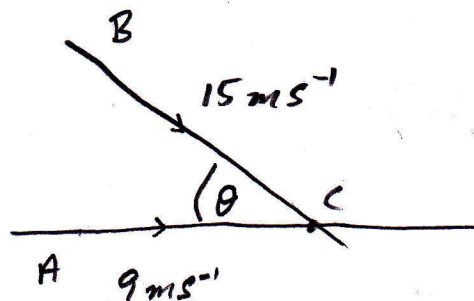2013 Q2.

(a)(i)

$$S = \frac{D}{T}$$
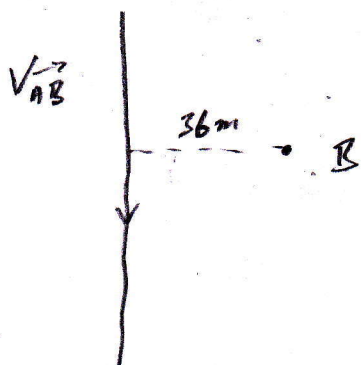
Time it takes B to get to C is $\frac{90}{15}$ sec.

During this time A has travelled $\frac{90}{15} \times 9$ m

$\Rightarrow$ |AB| at this time is $90 - \left(\frac{90}{15} \times 9\right)$ m

$$= 36 \, m$$

(ii) $V_A = 9\vec{i}$ $\qquad$ $V_B = 15\cos\theta\,\vec{i} - 15\sin\theta\,\vec{j}$

$V_{AB} = V_A - V_B = \left(9 - 15\cos\theta\right)\vec{i} + 15\sin\theta\,\vec{j}$
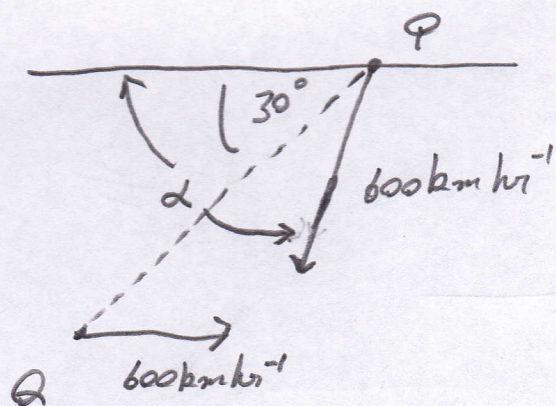

$9 - 15\cos\theta = 0$

$\Rightarrow \cos\theta = \frac{9}{15}$

$\Rightarrow \theta = 53.13°$

(b)

$$\vec{V_p} = -600 \cos \alpha \, \vec{i} - 600 \sin \alpha \, \vec{j}$$

$$\vec{V_Q} = 600 \, \vec{i}$$

$$\vec{V_{PQ}} = V_p - V_Q = (-600 \cos \alpha - 600) \vec{i} - 600 \sin \alpha \, \vec{j}$$

$$\text{Tan } 30° = \frac{600 \sin \alpha}{600 \cos \alpha + 600}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{600 \sin \alpha}{600 \cos \alpha + 600}$$

$\rightarrow \quad \sqrt{3} \, 600 \sin \alpha = 600 \cos \alpha + 600$

$\rightarrow \quad \sqrt{3} \sin \alpha = \cos \alpha + 1$

$\rightarrow \quad 3 \sin^2 \alpha = \cos^2 \alpha + 2 \cos \alpha + 1$

$\Rightarrow \quad 3(1 - \cos^2 \alpha) = \cos^2 \alpha + 2 \cos \alpha + 1$

$\Rightarrow \quad 3 - 3\cos^2 \alpha = \cos^2 \alpha + 2 \cos \alpha + 1$

$\Rightarrow \quad 0 = 4 \cos^2 \alpha + 2 \cos \alpha - 2$

$\Rightarrow \quad 0 = 2 \cos^2 \alpha + \cos \alpha - 1$

$\Rightarrow \quad 0 = (2 \cos \alpha - 1)(\cos \alpha + 1)$

$\rightarrow \quad \cos \alpha = \frac{1}{2} \quad$ or $\quad \cos \alpha = -1$

$\Rightarrow \quad \alpha = 60° \quad = \quad W \, 60° \, S$