Physicsaholics

DPP - 4(Vectors)

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Q 1. If $\vec{A} \times \vec{B} = \vec{C}$, then which of the following statements is wrong:

(a) $\vec{C} \perp \vec{A}$ (b) $\vec{C} \perp \vec{B}$

(c) $\vec{C} \perp (\vec{A} + \vec{B})$ (d) $\vec{C} \perp (\vec{A} \times \vec{B})$

Q 2. If two vectors $2\hat{\imath} + 3\hat{\jmath} - \hat{k}$ and $-4\hat{\imath} - 6\hat{\jmath} - \lambda\hat{k}$ are parallel to each other then value of λ be:

(a) 0 (b) -2 (c) 3 (d) -4

Q 3. What is the value of $(\vec{A} + \vec{B}).(\vec{A} \times \vec{B}) = ?$

(a) 0 (b) $A^2 - B^2$

(c) $A^2 + B^2 + 2AB$ (d) None of these

Q 4. Let $\vec{A} = \hat{\imath} + \hat{\jmath} + \hat{k}, \vec{B} = \hat{\jmath} - \hat{k}$. If $\vec{C}$ is a vector satisfying $\vec{A} \times \vec{C} = \vec{B}$ and $\vec{A}.\vec{C} = 3$, then $\vec{C}$ is:

(a) $\frac{1}{3}(5\hat{\imath} + 2\hat{\jmath} + 2\hat{k})$ (b) $\frac{1}{3}(5\hat{\imath} - 2\hat{\jmath} - 2\hat{k})$

(c) $3\hat{\imath} - \hat{\jmath} - \hat{k}$ (d) None of these

Q 5. The vector perpendicular to the vectors $4\hat{\imath} - \hat{\jmath} + 3\hat{k}$ and $-2\hat{\imath} + \hat{\jmath} - 2\hat{k}$ whose magnitude is 9:

(a) $3\hat{\imath} + 6\hat{\jmath} - 6\hat{k}$ (b) $3\hat{\imath} - 6\hat{\jmath} + 6\hat{k}$

(c) $-3\hat{\imath} + 6\hat{\jmath} + 6\hat{k}$ (d) None of these

Q 6. Find $\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times (\vec{c} + \vec{a}) + \vec{c} \times (\vec{a} + \vec{b}) = ?$

(a) $\vec{a} + \vec{b} + \vec{c}$ (b) $\vec{a} \cdot (\vec{a} + \vec{b} + \vec{c})$

(c) $(\vec{a} \cdot \vec{b} \cdot \vec{c}) \times (\vec{a} + \vec{b} + \vec{c})$ (d) zero

Q 7. Find $[2\hat{\jmath} \times (3\hat{\imath} - 4\hat{k})] \cdot [(\hat{\imath} - 2\hat{k}) \times \hat{k}] = ?$

(a) 0 (b) $\hat{\imath} + \hat{\jmath} - \hat{k}$

(c) $2\hat{\imath} + \hat{\jmath} - 3\hat{k}$ (d) 16

Q 8. Find $\hat{\imath} \cdot (\hat{\jmath} \times \hat{k}) + (\hat{\imath} \times \hat{k}) \cdot \hat{\jmath} = ?$

(a) $2\hat{\imath} + \hat{\jmath}$ (b) 1

(c) 0 (d) $\hat{\imath} + \hat{\jmath} + \hat{k}$

Q 9. If $|\vec{a}| = 13$, $|\vec{b}| = 5$ and $\vec{a} \cdot \vec{b} = 30$, then $|\vec{a} \times \vec{b}|$ =?

