$\Rightarrow \frac{d}{d\alpha}(\tan\theta) = \frac{2\cos\alpha - \cos^2\alpha - \sin^2\alpha}{(2-\cos\alpha)^2}$

$\Rightarrow \frac{d}{d\alpha}(\tan\theta) = \frac{2\cos\alpha - (\cos^2\alpha + \sin^2\alpha)}{(2-\cos\alpha)^2}$ ... $\cos^2\alpha + \sin^2\alpha = 1$

$\Rightarrow \frac{d}{d\alpha}(\tan\theta) = \frac{2\cos\alpha - 1}{(2-\cos\alpha)^2}$

Putting $\frac{d}{d\alpha}(\tan\theta) = 0$ gives

$\frac{2\cos\alpha - 1}{(2-\cos\alpha)^2} = 0$

$\Rightarrow 2\cos\alpha - 1 = 0$

$\Rightarrow \cos\alpha = \frac{1}{2}$

$\Rightarrow \alpha = 60°$

Shortest path will occur when $\alpha = 60°$

$\Rightarrow \overrightarrow{v_M} = (2 - \cos 60°)\vec{i} + \sin 60°\vec{j}$

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

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

$= \frac{36}{\frac{\sqrt{3}}{2}}$

$= \frac{72}{\sqrt{3}}$

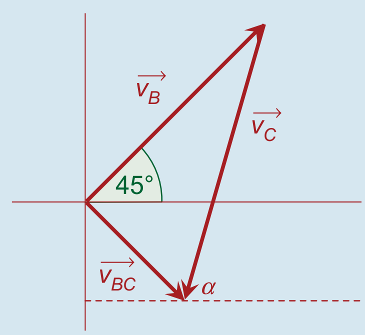
$= 24\sqrt{3}$ s

Q. 26. (a) $\cos A = \sqrt{1 - \sin^2 A}$

(b) $\overrightarrow{v_{BC}} = 5\vec{i} - 2\vec{j}$

$\overrightarrow{v_C} = 5\cos\alpha\vec{i} + 5\sin\alpha\vec{j}$

$\overrightarrow{v_B} = (5 + 5\cos\alpha)\vec{i} + (-2 + 5\sin\alpha)\vec{j}$



This is in a N.E. direction

$\therefore \frac{-2 + 5\sin\alpha}{5 + 5\cos\alpha} = \tan 45° = 1$

$\Rightarrow -2 + 5\sin\alpha = 5 + 5\cos\alpha$

$\Rightarrow -2 + 5\sin\alpha = 5 + 5\sqrt{1 - \sin^2\alpha}$

$\Rightarrow -7 + 5\sin\alpha = 5\sqrt{1 - \sin^2\alpha}$

$\Rightarrow 49 - 70\sin\alpha + 25\sin^2\alpha = 25(1 - \sin^2\alpha)$

$\Rightarrow 50\sin^2\alpha - 70\sin\alpha + 24 = 0$

$\Rightarrow 25\sin^2\alpha - 35\sin\alpha + 12 = 0$

$\Rightarrow (5\sin\alpha - 3)(5\sin\alpha - 4) = 0$

$\Rightarrow \sin\alpha = \frac{3}{5}$ **OR** $\sin\alpha = \frac{4}{5}$

$\Rightarrow \cos\alpha = \pm\frac{4}{5}$ **OR** $\cos\alpha = \pm\frac{3}{5}$