

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

**Question 1**

*[Maximum mark: 15]*

(a) For non-zero vectors  $a$  and  $b$ , show that

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

(ii)  $|a \times b|^2 = |a|^2 |b|^2 - (a \cdot b)^2$ . *[6 marks]*

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

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

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

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

**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  $r_a = (5t)\mathbf{i} + (3 - 6t)\mathbf{j}$  and  $r_b = (7 - 4t)\mathbf{i} + (7t - 6)\mathbf{j}$ .

(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]*

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**Ying Liu**



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