Yakeen NEET 2.0 2026

KPP [HCV questions]

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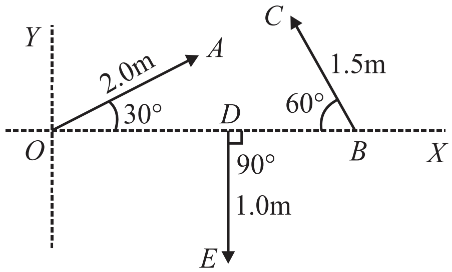
Vectors

1. Add vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ each having magnitude of 100 unit and inclined to the X-axis at angles 45°, 135° and 315° respectively.

2. Let $\vec{a} = 4\vec{i} + 3\vec{j}$ and $\vec{b} = 3\vec{i} + 4\vec{j}$. (a) Find the magnitudes of (1) $\vec{a}$, (2) $\vec{b}$, (3) $\vec{a} + \vec{b}$ and (4) $\vec{a} - \vec{b}$.

3. Refer to figure. Find (a) the magnitude, (b) x and y components and (c) the angle with the X-axis of the resultant of $\overrightarrow{OA}$, $\overrightarrow{BC}$ and $\overrightarrow{DE}$.



4. Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angle between them if the magnitude of the resultant is (a) 1 unit, (b) 5 unit and (c) 7 unit.

5. Suppose $\vec{a}$ is a vector of magnitude 4.5 unit due north. What is the vector (a) $3\vec{a}$, (b) $-4\vec{a}$?

6. Two vectors have magnitudes 2 m and 3 m. The angle between them is 60°. Find (a) the scalar product of the two vectors, (b) the magnitude of their vector product.

7. Let $\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{b} = 3\vec{i} + 4\vec{j} + 5\vec{k}$. Find the angle between them.

8. Prove that $\vec{A} \cdot (\vec{A} \times \vec{B}) = 0$.

9. If $\vec{A} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{B} = 4\vec{i} + 3\vec{j} + 2\vec{k}$, find $\vec{A} \times \vec{B}$.

10. The electric current in a charging R-C circuit is given by $i = i_0 e^{-t/RC}$ where i_0, R and C are constant parameters of the circuit and t is time. Find the rate of change of current at (a) $t = 0$, (b) $t = RC$, (c) t = 10 RC.

11. The electric current in a discharging R-C circuit is given by $i = i_0 e^{-t/RC}$ where i_0, R and C are constant parameters and t is time. Let $i_0 = 2.00$ A, $R = 6.00 \times 10^5\ \Omega$ and $C = 0.500\ \mu$F.
(a) Find the current at $t = 0.3$ s.
(b) Find the rate of change of current at $t = 0.3$ s.
(c) Find approximately the current at $t = 0.31$ s.

12. Find the area bounded under the curve $y = 3x^2 + 6x + 7$ and the X-axis with the ordinates at $x = 5$ and $x = 10$.

13. Find the area enclosed by the curve $y = \sin x$ and the X-axis between $x = 0$ and $x = \pi$.

14. Find the area bounded by the curve $y = e^{-x}$, the X-axis and the Y-axis.

15. The changes in a function y and the independent variable x are related as $\frac{dy}{dx} = x^2$. Find y as a function of x.

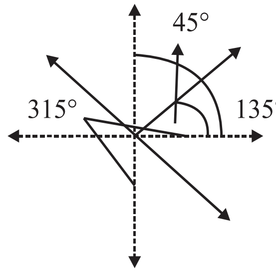
Answer Key

1. 100 unit at 45° with X-axis
2. **(1) 5, (2) 5, (3)** $7\sqrt{2}$, **(4)** $\sqrt{2}$
3. **(a) 1.6 m, (b) 0.98 m and 1.3 m respectively**
   (c) $\tan^{-1}(1.32)$
4. **(a) 180°, (b) 90°, (c) 0**
5. **(a) 13.5 unit due north, (b) 18 unit due south**
6. **(a) 3** m^2**, (b)** $3\sqrt{3}$ m^2
7. $\cos^{-1}(38/\sqrt{1450})$
8. $\vec{A} \cdot (\vec{A} \times \vec{B}) = 0$
9. $-6\vec{i} + 12\vec{j} - 6\vec{k}$
10. **(a)** $\frac{-i_0}{RC}$, (b) $\frac{-i_0}{RCe}$, (c) $\frac{-i_0}{RCe^{10}}$
11. **(a)** $\frac{2.00}{e}$ A, (b) $\frac{-20}{3e}$ A/s, (c) $\frac{5.8}{3e}$ A
12. **(1135)**
13. **(2)**
14. **(1)**
15. $y = \frac{x^3}{3} + C$