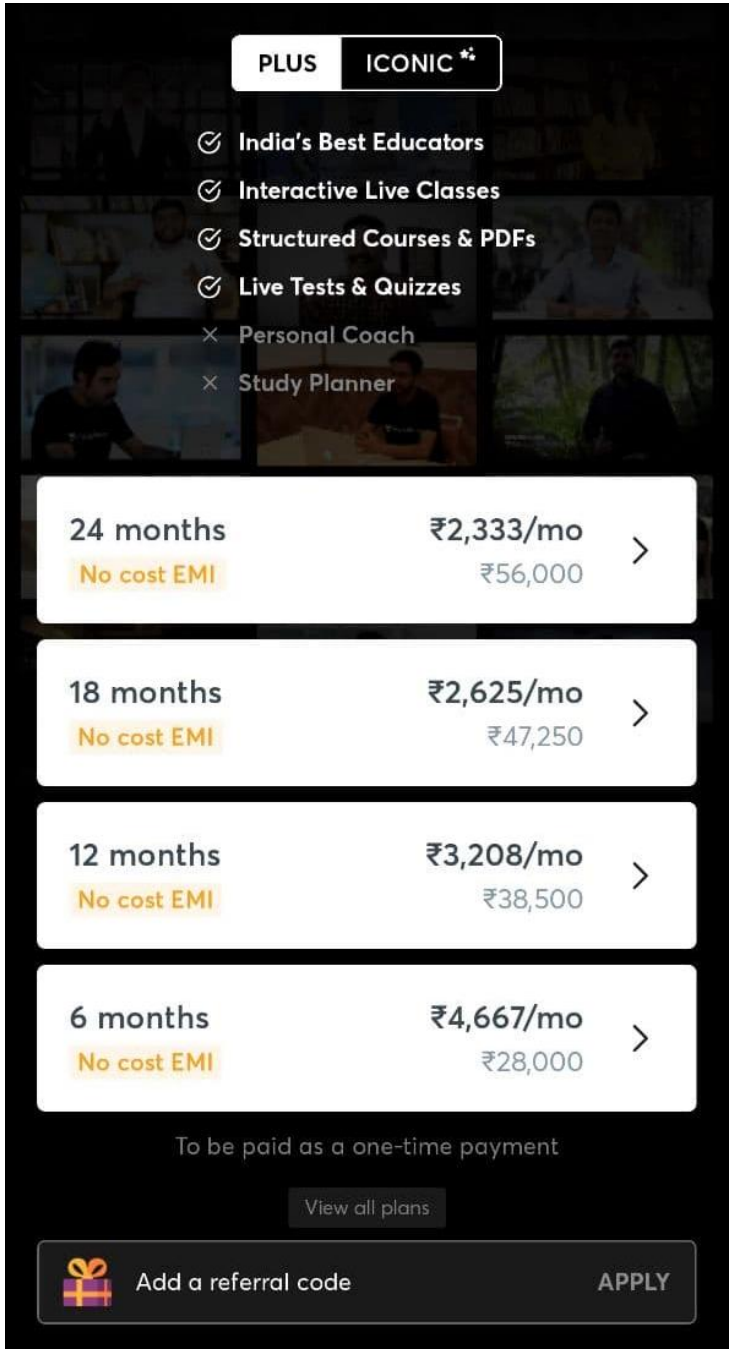
(a) 30
(b) $\frac{30}{25}\sqrt{233}$
(c) $\frac{30}{33}\sqrt{193}$
(d) $\frac{65}{13}\sqrt{133}$

Q 10. Vector $\vec{A}$ & $\vec{B}$ have scalar product 6.00 and their vector product has magnitude +9.00 What is the angle between these two vectors?

(a) $\tan^{-1}(1.5)$
(b) $\tan^{-1}(3)$
(c) $\tan^{-1}(2)$
(d) $\tan^{-1}\left(\frac{2}{3}\right)$

Answer Key

Q.1 d	**Q.2 b**	**Q.3 a**	**Q.4 a**	**Q.5 c**
Q.6 d	**Q.7 a**	**Q.8 c**	**Q.9 d**	**Q.10 a**



