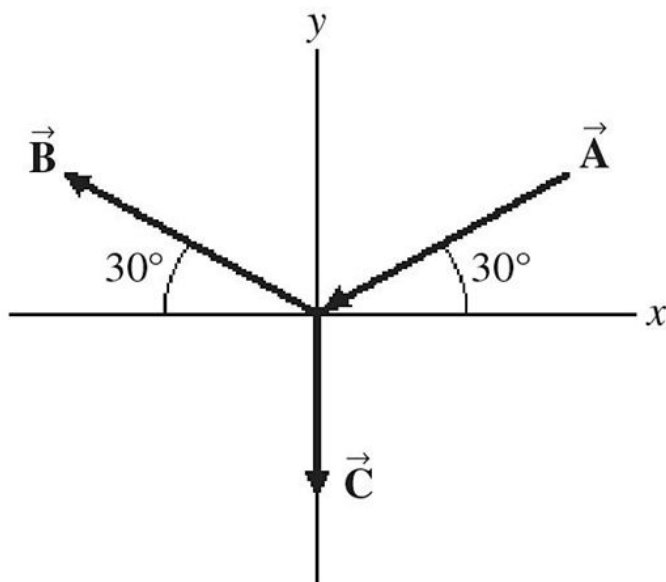
- 64) Addition by 1. Components: Vector  $\vec{A}$  has a magnitude of 8.0 m and points  $30^\circ$  north of east; vector  $\vec{B}$  has a magnitude of 6.0 m and points  $30^\circ$  west of north; and vector  $\vec{C}$  has a magnitude of 5.0 m and points  $30^\circ$  west of south. The resultant vector  $\vec{A} + \vec{B} + \vec{C}$  is given by

- A) 5.1 m at an angle  $74^\circ$  north of east.
- B) 4.8 m at an angle  $74^\circ$  east of north.
- C) 5.9 m at an angle  $74^\circ$  north of east.
- D) 2.1 m at an angle  $66^\circ$  east of north.
- E) 2.7 m at an angle  $74^\circ$  north of east.

Answer: A

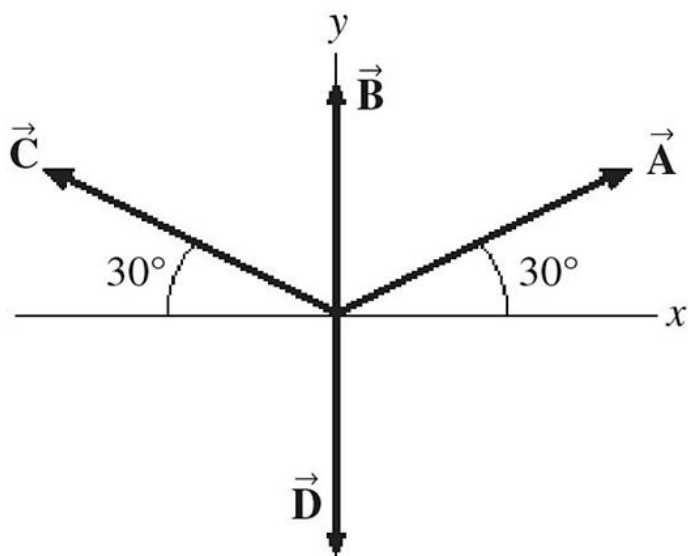
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 65) Addition by 1. Components: The figure shows three vectors,  $\vec{A}$ ,  $\vec{B}$ , and  $\vec{C}$ , having magnitudes 7.0 cm, 6.0 cm, and 4.0 cm, respectively. Find the  $x$  and  $y$  components of the resultant of these three vectors.



Answer: -11 cm ( $x$  component), -4.5 cm ( $y$  component)

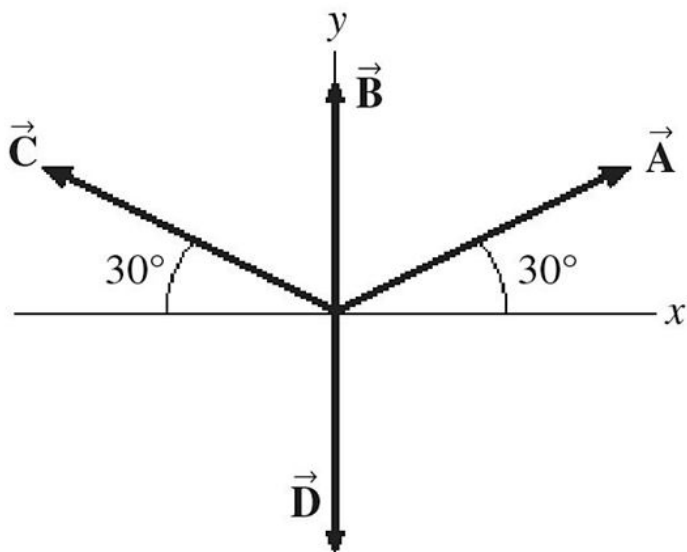
- 66) Addition by 1. Components: The figure shows four vectors,  $\vec{A}$ ,  $\vec{B}$ ,  $\vec{C}$ , and  $\vec{D}$ , having magnitudes 10.0 m, 8.00 m, 6.00 m, and 2.00 m, respectively. Find the magnitude of the sum of these four vectors.



