

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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