Solution

1. 100 unit at 45° with X-axis

Sol.



x component of $\vec{A} = 100\cos 45° = \frac{100}{\sqrt{2}}$ unit

x component of $\dot{B} = 100\cos 135° = \frac{100}{\sqrt{2}}$

x component of $\vec{C} = 100\cos 315° = \frac{100}{\sqrt{2}}$

Resultant x component $= \frac{100}{\sqrt{2}} - \frac{100}{\sqrt{2}} + \frac{100}{\sqrt{2}} = \frac{100}{\sqrt{2}}$

y component of $\vec{A} = 100\sin\ 45° = 100/\sqrt{2}$ unit

y component of $\vec{B} = 100\sin\ 135° = 100/\sqrt{2}$

y component of $\vec{C} = 100\sin\ 315° = -100/\sqrt{2}$

Resultant y component $= \frac{100}{\sqrt{2}} + \frac{100}{\sqrt{2}} - \frac{100}{\sqrt{2}} = \frac{100}{\sqrt{2}}$

Resultant = 100

Tan $\alpha = \frac{y \text{ component}}{x \text{ component}} = 1$

$\Rightarrow \alpha = \tan^{-1}(1) = 45°$

The resultant is 100 unit at 45° with x-axis.

2. (1) 5, (2) 5, (3) $7\sqrt{2}$, (4) $\sqrt{2}$

Sol. **(1)** $\vec{a} = 4\hat{i} + 3\hat{j}$

Calculate its magnitude:

$$|\vec{a}| = \sqrt{4^2+3^2} = \sqrt{16+9} = \sqrt{25} = 5$$

(2). $\vec{b} = 3\hat{i} + 4\hat{j}$

Calculate its magnitude:

$$|\vec{b}| = \sqrt{3^2+4^2} = \sqrt{9+16} = \sqrt{25} = 5$$

(3). Find $\vec{a}+\vec{b}$:

$$\vec{a}+\vec{b} = (4\hat{i}+3\hat{j}) + (3\hat{i}+4\hat{j})$$

$$= (4+3)\hat{i} + (3+4)\hat{j} = 7\hat{i} + 7\hat{j}$$

Calculate its magnitude:

$$|\vec{a}+\vec{b}| = \sqrt{7^2+7^2}$$

$$= \sqrt{49+49} = \sqrt{98} = 7\sqrt{2}$$

(4). Find $\vec{a}-\vec{b}$:

$$\vec{a}-\vec{b} = (4\hat{i}+3\hat{j}) - (3\hat{i}+4\hat{j})$$

$$= (4-3)\hat{i} + (3-4)\hat{j} = 1\hat{i} - 1\hat{j}$$

Calculate its magnitude:

$$|\vec{a}-\vec{b}| = \sqrt{1^2+(-1)^2} = \sqrt{1+1} = \sqrt{2}$$

3. (a) 1.6 m, (b) 0.98 m and 1.3 m respectively (c) $\tan^{-1}(1.32)$

Sol. x component of $\overrightarrow{OA} = 2\cos 30° = \sqrt{3}$

x component of $\overrightarrow{BC} = 1.5\cos 120° = -0.75$

x component of $\overrightarrow{DE} = 1\cos 270° = 0$

y component of $\overrightarrow{OA} = 2\sin 30° = 1$

y component of $\overrightarrow{BC} = 1.5\sin 120° = 1.3$

y component of $\overrightarrow{DE} = 1\sin 270° = -1$

$R_x = x$ component of resultant

$= \sqrt{3} - 0.75 + 0 = 0.98$ m

$R_y =$ resultant y component $= 1 + 1.3 - 1$

$= 1.3$ m

So, $R =$ Resultant $= 1.6$ m

If it makes and angle α with positive x-axis

Tan $\alpha = \frac{y \text{ component}}{x \text{ component}} = 1.32$

$\Rightarrow \alpha = \tan^{-1} 1.32$

4. (a) 180°, (b) 90°, (c) 0

Sol. $|\vec{a}| = 3m|\vec{b}| = 4$

(a) If $R = 1$ unit

$$\Rightarrow \sqrt{3^2+4^2+2\cdot 3\cdot 4\cdot\cos\theta} = 1$$

$\theta = 180°$

(b) $\sqrt{3^2+4^2+2\cdot 3\cdot 4\cdot\cos\theta} = 5$

$\theta = 90°$

(c) $\sqrt{3^2+4^2+2\cdot 3\cdot 4\cdot\cos\theta} = 7$

$\theta = 0°$

Angle between them is 0°.

5. (a) 13.5 unit due north, (b) 18 unit due south

Sol. $\vec{a}$ is a vector of magnitude 4.5 unit due north

(a) $3|\vec{a}| = 3 \times 4.5 = 13.5, 3|\vec{a}|$ is along north

having magnitude 13.5 units.
(b) $-4|\vec{a}| = -4 \times 4.5 = 18$ units
$-4\vec{a}$ is a vector of magnitude 18 units due south.

6. (a) 3 m^2, (b) $3\sqrt{3}$ m^2

Sol. $|\vec{a}| = 2$ m, $|\vec{b}| = 3$ m
angle between them $\theta = 60°$
(a) $\vec{a}\cdot\vec{b} = |\vec{a}|\cdot|\vec{b}|\cos 60° = 2\times 3\times\frac{1}{2} = 3\ \text{m}^2$
(b) $|\vec{a}\times\vec{b}| = |\vec{a}|\cdot|\vec{b}|\sin 60° = 2\times 3\times\sqrt{\frac{3}{2}} =$
$3\sqrt{3}\ \text{m}^2$.

7. $\cos^{-1}(38/\sqrt{1450})$

Sol. We have:

$\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$

$\vec{b} = 3\vec{i} + 4\vec{j} + 5\vec{k}$

Using scalar product, we can find the angle between vectors $\vec{a}$ and $\vec{b}$. i.e.,

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

So, $\theta = \cos^{-1}\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}\right)$

$$= \cos^{-1}\left(\frac{2\times 3 + 3\times 4 + 4\times 5}{\sqrt{(2^2+3^2+4^2)}\sqrt{(3^2+4^2+5^2)}}\right)$$

$$= \cos^{-1}\left(\frac{38}{\sqrt{29}\sqrt{50}} = \cos^{-1}\frac{38}{\sqrt{1450}}\right)$$

$\therefore$ The required angle is $\cos^{-1}\frac{38}{\sqrt{1450}}$.

8. $\vec{A}\cdot(\vec{A}\times\vec{B}) = 0$

Sol. $\vec{A}(\vec{A}\times\vec{B}) = 0$ (claim)

As $\vec{A}\times\vec{B} = AB\sin\theta\hat{n} < br >$ is a vector which is perpendicular to the place containing $\vec{A}$ and $\vec{B} < br >$ this implies that it is also perpendicular to $\vec{A}$. As dot product of two perpendicular vector is zero. $\vec{A}\cdot(\vec{A}\times\vec{B}) = 0$.

9. $-6\vec{i} + 12\vec{j} - 6\vec{k}$

Sol. The cross product $\vec{A}\times\vec{B}$ can be found using a determinant.

$$\vec{A}\times\vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

Substitute the components of $\vec{A}$ and $\vec{B}$.

$$\vec{A}\times\vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 3 & 4 \\ 4 & 3 & 2 \end{vmatrix}$$

Expand along the first row.

$$\vec{A}\times\vec{B} = \vec{i}\begin{vmatrix} 3 & 4 \\ 3 & 2 \end{vmatrix} - \vec{j}\begin{vmatrix} 2 & 4 \\ 4 & 2 \end{vmatrix} + \vec{k}\begin{vmatrix} 2 & 3 \\ 4 & 3 \end{vmatrix}$$

For the $\vec{i}$ component: (3)(2) – (4)(3) = 6 – 12 = –6.
For the $\vec{j}$ component: (2)(2) – (4)(4) = 4 – 16 = –12.
For the $\vec{k}$ component: (2)(3) – (3)(4) = 6 – 12 = –6.
Substitute the calculated values back into the expanded form.