Answer: 14.4 m

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 67) Addition by 1. Components: The figure shows four vectors,  $\vec{A}$ ,  $\vec{B}$ ,  $\vec{C}$ , and  $\vec{D}$ , having magnitudes 12.0 m, 10.0 m, 8.0 m, and 4.0 m, respectively. The sum of these four vectors is

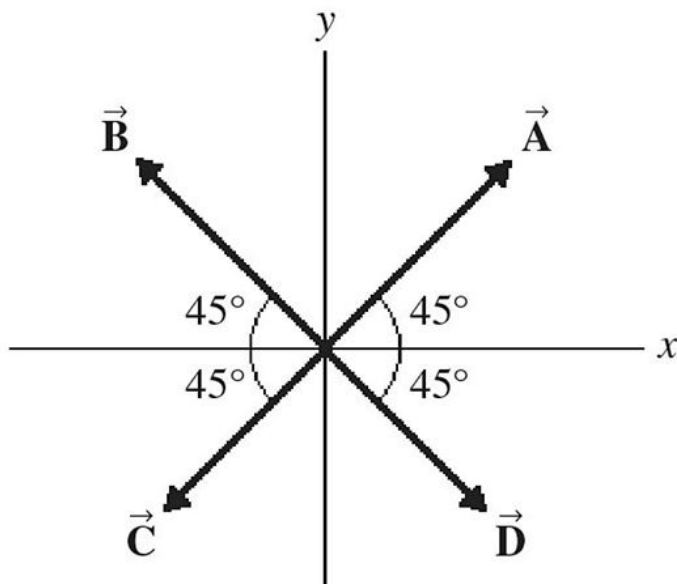


- A) 19.5 m at an angle  $12.3^\circ$  with respect to  $+x$ -axis.
- B) 8.20 m at an angle  $77.8^\circ$  with respect to  $+x$ -axis.
- C) 16.4 m at an angle  $77.8^\circ$  with respect to  $+x$ -axis.
- D) 16.4 m at an angle  $12.3^\circ$  with respect to  $+x$ -axis.
- E) 19.5 m at an angle  $77.8^\circ$  with respect to  $+x$ -axis.

Answer: C

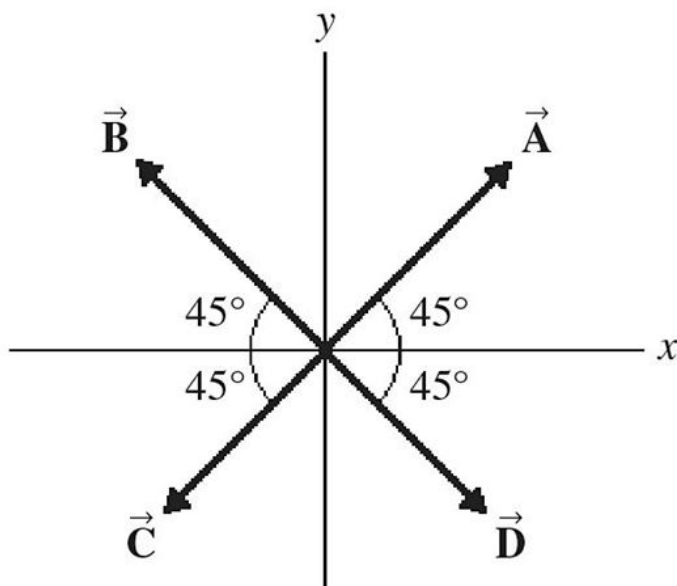
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 68) Addition by 1. Components: The figure shows four vectors,  $\vec{A}$ ,  $\vec{B}$ ,  $\vec{C}$ , and  $\vec{D}$ . Vectors  $\vec{A}$  and  $\vec{B}$  each have a magnitude of 7.0 cm, and vectors  $\vec{C}$  and  $\vec{D}$  each have a magnitude of 4.0 cm. Find the  $x$  and  $y$  components of the sum of these four vectors.



