

Topic : Mathematical Tools

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.8

(3 marks, 3 min.)

M.M., Min.

[24, 24]

Multiple choice objective ('-1' negative marking) Q.9

(4 marks, 4 min.)

[4, 4]

Subjective Questions ('-1' negative marking) Q.10

(4 marks, 5 min.)

[4, 5]

1. Given : $\vec{A} = 2\hat{i} - 3\hat{j}$ and $\vec{B} = 5\hat{i} - 6\hat{j}$

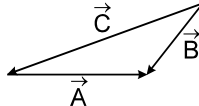
The magnitude of $(\vec{A} + \vec{B})$ is :

- (A) $\sqrt{120}$ units (B) $\sqrt{130}$ units (C) $\sqrt{58}$ units (D) $\sqrt{65}$ units

2. Unit vector along $3\hat{i} + 3\hat{j}$ is

- (A) $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$ (B) $\frac{3\hat{i} + 3\hat{j}}{2}$ (C) $\hat{i} + \hat{j}$ (D) $\frac{\hat{i} + \hat{j}}{\sqrt{3}}$

3. For the figure shown.



- (A) $\vec{A} + \vec{B} = \vec{C}$ (B) $\vec{B} + \vec{C} = \vec{A}$ (C) $\vec{C} + \vec{A} = \vec{B}$ (D) $\vec{A} + \vec{B} + \vec{C} = 0$

4. Parallelogram law of vectors is applicable to the addition of :

- (A) Any two vectors (B) Two scalars
(C) A vector and a scalar (D) Two vectors representing same physical quantity.

5. If $\vec{A}$ and $\vec{B}$ are two non-zero vectors such that $|\vec{A} + \vec{B}| = \frac{|\vec{A} - \vec{B}|}{2}$ and $|\vec{A}| = 2|\vec{B}|$ then the angle between $\vec{A}$ and $\vec{B}$ is :

- (A) 37° (B) 53° (C) $\cos^{-1}(-3/4)$ (D) $\cos^{-1}(-4/3)$

6. Vectors $\vec{A} = \hat{i} + \hat{j} - 2\hat{k}$ and $\vec{B} = 3\hat{i} + 3\hat{j} - 6\hat{k}$ are :

- (A) Parallel (B) Antiparallel (C) Perpendicular (D) at acute angle with each other

7. A particle is moving with speed 6 m/s along the direction of $\vec{A} = 2\hat{i} + 2\hat{j} - \hat{k}$, then its velocity is :

- (A) $(4\hat{i} + 2\hat{j} - 4\hat{k})$ units (B) $(4\hat{i} + 4\hat{j} - 2\hat{k})$ units
(C) $(4\hat{i} + 4\hat{j} - 4\hat{k})$ units (D) $(2\hat{i} + 4\hat{j} - 2\hat{k})$ units

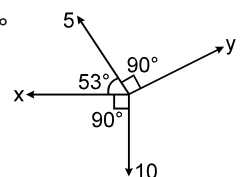
8. If $\vec{P} = \hat{i} + \hat{j} - \hat{k}$ and $\vec{Q} = \hat{i} - \hat{j} + \hat{k}$, then unit vector along $(\vec{P} - \vec{Q})$ is :

- (A) $\frac{1}{\sqrt{2}}\hat{i} - \frac{1}{2}\hat{k}$ (B) $\frac{\sqrt{2}\hat{j} - \sqrt{2}\hat{k}}{2}$ (C) $\frac{\hat{j} - \hat{k}}{2\sqrt{2}}$ (D) $\frac{2\hat{j} - 2\hat{k}}{4}$

9. If $|\vec{a} + \vec{b}| \geq |\vec{a} - \vec{b}|$ then angle between $\vec{a}$ and $\vec{b}$ may be

- (A) 50° (B) 90° (C) 60° (D) 120°

10. Find the magnitude of the unknown forces X and Y if sum of all forces is zero.



Answers Key

DPP NO. - 9

1. (B) 2. (A) 3. (C) 4. (D) 5. (C)
6. (A) 7. (B) 8. (B) 9. (A), (B), (C)
10. (5, 10)

