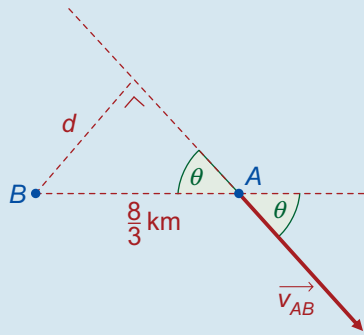


$$\begin{aligned} \text{Time for A to get to junction} &= \frac{\text{distance}}{\text{speed}} \\ &= \frac{3.5}{30} \\ &= \frac{7}{60} \text{ h} \end{aligned}$$

$$\begin{aligned} \text{Distance travelled by B} &= \text{speed} \times \text{time} \\ &= 40 \times \frac{7}{60} = \frac{14}{3} \text{ km} \end{aligned}$$



\Rightarrow When A is at the junction, B is $\frac{8}{3}$ km past the junction.

$$\begin{aligned} \tan \theta &= \frac{15\sqrt{3}}{25} \\ &= \frac{3\sqrt{3}}{5} \end{aligned}$$

$$\Rightarrow \sin \theta = \frac{3\sqrt{3}}{2\sqrt{13}}$$

$$\text{But, } \sin \theta = \frac{d}{\frac{8}{3}} = \frac{3d}{8}$$

$$\Rightarrow \frac{3d}{8} = \frac{3\sqrt{3}}{2\sqrt{13}}$$

$$\Rightarrow d = \frac{4\sqrt{39}}{13}$$

$$= 1.92 \text{ km}$$

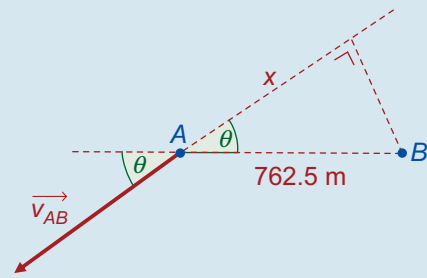
Q. 8. (a) $\vec{v}_A = -16 \cos 60^\circ \vec{i} - 16 \sin 60^\circ \vec{j}$
 $= -16 \left(\frac{1}{2}\right) \vec{i} - 16 \left(\frac{\sqrt{3}}{2}\right) \vec{j}$
 $= -8\vec{i} - 8\sqrt{3}\vec{j}$

$$\vec{v}_B = 20\vec{i}$$

$$\begin{aligned} \vec{v}_{AB} &= \vec{v}_A - \vec{v}_B \\ &= -28\vec{i} - 8\sqrt{3}\vec{j} \end{aligned}$$

(b) (i) Find out how long it takes for A to reach O:

$$\begin{aligned} \text{Time} &= \frac{\text{distance}}{\text{speed}} \\ &= \frac{450}{16} \\ &= 28.125 \text{ s} \end{aligned}$$



Find out how far B has travelled in this time:

$$\begin{aligned} \text{Distance} &= \text{speed} \times \text{time} \\ &= 20 \times 28.125 = 562.5 \text{ m} \end{aligned}$$

\Rightarrow B is now 762.5 m from O.

$$\tan \theta = \frac{8\sqrt{3}}{28} = \frac{2\sqrt{3}}{7}$$

$$\Rightarrow \cos \theta = \frac{7}{\sqrt{61}}$$

$$\text{But, } \cos \theta = \frac{x}{762.5}$$

$$\Rightarrow \frac{x}{762.5} = \frac{7}{\sqrt{61}}$$

$$\Rightarrow x = 683.4 \text{ m}$$

$$\begin{aligned} \text{Time} &= \frac{\text{relative distance}}{\text{relative speed}} \\ &= \frac{683.4}{\sqrt{(-28)^2 + (-8\sqrt{3})^2}} \end{aligned}$$

$$= 21.875 \text{ s}$$

\Rightarrow Closest together 21.875 seconds before they were side by side.

$$28.125 - 21.875 = 6.25 \text{ s}$$

(ii) Distance of A from O = $450 - 16t$

$$\text{Distance of B from O} = 200 + 20t$$

Equidistant from O when

$$450 - 16t = 200 + 20t$$

$$\Rightarrow 36t = 250$$

$$\Rightarrow t = 6.94 \text{ s}$$

Exercise 4D

Q. 1. (i) $\vec{v}_B = \vec{i} + 2\vec{j}$

$$\text{Time across} = \frac{\text{distance across}}{\text{speed across}}$$

$$= \frac{40}{2}$$

$$= 20 \text{ s}$$