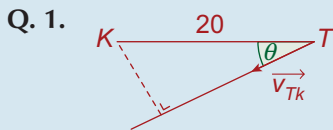


Q. 20. (i)  $\vec{r}_P = -11\vec{i} + \vec{j}$   
 $\vec{r}_Q = 4\vec{i} - 13\vec{j}$   
 $\vec{r}_{QP} = \vec{r}_Q - \vec{r}_P = 15\vec{i} - 14\vec{j}$   
 $\vec{v}_P = 3\vec{i}$   
 $\vec{v}_Q = x\vec{j}$   
 $\vec{v}_{QP} = \vec{v}_Q - \vec{v}_P = -3\vec{i} + x\vec{j}$   
 $\frac{15}{-3} = \frac{-14}{x}$  ...collision course  
 $\Rightarrow \vec{v}_{QP}$  is a scalar multiple of  $\vec{r}_{QP}$   
 $\Rightarrow 15x = 42$   
 $\Rightarrow x = \frac{14}{5}$

(ii)  $\vec{r}_{QP} = 15\vec{i} - 14\vec{j}$   
 $\vec{v}_{QP} = -3\vec{i} + \frac{14}{5}\vec{j}$   
 Time to collision =  $\frac{\text{relative distance}}{\text{relative speed}}$   
 $= \frac{\sqrt{15^2 + (-14)^2}}{\sqrt{(-3)^2 + (\frac{14}{5})^2}}$   
 $= 5$  hours  
 $\Rightarrow$  Collision occurs at 17.00 hours.

### Exercise 4B



$\vec{v}_{KT} = (\vec{i} + 2\vec{j}) - (-2\vec{i} - 2\vec{j})$   
 $= 3\vec{i} + 4\vec{j}$  m/s

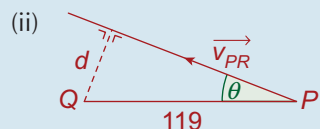
$\tan \theta = \frac{4}{3}$

$\Rightarrow \sin \theta = \frac{4}{5}$

$d = 20 \sin \theta$

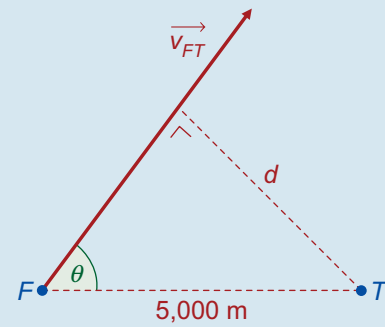
$= 20\left(\frac{4}{5}\right) = 16$  m

Q. 2. (i)  $\vec{v}_{PQ} = (-8\vec{i} + 12\vec{j}) - (7\vec{i} + 4\vec{j})$   
 $= -15\vec{i} + 8\vec{j}$



(iii)  $\tan \theta = \frac{8}{15}$   
 $\Rightarrow \sin \theta = \frac{8}{17}$   
 $d = 119 \sin \theta$   
 $= 119\left(\frac{8}{17}\right) = 56$  units

Q. 3.



(i)  $\vec{v}_F = 2\vec{i} + 5\vec{j}$   
 $\vec{v}_T = -4\vec{i} - 3\vec{j}$   
 $\vec{v}_{FT} = \vec{v}_F - \vec{v}_T$   
 $= 2\vec{i} + 5\vec{j} + 4\vec{i} + 3\vec{j}$   
 $= 6\vec{i} + 8\vec{j}$

(ii)  $\tan \theta = \frac{8}{6}$   
 $= \frac{4}{3}$

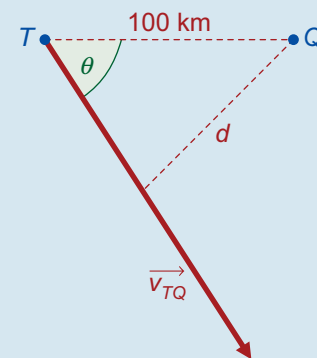
$\Rightarrow \sin \theta = \frac{4}{5}$

But,  $\sin \theta = \frac{d}{5,000}$

$\Rightarrow \frac{d}{5,000} = \frac{4}{5}$

$\Rightarrow d = 4000$  m ... shortest distance between P and Q in subsequent motion.

Q. 4.



(i)  $\vec{v}_T = 10 \cos 30^\circ \vec{i} - 10 \sin 30^\circ \vec{j}$   
 $= 10\left(\frac{\sqrt{3}}{2}\right)\vec{i} - 10\left(\frac{1}{2}\right)\vec{j}$   
 $= 5\sqrt{3}\vec{i} - 5\vec{j}$