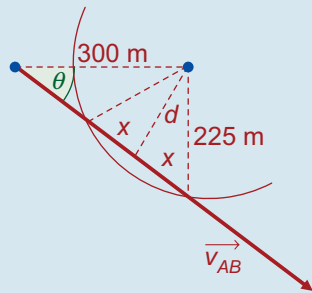


$\Rightarrow P$ and Q are within range for a relative distance of 400 km.

$$\begin{aligned} \text{Time} &= \frac{\text{relative distance}}{\text{relative speed}} \\ &= \frac{400}{5} \\ &= 80 \text{ hours} \end{aligned}$$

Q. 7.



$$\begin{aligned} \text{(i)} \quad \vec{v}_A &= 2\vec{i} - \vec{j} \\ \vec{v}_B &= -2\vec{i} + 2\vec{j} \\ \vec{v}_{AB} &= \vec{v}_A - \vec{v}_B \\ &= 4\vec{i} - 3\vec{j} \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad \tan \theta &= \frac{3}{4} \\ \Rightarrow \sin \theta &= \frac{3}{5} \\ \text{But, } \sin \theta &= \frac{d}{300} \\ \Rightarrow \frac{d}{300} &= \frac{3}{5} \\ \Rightarrow 5d &= 900 \\ \Rightarrow d &= 180 \text{ m} \end{aligned}$$

(iii) Draw a circle of radius 225 metres with centre at B .

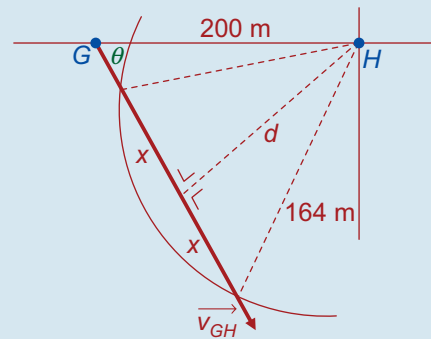
A and B will be able to exchange signals as long as the relative path, \vec{v}_{AB} , is inside this circle. This will be for a relative distance of $2x$.

$$\begin{aligned} x^2 + d^2 &= 225^2 \quad \dots \text{ but } d = 180 \\ \Rightarrow x &= \sqrt{225^2 - 180^2} = 135 \end{aligned}$$

$\Rightarrow A$ and B will be able to exchange signals for a relative distance of 270 m.

$$\begin{aligned} \text{Time} &= \frac{\text{relative distance}}{\text{relative speed}} \\ &= \frac{270}{\sqrt{4^2 + (-3)^2}} \\ &= 54 \text{ s} \end{aligned}$$

Q. 8.



$$\begin{aligned} \text{(i)} \quad \vec{v}_G &= 6\vec{i} \\ \vec{v}_H &= 8\vec{j} \\ \vec{v}_{GH} &= \vec{v}_G - \vec{v}_H = 6\vec{i} - 8\vec{j} \\ \tan \theta &= \frac{8}{6} = \frac{4}{3} \Rightarrow \sin \theta = \frac{4}{5} \\ \text{But, } \sin \theta &= \frac{d}{200} \\ \Rightarrow \frac{d}{200} &= \frac{4}{5} \Rightarrow d = 160 \text{ m} \end{aligned}$$

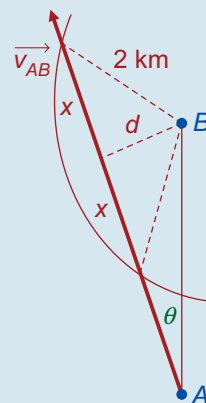
(ii) Draw a circle with radius 164 m with centre H . As long as the relative path, \vec{v}_{GH} , is inside this circle, the cars will be no more than 164 m apart. This will be for a distance of $2x$.

$$\begin{aligned} x^2 + d^2 &= 164^2 \quad \dots \text{ but } d = 160 \\ \Rightarrow x &= \sqrt{164^2 - 160^2} = 36 \end{aligned}$$

\Rightarrow Less than or equal to 164 m apart for a relative distance of 72 m.

$$\begin{aligned} \text{Time} &= \frac{\text{relative distance}}{\text{relative speed}} \\ &= \frac{72}{\sqrt{6^2 + (-8)^2}} \\ &= 7.2 \text{ s} \end{aligned}$$

Q. 9.



$$\begin{aligned} \text{(i)} \quad \vec{v}_A &= 16 \cos 45^\circ \vec{i} + 16 \sin 45^\circ \vec{j} \\ &= 16 \left(\frac{1}{\sqrt{2}} \right) \vec{i} + 16 \left(\frac{1}{\sqrt{2}} \right) \vec{j} \\ &= 8\sqrt{2} \vec{i} + 8\sqrt{2} \vec{j} \end{aligned}$$