

106 Vector Problems and FRQ

17pts total = 10pts MC + 7pts FRQ

1. Two vectors, A and B, have the same magnitude, m , but vector A points north whereas vector B points east. What is the sum, $A + B$?

(A) m , northeast
(B) $m\sqrt{2}$, northeast
(C) $m\sqrt{2}$, northwest
(D) $2m$, northwest

2. If $\mathbf{F}_1 = -20\mathbf{j}$, $\mathbf{F}_2 = -10\mathbf{i}$, and $\mathbf{F}_3 = 5\mathbf{i} + 10\mathbf{j}$, what is the sum $\mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3$?

(A) $-15\mathbf{i} + 10\mathbf{j}$
(B) $-5\mathbf{i} - 10\mathbf{j}$
(C) $5\mathbf{i}$
(D) $5\mathbf{i} - 10\mathbf{j}$

3. Both the x - and y -components of a vector are doubled. Which of the following describes what happens to the resulting vector?

(A) Magnitude increases by a factor of $\sqrt{2}$
(B) Magnitude increases by a factor of $\sqrt{2}$, and the direction changes
(C) Magnitude increases by a factor of 2
(D) Magnitude increases by a factor of 2, and the direction changes

4. If vectors $v_0 = 15 \text{ m/s}$ north and $v_f = 5 \text{ m/s}$ south, what is $v_f - v_0$?
- (A) 10 m/s north
 - (B) 10 m/s south
 - (C) 20 m/s north
 - (D) 20 m/s south
5. The magnitude of vector \mathbf{A} is 10. Which of the following could be the components of \mathbf{A} ?
- (A) $A_x = 5, A_y = 5$
 - (B) $A_x = 6, A_y = 8$
 - (C) $A_x = 7, A_y = 9$
 - (D) $A_x = 10, A_y = 10$
6. If the vector $\mathbf{A} = \hat{i} - 2\hat{j}$ and the vector $\mathbf{B} = 4\hat{i} - 5\hat{j}$, what angle does $\mathbf{A} + \mathbf{B}$ form with the x -axis?
- (A) $\theta = \tan^{-1} \frac{3}{5}$
 - (B) $\theta = \tan^{-1} \frac{7}{5}$
 - (C) $\theta = \sin^{-1} \frac{3}{5}$
 - (D) $\theta = \sin^{-1} \frac{5}{7}$

7. An object travels along the vector $d_1 = 4\text{m } \hat{i} + 5\text{m } \hat{j}$ and then along the vector $d_2 = 2\text{m } \hat{i} - 3\text{m } \hat{j}$. How far is the object from where it started?

- (A) 6.3 m
- (B) 8 m
- (C) 10 m
- (D) 14 m

8. If $\mathbf{A} = \begin{array}{c} \nearrow \\ \text{vector} \end{array}$ and $\mathbf{B} = \begin{array}{c} \nearrow \\ \text{vector} \end{array}$, which of the following best represents the direction of $\mathbf{A} - \mathbf{B}$?

- (A) \longrightarrow
- (B) \longleftarrow
- (C) $\begin{array}{c} \nearrow \\ \text{vector} \end{array}$
- (D) $\begin{array}{c} \nearrow \\ \text{vector} \end{array}$

9. The x -component of vector \mathbf{A} is -42 , and the angle it makes with the positive x -direction is 130° . What is the y -component of vector \mathbf{A} ?

- (A) -65.3
- (B) -50.1
- (C) 50.1
- (D) 65.3

10. If two non-zero vectors are added together, and the resultant vector is zero, what must be true of the two vectors?
- (A) They have equal magnitude and are pointed in the same direction.
 - (B) They have equal magnitude and are pointed in opposite directions.
 - (C) They have different magnitudes and are pointed in opposite directions.
 - (D) It is not possible for the sum of two non-zero vectors to be zero.

FRQ (7pts)

1. Let the vectors, \mathbf{A} , \mathbf{B} , and \mathbf{C} be defined by: $\mathbf{A} = 3\hat{i} + 6\hat{j}$, $\mathbf{B} = -\hat{i} + 4\hat{j}$, and $\mathbf{C} = 5\hat{i} - 2\hat{j}$.
 - (a) What is the magnitude of vector \mathbf{A} ?
 - (b) Sketch the vector subtraction problem $\mathbf{B} - \mathbf{C}$ and find the components of the resultant vector.
 - (c) Find the components of $\mathbf{A} + 2\mathbf{B}$.
 - (d) Express $\mathbf{A} - \mathbf{B} - \mathbf{C}$ as a magnitude and angle relative to the horizontal.

2. An ant walks 20 cm due north, 30 cm due east, and then 14 cm northeast.
 - (a) Assuming that each portion of the ant's journey is a vector, sketch the ant's path.
 - (b) How far has the ant travelled from its original position?
 - (c) If the ant does not want to travel farther than 80 cm from its original position, how much farther north could it walk?