

# CH # 5 VECTORS

Some important formulae:

i)  $F_x = F \cos \theta$  &  $F_y = F \sin \theta$       ii)  $\sqrt{F_x^2 + F_y^2}$

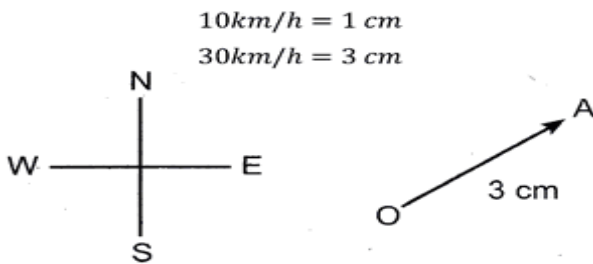
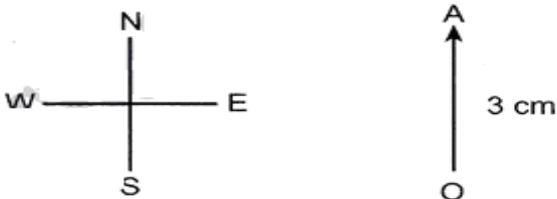
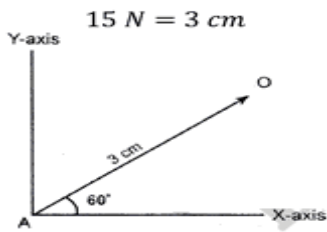
5.1: Draw the representative lines of the following vectors.

i) Force of 15N making an angle of  $60^\circ$  with x-axis.

ii) Displacement of 60Km in the direction of north-south.

iii) Velocity of 30Km/h towards north-east.

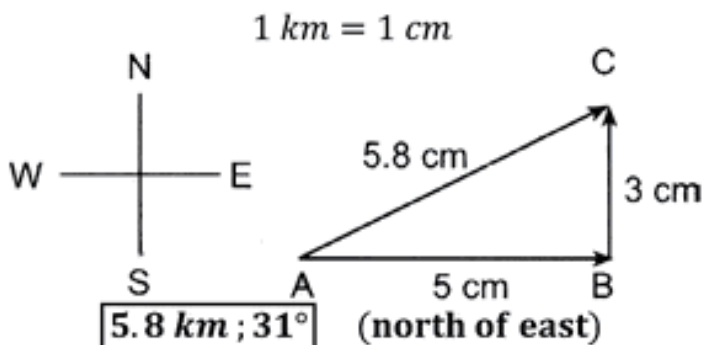
Solution:



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5.2: A body moves 5Km towards east from a fixed point A and reaches a point B. From B it covers 3Km towards north and arrives at point C. Find the distance and direction of the displacement.

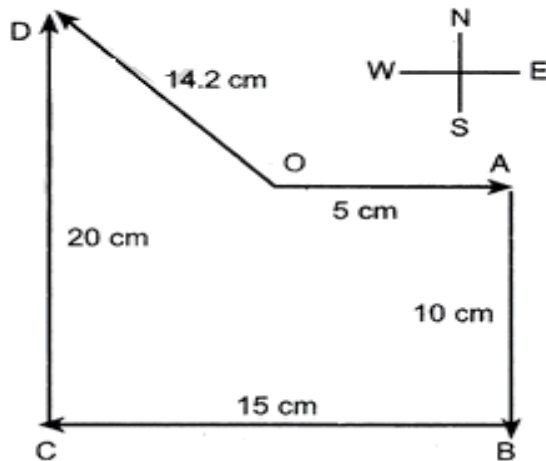
Solution:



Ans.

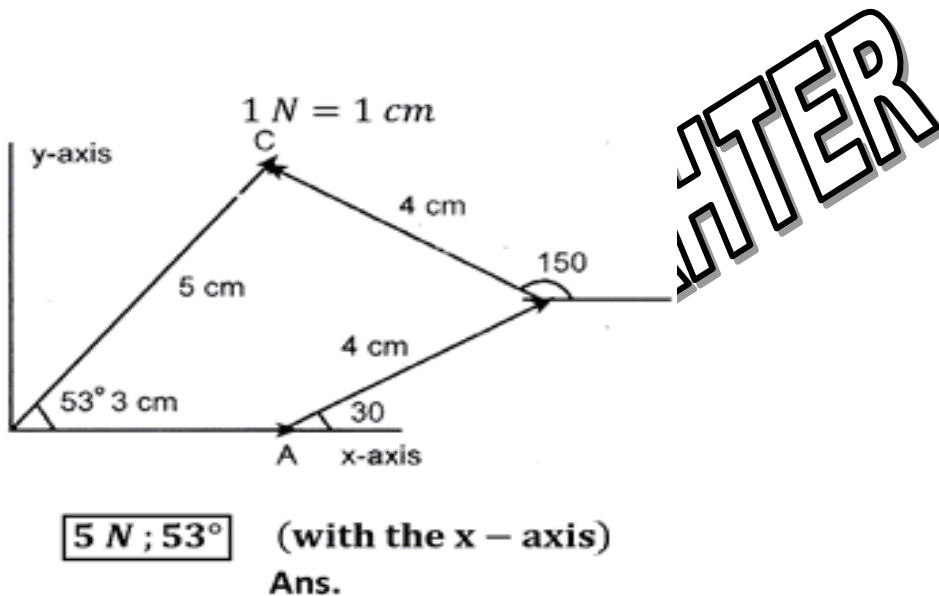
5.3: A man drives his car 5Km east of his straight point. Then he travel 10Km south and reaches a point. From here he travels 15Km towards west and reaches another point. Finally he travels 20Km towards north. Find the net displacement of the man from where he started.