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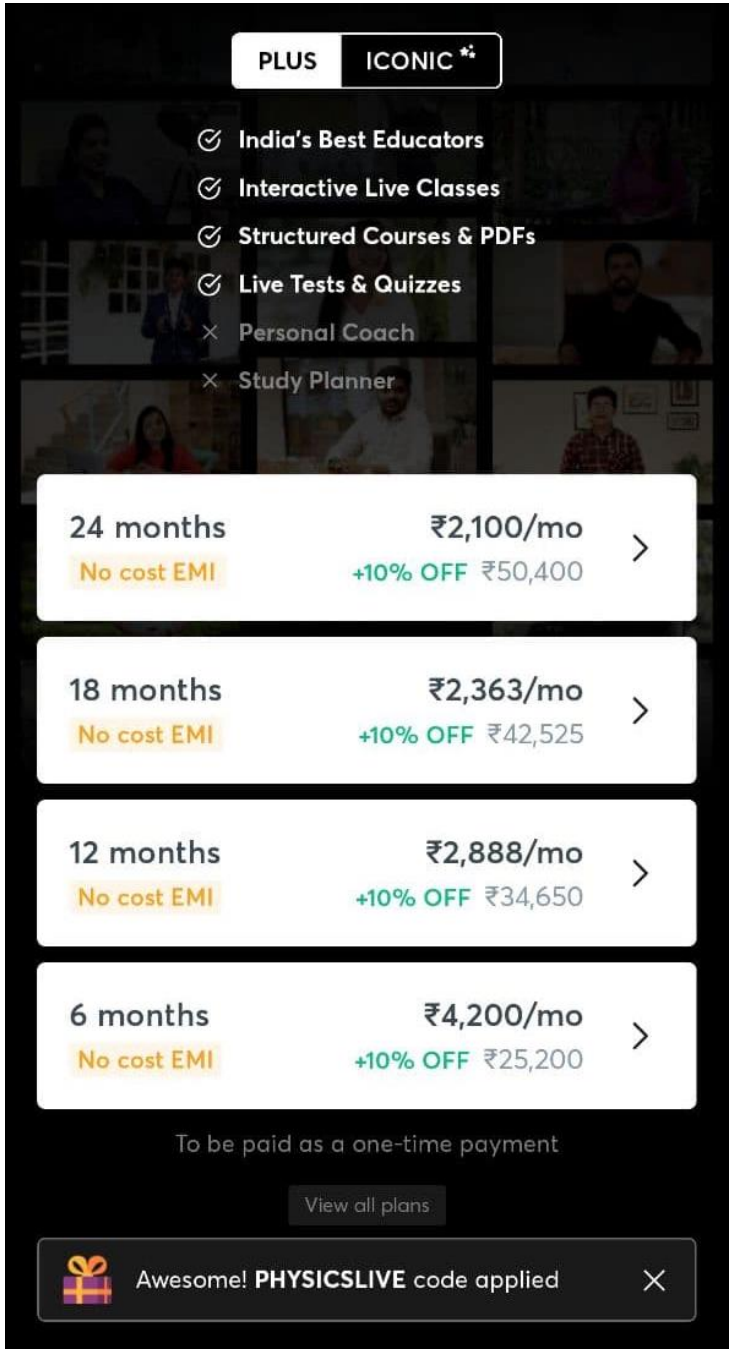

Written Solution

DPP-4 Vectors (Cross product)

By Physicsaholics Team

Solution.1

$\vec{A} \times \vec{B} = \vec{C}$

Means; $\vec{C} \perp \vec{A}$
and $\vec{C} \perp \vec{B}$

and $\vec{C}$ is $\perp$ to plane of $\vec{A}$ & $\vec{B}$

$\because \vec{A} + \vec{B}$ is in the plane of $\vec{A}$ & $\vec{B}$

$\therefore \vec{C} \perp (\vec{A} + \vec{B})$

& $\vec{C} = \vec{A} \times \vec{B}$

so) $\vec{C}$ cant be $\perp$ to $\vec{A} \times \vec{B}$
$\therefore \vec{C}$ is equal to $\vec{A} \times \vec{B}$

Ans.d

Solution.2

$\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{b} = -4\hat{i} - 6\hat{j} - d\hat{k}$

$\vec{a} \parallel \vec{b}$; then $\vec{a} \times \vec{b} = 0$

$\therefore \vec{a} \times \vec{b} = (2\hat{i} + 3\hat{j} - \hat{k}) \times (-4\hat{i} - 6\hat{j} - d\hat{k})$