$\vec{A}\times\vec{B} = -6\vec{i} - (-12)\vec{j} + (-6)\vec{k}$

$\vec{A}\times\vec{B} = -6\vec{i} + 12\vec{j} - 6\vec{k}$

10. (a) $\frac{-i_0}{RC}$, (b) $\frac{-i_0}{RCe}$, (c) $\frac{-i_0}{RCe^{10}}$

Sol. The rate of change of current is
Given that, $i = i_0 e^{-t/RC}$

$\therefore$ Rate of change of current $= \frac{di}{dt} = \frac{d}{dt} i_0 e^{-i/RC}$

$= i_0 \frac{d}{dt} e^{-t/RC} = \frac{-i_0}{RC}\times e^{-t/RC}$

When

(a) $t = 0$, $\frac{di}{dt} = \frac{-i_0}{RC}$

(b) when $t = RC$, $\frac{di}{dt} = \frac{-i_0}{RCe}$

(c) when $t = 10RC$, $\frac{di}{dt} = \frac{-i_0}{RCe^{10}}$

11. (a) $\frac{2.00}{e}$ A, (b) $\frac{-20}{3e}$ A/s, (c) $\frac{5.8}{3e}$ A

Sol. Equation $i = i_0 . e^{-\frac{t}{RC}}$, where

$i_0 = 2\ A, R = 6\times 10^5 \text{ohm}$

$C = 0.0500\times 10^{-6} F$

$= 5\times 10^{-7} F$

$i = 2.0 e^{-\frac{t}{0.3}}$

(a) $i = 2 \times xe^{(-1)} = \frac{2}{e}$ amp

(b) $\frac{di}{dt} = \frac{(-i_0)}{RC} \cdot e^{\left(-\frac{t}{RC}\right)}$

when $t = 0.3$sec, then $di/dt = 2/$

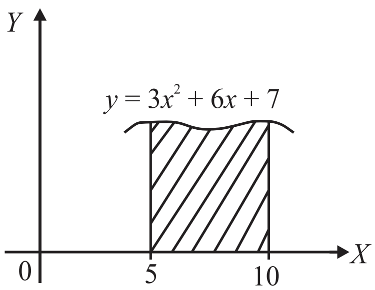
$(0.3)e^{\wedge})(-0.3)/(0.3)\ ) = \frac{-20}{3e}$ amp/sec

(c) At $t = 0.31$ st

$i = 2e((-0.3)/0.3), \frac{5.8}{3e}$ amp (approx)

12. 1135

Sol.



The area bounded by the curve and the X-axis with coordinates $x_1 = 5$ and $x_2 = 10$ is given by:

$$\int_{x_1}^{x_2} ydx = \int_5^{10} \left(3x^2 + 6x + 7\right)dx = \left[\frac{3x^3}{3} + \frac{6x^2}{2} + 7x\right]_5^{10}$$

$= 1000 - 125 + 300 - 75 + 70 - 35$

$= 1370 - 235$

$= 1135$ sq. units

13. 2

Sol. Area $= \int^{x_2} - (x_1)\, ydx = \int^{\pi} - 0 \sin xdx < br >$

$= [\cos x]^{\pi} - 0 < br > = -\cos\pi - (-\cos 0)$

$< br > = +1 + 1 = 2$

14. 1

Sol. The given function is $y = e^{-x}$.

When $x = 0$, $y = e^{-0} = 1$

When x increases, the value of y decrease. Also, only when $x = \infty$, $y = 0$

So, the required area can be determined by integrating the function from 0 to ∞.

$\therefore$ Area $= \int_0^{\infty} e^{-x} dx = -\left[e^{-x}\right]_0^{\infty}$

$= -[0 - 1] = 1$ sq. unit

15. $y = \frac{x^3}{3} + C$

Sol. Change in a functin of y and the independent variable x are related as $\frac{dy}{dx} = x^2 \langle br \rangle \to dy = x^2 dx$

Taking integration of both sides we get $\int dy = \int x^2 dx < br > \to y = \frac{x^3}{3} + c < br > y$ as a function of x is represented b

$y = \frac{x^3}{3} + c$