

Mathematics

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(Chapter – 10) (Vector Algebra) (Miscellaneous Exercise)
(Class – XII)

Question 1:

Write down a unit vector in XY-plane, making an angle of 30° with the positive direction of x-axis.

Answer 1:

If $\vec{r}$ is a unit vector in the XY- plane , then $\vec{r} = \cos \theta \hat{i} + \sin \theta \hat{j}$

Here, θ is the angle made by the unit vector with the positive direction of the x-axis.

Therefore, for $\theta = 30^\circ$:

$$\vec{r} = \cos 30^\circ \hat{i} + \sin 30^\circ \hat{j} = \frac{\sqrt{3}}{2} \hat{i} + \frac{1}{2} \hat{j}$$

Hence, the required unit vector is $\frac{\sqrt{3}}{2} \hat{i} + \frac{1}{2} \hat{j}$

Question 2:

Find the scalar components and magnitude of the vector joining the points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$

Answer 2:

The vector joining the point $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ $\vec{PQ}$ = Position vector of Q – Position vector of P

$$= (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$$

$$|\vec{PQ}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Hence, the scalar components and the magnitude of the vector joining the given points are respectively

$$\{(x_2 - x_1), (y_2 - y_1), (z_2 - z_1)\} \text{ and } \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}.$$

Question 3:

A girl walks 4 km towards west, then she walks 3 km in a direction 30° east of north and stops. Determine the girl's displacement from her initial point of departure.

Answer 3:

Let O and B be the initial and final positions of the girl respectively.

Then, the girl's position can be shown as:

Now we have, $\vec{OA} = -4\hat{i}$

$$\vec{AB} = i|\vec{AB}| \cos 60^\circ + j|\vec{AB}| \sin 60^\circ$$

$$= i3 \times \frac{1}{2} + j3 \times \frac{\sqrt{3}}{2}$$

$$= \frac{3}{2} \hat{i} + \frac{3\sqrt{3}}{2} \hat{j}$$

By the triangle law of vector addition, we have:

$$\vec{OB} = \vec{OA} + \vec{AB}$$

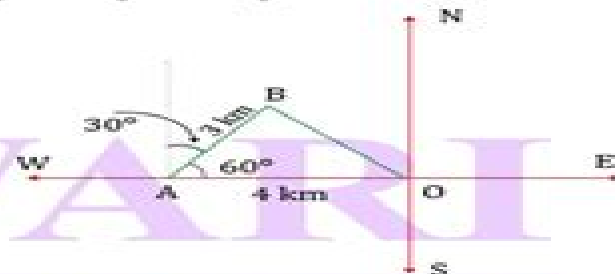
$$\Rightarrow (-4\hat{i}) + \left(\frac{3}{2}\hat{i} + \frac{3\sqrt{3}}{2}\hat{j}\right)$$

$$= \left(-4 + \frac{3}{2}\right)\hat{i} + \left(\frac{3\sqrt{3}}{2}\right)\hat{j}$$

$$\Rightarrow \left(\frac{-8 + 3}{2}\right)\hat{i} + \left(\frac{3\sqrt{3}}{2}\right)\hat{j}$$

$$= \frac{-5}{2} \hat{i} + \frac{3\sqrt{3}}{2} \hat{j}$$

Hence, the girl's displacement from her initial point of departure is $\frac{-5}{2} \hat{i} + \frac{3\sqrt{3}}{2} \hat{j}$



Miscellaneous Exercise On Chapter Solution

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