

Subject – Math(Higher Level)  
Topic - Vector  
Year - Nov 2011 – Nov 2019

**Question 1**

[Maximum mark: 15]

(a) For non-zero vectors  $\mathbf{a}$  and  $\mathbf{b}$ , show that

(i) if  $|\mathbf{a} - \mathbf{b}| = |\mathbf{a} + \mathbf{b}|$ , then  $\mathbf{a}$  and  $\mathbf{b}$  are perpendicular;

(ii)  $|\mathbf{a} \times \mathbf{b}|^2 = |\mathbf{a}|^2 |\mathbf{b}|^2 - (\mathbf{a} \cdot \mathbf{b})^2$ . [8 marks]

(b) The points A, B and C have position vectors  $\mathbf{a}$ ,  $\mathbf{b}$  and  $\mathbf{c}$ .

(i) Show that the area of triangle ABC is  $\frac{1}{2} |\mathbf{a} \times \mathbf{b} + \mathbf{b} \times \mathbf{c} + \mathbf{c} \times \mathbf{a}|$ .

(ii) Hence, show that the shortest distance from B to AC is

$$\frac{|\mathbf{a} \times \mathbf{b} + \mathbf{b} \times \mathbf{c} + \mathbf{c} \times \mathbf{a}|}{|\mathbf{c} - \mathbf{a}|}. \quad [7 \text{ marks}]$$

**Question 2**

[Maximum mark: 5]

Find the values of  $x$  for which the vectors  $\begin{pmatrix} 1 \\ 2 \cos x \\ 0 \end{pmatrix}$  and  $\begin{pmatrix} -1 \\ 2 \sin x \\ 1 \end{pmatrix}$  are perpendicular,  
 $0 \leq x \leq \frac{\pi}{2}$ .

**Question 3**

[Maximum mark: 6]

Two boats, A and B, move so that at time  $t$  hours, their position vectors, in kilometres, are  $\mathbf{r}_A = (5t)\mathbf{i} + (3 - 6t)\mathbf{j}$  and  $\mathbf{r}_B = (7 - 4t)\mathbf{i} + (7t - 6)\mathbf{j}$ .

(a) Find the coordinates of the common point of the paths of the two boats. [4 marks]

(b) Show that the boats do not collide. [2 marks]

# Ib Maths HL 2013 Past Paper

**Siddappa N.Byraredddy**

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