Vectors in two dimensions – 2022 O Level Additional Math

1. June/2022/Paper_11/No.5

(a) Find the vector which is in the opposite direction to $\begin{pmatrix} 15 \\ -8 \end{pmatrix}$ and has a magnitude of 8.5. [2]

(b) Find the values of a and b such that $5\begin{pmatrix} 3a \\ b \end{pmatrix} + \begin{pmatrix} 2a+1 \\ 2 \end{pmatrix} = 6\begin{pmatrix} b+a \\ 2 \end{pmatrix}$. [3]

2. June/2022/Paper_12/No.4

(a) Find the unit vector in the same direction as $\begin{pmatrix} -15 \\ 8 \end{pmatrix}$. [2]

(b) Given that $\begin{pmatrix} 2a \\ -5 \end{pmatrix} + \begin{pmatrix} 4b-12 \\ 3 \end{pmatrix} = 4\begin{pmatrix} b-a \\ a+2b \end{pmatrix}$, find the values of a and b. [3]

3. June/2022/Paper_21/No.8

In this question, **i** is a unit vector due east and **j** is a unit vector due north. Distances are measured in kilometres and time is measured in hours.

At 09 00, ship A leaves a point P with position vector $5\mathbf{i}+16\mathbf{j}$ relative to an origin O. It sails with a constant speed of $6\sqrt{3}$ on a bearing of 120°.

(a) Show that the velocity vector of A is $9\mathbf{i}-3\sqrt{3}\mathbf{j}$. [2]

(b) Find the position vector of A at 12 00. [1]

(c) At 11 00 ship B leaves a point Q with position vector $29\mathbf{i}+16\mathbf{j}$. It sails with constant velocity $-12\sqrt{3}\mathbf{j}$. Write down the position vector of B, t hours after it starts sailing. [1]

(d) Find the distance between the two ships at 12 00. [3]

4. June/2022/Paper_22/No.6

(a) In this question, **i** is a unit vector due east and **j** is a unit vector due north.

A cyclist rides at a speed of $4\,\text{ms}^{-1}$ on a bearing of 015°. Write the velocity vector of the cyclist in the form $x\mathbf{i} + y\mathbf{j}$, where x and y are constants. [2]

(b) A vector of magnitude 6 on a bearing of 300° is added to a vector of magnitude 2 on a bearing of 230° to give a vector **v**. Find the magnitude and bearing of **v**. [5]