$= \hat{i}(-3d - 6) + \hat{j}(2d + 4) + \hat{k}(-12 + 12)$

$= \hat{i}(-3d - 6) + \hat{j}(2d + 4) + \hat{k}(0)$

$\therefore \vec{a} \times \vec{b} = 0$

$\Rightarrow \hat{i}(-3d - 6) + \hat{j}(2d + 4) + \hat{k}(0) = 0$

$-3d - 6 = 0 \Rightarrow d = -2$

$2d + 4 = 0 \Rightarrow d = -2$

$\therefore \boxed{d = -2}$

Ans.b

Solution.3

$(\vec{A}+\vec{B})\cdot(\vec{A}\times\vec{B}) = ?$

Let $\vec{C} = \vec{A}\times\vec{B}$

then $\vec{C}$ is $\perp$ to $\vec{A}$

& $\vec{C}$ is $\perp$ to $\vec{B}$

and $\vec{C}$ is $\perp$ to $(\vec{A}+\vec{B})$

$\therefore$ dot product of $\perp$ vectors is zero.

$\therefore (\vec{A}+\vec{B})\cdot(\vec{A}\times\vec{B})$

$= (\vec{A}+\vec{B})\cdot(\vec{C})$

$(\vec{A}+\vec{B})\cdot(\vec{C}) =$ zero

Ans.a

Solution.4

$\vec{A} = \hat{i} + \hat{j} + \hat{k}$

$\vec{B} = \hat{j} - \hat{k}$

Given; $\vec{A} \times \vec{C} = \vec{B}$

$\vec{A} \cdot \vec{C} = 3$

Let; $\vec{C} = x\hat{i} + y\hat{j} + z\hat{k}$

$\therefore \vec{A} \times \vec{C} = \vec{B}$

$(\hat{i} + \hat{j} + \hat{k}) \times (x\hat{i} + y\hat{j} + z\hat{k}) = \hat{j} - \hat{k}$

$\hat{i}(z-y) + \hat{j}(x-z) + \hat{k}(y-x) = \hat{j} - \hat{k}$

$\Rightarrow z - y = 0 \; ; \; x - z = 1, \; y - x = -1$

$\boxed{y = z} \; ; \; \boxed{x = 1 + z}; \; \boxed{y = x - 1}$

& $\vec{A} \cdot \vec{C} = 3$

$(\hat{i} + \hat{j} + \hat{k}) \cdot (x\hat{i} + y\hat{j} + z\hat{k}) = 3$

$x + y + z = 3$

$(1+z) + (z) + z = 3$

$3z = 2 \Rightarrow \boxed{z = \frac{2}{3}}$

$\Rightarrow x = 1 + \frac{2}{3} = \frac{5}{3} \Rightarrow \boxed{x = \frac{5}{3}}$

$\boxed{y = z = \frac{2}{3}}$

$\vec{C} = \frac{5}{3}\hat{i} + \frac{2}{3}\hat{j} + \frac{2}{3}\hat{k}$

$\vec{C} = \frac{5}{3}\hat{i} + \frac{2}{3}\hat{j} + \frac{2}{3}\hat{k}$

$\boxed{\vec{C} = \frac{1}{3}(5\hat{i} + 2\hat{j} + 2\hat{k})}$

Ans.a

Solution.5

$\vec{a} = 4\hat{i} - \hat{j} + 3\hat{k}$

$\vec{b} = -2\hat{i} + \hat{j} - 2\hat{k}$

Let $\vec{c} = \vec{a} \times \vec{b}$

$\Rightarrow \vec{c}$ is $\perp \vec{a}$

& $\vec{c} \perp \vec{b}$

$\therefore \vec{c} = (4\hat{i} - \hat{j} + 3\hat{k}) \times (-2\hat{i} + \hat{j} - 2\hat{k})$

