## 1984 Q2. H.L.

A ship B is travelling in a direction 41° East of North at 15 m/s. A second ship C is travelling 41° South of East at 20 m/s.

Calculate:
- (i) the velocity of B relative to C;
- (ii) the shortest distance between the ships if C is 3 km east of B at a particular moment;
- (iii) the time interval during which the ships remain in visual contact, if visibility is limited to 3 km.

$$\vec{V_B} = 15\sin A\,\vec{i} + 15\cos A\,\vec{j}$$
$$\vec{V_C} = 20\cos A\,\vec{i} - 20\sin A\,\vec{j}$$

$$\vec{V_{BC}} = \vec{V_B} - \vec{V_C}$$

$A = 41°$
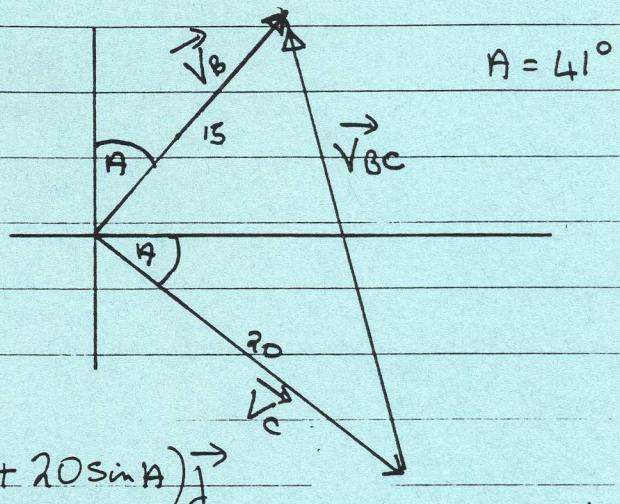
$$\vec{V_{BC}} = (15\sin A - 20\cos A)\vec{i} + (15\cos A + 20\sin A)\vec{j}$$

$$\Rightarrow V_{BC}^2 = 15^2 + 20^2 = 25^2.$$

(i) $\vec{V_{BC}} = -5.2533\,\vec{i} + 24.4418\,\vec{j}$ m/s.
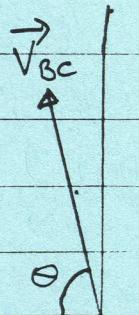
$V_{BC} = 25$ m/s in a direction $\theta°$ N of W where

$$\theta = \tan^{-1}\left(\frac{24.4418}{5.25}\right) = 77.8699°$$

(ii) $d = 3000\sin\theta = 2933$ m
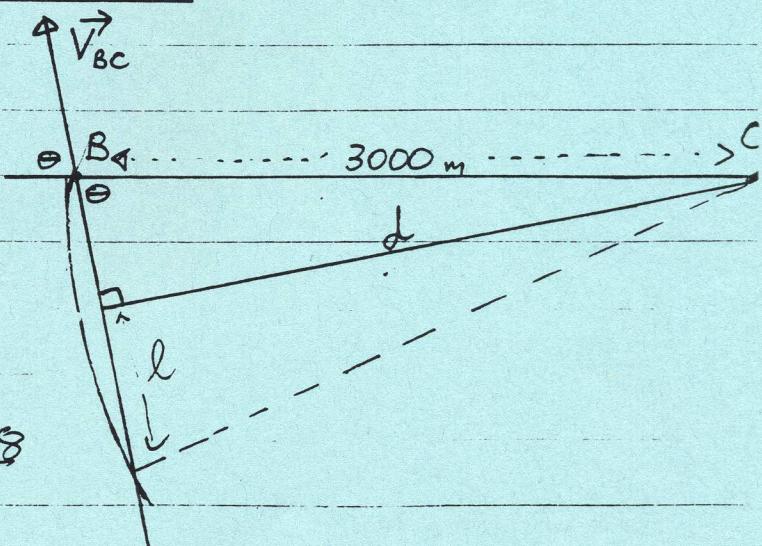
(iii) Visual contact remains over a time t where

$$t = \frac{2l}{V_{BC}} = \frac{2d\cos\theta}{25} = \frac{1260.8}{25}$$

$$\Rightarrow t = 50.43 \text{ sec.}$$