Solution:



5.4: Three forces of magnitude 3N, 4N and 4N are acting at an angle of  $0^\circ$ ,  $30^\circ$  and  $150^\circ$  with the x-axis respectively. Find the resultant force.

Solution:



5.5: Find the x and y component of the following forces by trigonometric method.

- i)  $10\sqrt{2}$  N at  $45^\circ$  with the x-axis.
- ii) 15 N at  $60^\circ$  with the x-axis.
- iii) 20 N at  $90^\circ$  with the x-axis.

1) Given:

Force =  $F = 10\sqrt{2}$  N

Angle =  $\theta = 45^\circ$  with the x-axis

*REQUIRED:*

X and Y component of force

Solution:

X-Component:

$$F_x = F \cos \theta$$

$$F_x = 10\sqrt{2} \cos(45)$$

$$F_x = 10\sqrt{2} \left( \frac{1}{\sqrt{2}} \right)$$

$$F_x = 10 \text{ N}$$

Y-Component:

$$F_y = F \sin \theta$$

$$F_y = 10\sqrt{2} \sin(45)$$

$$F_y = 10\sqrt{2} \left( \frac{1}{\sqrt{2}} \right)$$

$$F_y = 10 \text{ N}$$

*II) Given:*

Force =  $F = 15 \text{ N}$

Angle =  $\theta = 60^\circ$  with the x-axis

*REQUIRED:*

X and Y component of force

Solution:

X-Component:

$$F_x = F \cos \theta$$

$$F_x = 15 \cos(60)$$

$$F_x = 15 \left( \frac{1}{2} \right)$$

$$F_x = 7.5 \text{ N}$$

Y-Component:

$$F_y = F \sin \theta$$

$$F_y = 15 \sin(60)$$

$$F_y = 15 \left( \frac{\sqrt{3}}{2} \right)$$

$$F_y = 13 \text{ N}$$

*iii) Given:*

Force =  $F = 20 \text{ N}$

Angle =  $\theta = 90^\circ$  with the x-axis

*REQUIRED:*

X and Y component of force

Solution:

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X-Component:

$$F_x = F \cos \theta$$

$$F_x = 20 \cos(90)$$

$$F_x = 20 (0)$$

$$F_x = 0 \text{ N}$$

Y-Component:

$$F_y = F \sin \theta$$

$$F_y = 20 \sin(90)$$

$$F_y = 20 (1)$$

$$F_y = 20 \text{ N}$$

**5.6: Determine completely the resultant displacement vector in each of the following cases:**

**X-Components**

**Y-Components**

**i) 5Km**

**3Km**

**ii) 7.5Km**

**18Km**

**iii) 5.3Km**

**43.8Km**

*i) GIVEN:*

X-Component = 5Km

Y-Component = 3Km

*REQUIRED:*

Resultant vector = R = ?

*SOLUTION:*

Magnitude of resultant vector:

$$R = \sqrt{(X - \text{Comp})^2 + (Y - \text{Comp})^2}$$

$$R = \sqrt{(5)^2 + (3)^2}$$

$$R = \sqrt{25 + 9}$$

$$R = \sqrt{36}$$

$$R = 6 \text{ Km}$$

Direction of resultant vector:

$$\theta = \tan^{-1} \left\{ \frac{(Y - \text{Comp})}{(X - \text{Comp})} \right\}$$

$$\theta = \tan^{-1} \left( \frac{3}{5} \right)$$

$$\theta = 30.96^\circ \text{ with +Ve x axis}$$

*ii) GIVEN:*

X-Component = 7.5Km

Y-Component = 18Km

*REQUIRED:*

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Resultant vector = R = ?

*SOLUTION:*

Magnitude of resultant vector:

$$R = \sqrt{(X - \text{Comp})^2 + (Y - \text{Comp})^2}$$

$$R = \sqrt{(7.5)^2 + (18)^2}$$

$$R = \sqrt{56.25 + 324}$$

$$R = \sqrt{380.25}$$

$$R = 19.5 \text{ Km}$$

Direction of resultant vector:

$$\theta = \tan^{-1} \left\{ \frac{(Y - \text{Comp})}{(X - \text{Comp})} \right\}$$

$$\theta = \tan^{-1} \left( \frac{18}{7.5} \right)$$

$$\theta = 67.38^\circ \text{ with +Ve x axis}$$

iii) *GIVEN:*

X-Component = 5.3Km

Y-Component = 43.8Km

*REQUIRED:*

Resultant vector = R = ?

*SOLUTION:*

Magnitude of resultant vector:

$$R = \sqrt{(X - \text{Comp})^2 + (Y - \text{Comp})^2}$$

$$R = \sqrt{(5.3)^2 + (43.8)^2}$$

$$R = \sqrt{28.09 + 2332.89}$$

$$R = \sqrt{2360.98}$$

$$R = 48.58 \text{ Km}$$

Direction of resultant vector:

$$\theta = \tan^{-1} \left\{ \frac{(Y - \text{Comp})}{(X - \text{Comp})} \right\}$$

$$\theta = \tan^{-1} \left( \frac{5.3}{43.8} \right)$$

$$\theta = 6.89^\circ \text{ with +Ve x axis}$$

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