Q. 5. $\overrightarrow{v_A} = -16\cos\theta\vec{i} - 16\sin\theta\vec{j}$

$= -16\left(\frac{3}{5}\right)\vec{i} - 16\left(\frac{4}{5}\right)\vec{j} = -9.6\vec{i} - 12.8\vec{j}$

$\overrightarrow{v_B} = -v\vec{i}$

$\overrightarrow{v_{AB}} = \overrightarrow{v_A} - \overrightarrow{v_B} = (v - 9.6)\vec{i} - 12.8\vec{j}$

$|\overrightarrow{v_{AB}}| = 16$

$\Rightarrow \sqrt{\left(v - \frac{48}{5}\right)^2 + \left(-\frac{64}{5}\right)^2} = 16$

$\Rightarrow v^2 - \frac{96}{5}v + \frac{2{,}304}{25} + \frac{4{,}096}{25} = 256$

$\Rightarrow 25v^2 - 480v + 6{,}400 = 6{,}400$

$\Rightarrow 25v^2 - 480v = 0$

$\Rightarrow 5v^2 - 96v = 0$

$\Rightarrow v(5v - 96) = 0$

$\Rightarrow v = \frac{96}{5}$

$= 19.2$ m/s

(i) Find out how long it takes for A to get to the junction.

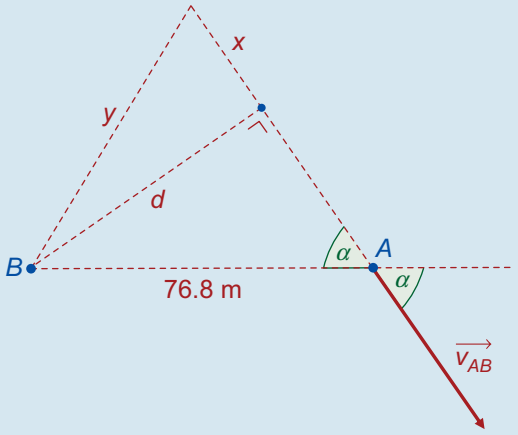
$\text{Time} = \frac{\text{distance}}{\text{speed}} = \frac{96}{16} = 6$ s

Find out how far B has travelled at this time.

Distance = speed × time

$= 19.2 \times 6 = 115.2$ m

Since B was 38.4 m from O at the beginning, B is now 76.8 m past O.



$\overrightarrow{v_{AB}} = 9.6\vec{i} - 12.8\vec{j}$

$\tan\alpha = \frac{12.8}{9.6} = \frac{4}{3} \Rightarrow \sin\alpha = \frac{4}{5}$

But, $\sin\alpha = \frac{d}{76.8}$

$\Rightarrow \frac{d}{76.8} = \frac{4}{5}$

$\Rightarrow d = 61.44$ m

(ii) 2 seconds before:

Relative distance = x

= relative speed × time

$= 16 \times 2 = 32$ m

Actual distance = y

$y^2 = 32^2 + 61.44^2$

$\Rightarrow y = 69$ m

Q. 6. $\overrightarrow{v_A} = -10\cos\theta\vec{i} - 10\sin\theta\vec{j}$

$= -10\left(\frac{4}{5}\right)\vec{i} - 10\left(\frac{3}{5}\right)\vec{j} = -8\vec{i} - 6\vec{j}$

$\overrightarrow{v_B} = -20\vec{i}$

$\overrightarrow{v_{AB}} = \overrightarrow{v_A} - \overrightarrow{v_B} = 12\vec{i} - 6\vec{j}$

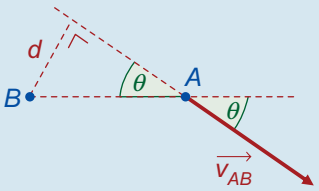
Find out how long it takes for A to get to the junction.

$\text{Time} = \frac{\text{distance}}{\text{speed}} = \frac{100}{10} = 10$ s

Find out how far B has travelled at this time.

Distance = speed × time = 20×10

$= 200$ m



Since B was 100 m from O at the beginning, B is now 100 m past O.

$\tan\theta = \frac{6}{12} = \frac{1}{2} \Rightarrow \sin\theta = \frac{1}{\sqrt{5}}$

But, $\sin\theta = \frac{d}{100}$

$\Rightarrow \frac{d}{100} = \frac{1}{\sqrt{5}}$

$\Rightarrow d = \frac{100}{\sqrt{5}}$

$= 20\sqrt{5}$

$= 44.72$ m

Q. 7. $\overrightarrow{v_A} = -30\cos 60°\vec{i} - 30\sin 60°\vec{j}$

$= -30\left(\frac{1}{2}\right)\vec{i} - 30\left(\frac{\sqrt{3}}{2}\right)\vec{j} = -15\vec{i} - 15\sqrt{3}\vec{j}$

$\overrightarrow{v_B} = -40\vec{i}$

$\overrightarrow{v_{AB}} = \overrightarrow{v_A} - \overrightarrow{v_B}$

$= 25\vec{i} - 15\sqrt{3}\vec{j}$