$\vec{c} = \hat{i}(2-3) + \hat{j}(8-6) + \hat{k}(4-2)$

$\vec{c} = -\hat{i} + 2\hat{j} + 2\hat{k}$

$|\vec{c}| = \sqrt{1^2 + 2^2 + 2^2} = \sqrt{9} = 3$

$\hat{c} = \frac{-\hat{i} + 2\hat{j} + 2\hat{k}}{3}$

$\vec{d} = 9\hat{c}$

$\vec{d} = 9\left(\frac{-\hat{i} + 2\hat{j} + 2\hat{k}}{3}\right)$

$\boxed{\vec{d} = -3\hat{i} + 6\hat{j} + 6\hat{k}}$

Ans.c

Solution.6

$\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times (\vec{c} + \vec{a}) + \vec{c} \times (\vec{a} + \vec{b}) = ?$

$\vec{a} \times \vec{b} + \vec{a} \times \vec{c} + \vec{b} \times \vec{c} + \vec{b} \times \vec{a} + \vec{c} \times \vec{a} + \vec{c} \times \vec{b}$

$\because \vec{a} \times \vec{b} = -\vec{b} \times \vec{c} \Rightarrow (\vec{a} \times \vec{b}) + (\vec{b} \times \vec{c}) = 0$

& $\vec{b} \times \vec{c} = -\vec{c} \times \vec{b} \Rightarrow (\vec{b} \times \vec{c}) + (\vec{c} \times \vec{b}) = 0$

& $\vec{a} \times \vec{c} = -\vec{c} \times \vec{a} = (\vec{a} \times \vec{c}) + (\vec{c} \times \vec{a}) = 0$

$\therefore (\vec{a} \times \vec{b}) + (\vec{b} \times \vec{c}) + (\vec{b} \times \vec{c}) + (\vec{c} \times \vec{b}) + (\vec{c} \times \vec{a}) + (\vec{a} \times \vec{c})$

$= 0 + 0 + 0$

$= 0$

Ans.d

Solution.7

$$\left[2\hat{i} \times (3\hat{j} - 4\hat{k})\right] \cdot \left[(\hat{i} - 2\hat{k}) \times \hat{k}\right]$$

$$\Rightarrow \left[-6\hat{k} - 8\hat{j}\right] \cdot \left(-\hat{j} + 0\right)$$

$$= (-6\hat{k} - 8\hat{j}) \cdot (-\hat{j})$$

$$= 0$$

Ans.a

Solution.8

$$K = \hat{j} \cdot (\hat{j} \times \hat{k}) + (\hat{i} \times \hat{k}) \cdot \hat{j} = ?$$

$$K = \hat{j} \cdot (\hat{i}) + (-\hat{j}) \cdot \hat{j}$$

$$K = 1 + (-1)$$

$$K = 1 - 1$$

$$\boxed{K = 0}$$

Ans.c

Solution.9

$|\vec{a}| = 13$, $|\vec{b}| = 5$; $\vec{a} \cdot \vec{b} = 30$

$\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta$

$30 = (13)(5) \cos\theta$

$\cos\theta = \frac{6}{13}$

$\sin\theta = \frac{\sqrt{13^2 - 6^2}}{13}$

$\sin\theta = \frac{\sqrt{133}}{13}$

$|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin\theta$

$\sin\theta \Rightarrow$

$|\vec{a} \times \vec{b}| = (13)(5)\left(\frac{\sqrt{133}}{13}\right)$

$$\boxed{|\vec{a} \times \vec{b}| = 5\sqrt{133}}$$

or

$$\boxed{|\vec{a} \times \vec{b}| = \frac{65}{13}\sqrt{133}}$$

Ans.d

Solution.10

$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta = 6 \quad \text{—(1)}$$

$$|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\theta = 9 \quad \text{—(2)}$$

$$\frac{(2)}{(1)} = \frac{\sin\theta}{\cos\theta} = \frac{9}{6}$$

$$\tan\theta = \frac{3}{2}$$

$$\tan\theta = 1.5$$

$$\boxed{\theta = \tan^{-1}(1.5)}$$

Ans.a

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