ELECTRIC AND MAGNETIC FIELDS

ASSIGNMENT 1

Note: Questions 1 – 6 count for 95% of the marks and question 7 for 5%

Q1 $\overline{A} = -8\hat{i} + 2\hat{j} + 6\hat{k}$ and $\overline{B} = 3\hat{i} - 3\hat{j} + 3\hat{k}$

Find $\overline{\mathbf{A}} + \overline{\mathbf{B}}$, $\overline{\mathbf{A}} - \overline{\mathbf{B}}$, and $4\overline{\mathbf{A}} - 3\overline{\mathbf{B}}$.

Q2 Two vectors $\overline{\mathbf{E}}_1$ and $\overline{\mathbf{E}}_2$ are in the x-y plane. $\overline{\mathbf{E}}_1$ has magnitude 30 units and makes an angle of 60^o with the X-axis. $\overline{\mathbf{E}}_2$ has magnitude 10 units and points in the negative Y-direction.

(i) Draw a diagram showing the two vectors.
(ii) Express $\overline{\mathbf{E}}_1$ and $\overline{\mathbf{E}}_2$ in terms of the orthogonal unit vectors $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$
(iii) Find the resultant vector $\overline{E}_1 - \overline{E}_2$ in terms of the orthogonal unit vectors, and illustrate it on another diagram.

Q3 $\overline{A} = 6\hat{i} + 6\hat{j} - 9\hat{k}$

Find a vector whose direction is opposite to $\overline{\mathbf{A}}$, and whose magnitude is 27 units.

Q4 (i) Calculate the dot product of

$\overline{\mathbf{A}} = -3\hat{\mathbf{i}} - 8\hat{\mathbf{j}} + 7\hat{\mathbf{k}}$ and $\overline{B} = 2\hat{i} - 3\hat{j} + 5\hat{k}$.

(ii) What is the angle between $\overline{\mathbf{A}}$ and $\overline{\mathbf{B}}$?

Q5 $\overline{\mathbf{P}} = 3\hat{\mathbf{i}} - 5\hat{\mathbf{j}}$ $\overline{E} = 2\hat{i} - 4\hat{j}$

Find the cross product $\overline{\mathbf{P}} \times \overline{\mathbf{E}}$ *without using the determinant method. Use the fact that the cross product is distributive.*

Q6 $\overline{A} = 5\hat{i}$ $\overline{B} = 4\hat{j}$ $\overline{C} = 3\hat{k}$

(i) Draw a diagram showing the x, y and z axes, the orthogonal unit vectors, and the vectors $\overline{\mathbf{A}}$, $\overline{\mathbf{B}}$ and $\overline{\mathbf{C}}$.

(ii) Find $\overline{\mathbf{A}} \times \overline{\mathbf{B}}$, $\overline{\mathbf{A}} \times \overline{\mathbf{C}}$, $\overline{\mathbf{C}} \times \overline{\mathbf{B}}$, $\overline{\mathbf{A}} \cdot \overline{\mathbf{B}}$, $\overline{\mathbf{A}} \cdot \overline{\mathbf{C}}$, and $\overline{\mathbf{C}} \cdot \overline{\mathbf{B}}$

Q7 $\overline{\mathbf{A}} = -2\hat{\mathbf{i}} + 6\hat{\mathbf{j}} + 5\hat{\mathbf{k}}$

Find a vector, $\overline{\mathbf{B}}$, whose magnitude is $90^{1/2}$, which lies in the first quadrant of the x-y plane, and whose direction is perpendicular to $\overline{\mathbf{A}}$.