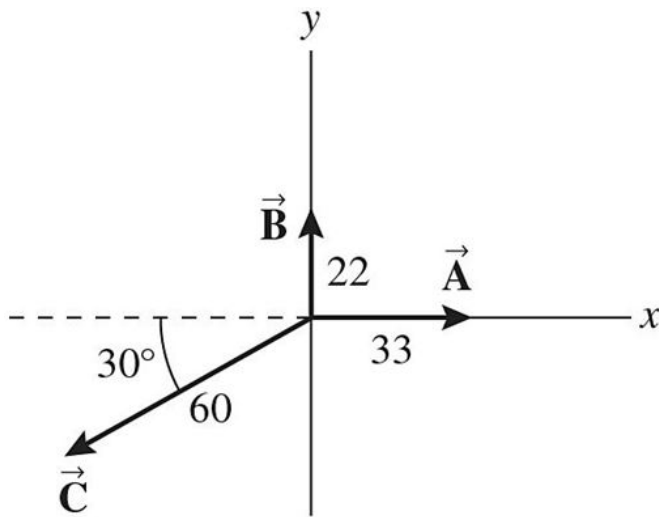
Answer: 0.00 cm ( $x$  component), 4.2 cm ( $y$  component)

- 69) Addition by 1. Components: The figure shows four vectors,  $\vec{A}$ ,  $\vec{B}$ ,  $\vec{C}$ , and  $\vec{D}$ . Vectors  $\vec{A}$  and  $\vec{B}$  both have a magnitude of 7.0 cm, and vectors  $\vec{C}$  and  $\vec{D}$  both have a magnitude of 4.0 cm. Find the magnitude and direction of the sum of these four vectors.



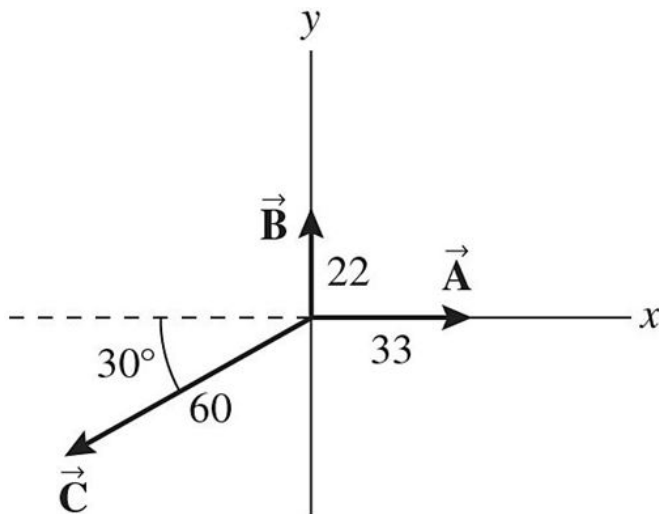
Answer: 4.2 cm along the  $+y$ -axis

- 70) Addition by 1. Components: The figure shows three vectors,  $\vec{A}$ ,  $\vec{B}$ , and  $\vec{C}$ , along with their magnitudes. Determine the magnitude and direction of the vector given by  $\vec{A} - \vec{B} - \vec{C}$ .



Answer: 85 m at  $5.4^\circ$  above the  $+x$ -axis

- 71) Addition by 1. Components: The figure shows three vectors,  $\vec{A}$ ,  $\vec{B}$ , and  $\vec{C}$ , along with their magnitudes. Determine the magnitude and direction of the vector given by  $\vec{A} + \vec{B} - \vec{C}$ .



Answer: 100 m at  $31^\circ$  above the  $+x$ -axis

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 72) Addition by 1. Components: Three vectors,  $\vec{S}$ ,  $\vec{T}$ , and  $\vec{U}$ , have the components shown in the table. What is the magnitude of the resultant of these three vectors?

	$x$ component	$y$ component
$\vec{S}$	3.50 m	-4.50 m
$\vec{T}$	2.00 m	0.00 m
$\vec{U}$	-5.50 m	2.50 m

- A) 11.1 m                      B) 13.0 m                      C) 5.50 m                      D) 2.00 m                      E) 7.00 m

Answer: D

- 73) Addition by 1. Components: Three vectors,  $\vec{S}$ ,  $\vec{T}$ , and  $\vec{U}$ , have the components shown in the table. What angle does the resultant of these three vectors make with the  $+x$ -axis?

	$x$ component	$y$ component
$\vec{S}$	-3.5 m	4.5 m
$\vec{T}$	0.00 m	-6.5 m
$\vec{U}$	5.5 m	-2.5 m

- A)  $24^\circ$  above the  $+x$ -axis                      B)  $24^\circ$  below the  $+x$ -axis  
C)  $66^\circ$  below the  $+x$ -axis                      D)  $66^\circ$  above the  $+x$ -axis

Answer: C