Hint & Solutions

DPP NO. - 9

1. $(\vec{A} + \vec{B}) = 7\hat{i} - 9\hat{j}$

$$\therefore |\vec{A} + \vec{B}| = \sqrt{49 + 81} = \sqrt{130}$$

2. unit vector $= \frac{3\hat{i} + 3\hat{j}}{\sqrt{3^2 + 3^2}} = \frac{\hat{i} + \hat{j}}{\sqrt{2}}$

3. Apply triangle law of vector addition.

5. $(A^2 + B^2 + 2AB \cos \theta) = \frac{1}{4} (A^2 + B^2 - 2AB \cos \theta)$

$$\Rightarrow 3A^2 + 3B^2 + 10AB \cos \theta = 0$$

$$\text{or } 12B^2 + 3B^2 + 10(2B)(B) \cos \theta = 0$$

$$15B^2 + 20B^2 \cos \theta = 0$$

$$\cos \theta = -\frac{3}{4}$$

6. Since $\vec{B} = 3\vec{A}$, so both are parallel.

7. Velocity = (speed) $\hat{A}$

$$= 6 \frac{(2\hat{i} + 2\hat{j} - \hat{k})}{\sqrt{4 + 4 + 1}} = (4\hat{i} + 4\hat{j} - 2\hat{k}) \text{ units.}$$

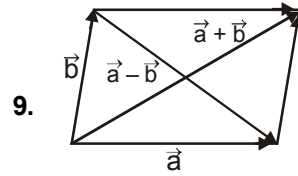
8. $\vec{P} - \vec{Q} = (\hat{i} + \hat{j} - \hat{k}) - (\hat{i} - \hat{j} + \hat{k}) = 2\hat{j} - 2\hat{k}$

$\therefore$ unit vector along

$$\frac{\vec{P} - \vec{Q}}{|\vec{P} - \vec{Q}|} = \frac{2\hat{j} - 2\hat{k}}{\sqrt{(2)^2 + (-2)^2}}$$

$$\therefore \frac{\vec{P}-\vec{Q}}{|\vec{P}-\vec{Q}|} = \frac{(\vec{P}-\vec{Q})}{\sqrt{(2)^2 + (-2)^2}} = \frac{2\hat{j}-2\hat{k}}{\sqrt{4+4}}$$

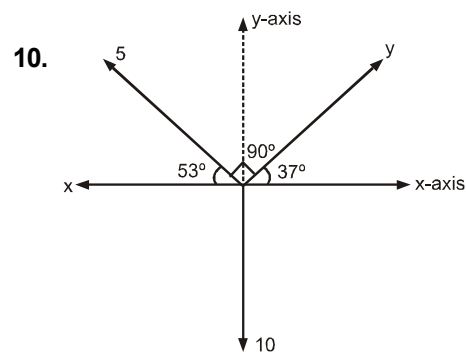
$$= \frac{2\hat{j}-2\hat{k}}{\sqrt{4+4}} = \frac{2\hat{j}-2\hat{k}}{2\sqrt{2}} = \frac{\hat{j}-\hat{k}}{\sqrt{2}}$$



$$|\vec{a} + \vec{b}| \geq |\vec{a} - \vec{b}|$$

$$\Rightarrow \text{angle between } \vec{a} \text{ \& } \vec{b} \leq 90^\circ$$

$$\Rightarrow \vec{a} \cdot \vec{b} \leq 90^\circ$$



$$\Sigma \vec{F} = 0$$

$$\Rightarrow (y \cos 37^\circ \hat{i} + y \sin 37^\circ \hat{j}) + (5 \cos 53^\circ (-\hat{i}) + 5$$

$$\sin 53^\circ \hat{j}) + (x(-\hat{i}) + 10(-\hat{j})) = 0$$

$$\Rightarrow \left(\frac{4y}{5} - 3 - x \right) \hat{i} + \left(\frac{3y}{5} + 4 - 10 \right) \hat{j} = 0\hat{i} + 0\hat{j}$$

Comparing coefficients of $\hat{i}$ & $\hat{j}$ both sides—

$$\frac{4y}{5} - x = 3 \quad \dots\dots(i)$$

$$\frac{3y}{5} = 6 \quad \Rightarrow y = 10$$

$$\text{Putting } 8 - x = 3 \quad \Rightarrow x = 5$$