<u>Vectors</u>

Relative to a fixed origin O

- the point A has position vector 5i + 3j + 2k
- the point B has position vector 2i + 4j + ak
 where a is a positive integer.

(a) Show that
$$|\overrightarrow{OA}| = \sqrt{38}$$

(1)

(b) Find the smallest value of a for which

$$|\overrightarrow{OB}| > |\overrightarrow{OA}|$$

(2)

Relative to a fixed origin O,

the point A has position vector $(2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k})$,

the point B has position vector $(4\mathbf{i} - 2\mathbf{j} + 3\mathbf{k})$,

and the point C has position vector (ai + 5j - 2k), where a is a constant and a < 0

D is the point such that $\overrightarrow{AB} = \overrightarrow{BD}$.

(a) Find the position vector of D.

(2)

Given $|\overrightarrow{AC}| = 4$

(b) find the value of a.

(3)

Q3.

Relative to a fixed origin O

- the point A has position vector 4i 3j + 5k
- the point B has position vector 4j + 6k
- the point C has position vector -16i + pj + 10k

where *p* is a constant.

Given that A, B and C lie on a straight line,

(a) find the value of *p*.

(3)

The line segment OB is extended to a point D so that \overrightarrow{CD} is parallel to \overrightarrow{OA}

(b) Find $|\overrightarrow{OD}|$, writing your answer as a fully simplified surd.

(3)

Q4.

Given that the point A has position vector $4\mathbf{i} - 5\mathbf{j}$ and the point B has position vector $-5\mathbf{i} - 2\mathbf{j}$,

(a) find the vector \overrightarrow{AB} ,

(2)

(b) find $|\overrightarrow{AB}|$

Give your answer as a simplified surd.

(i) Two non-zero vectors, **a** and **b**, are such that

$$|\mathbf{a} + \mathbf{b}| = |\mathbf{a}| + |\mathbf{b}|$$

Explain, geometrically, the significance of this statement.

(1)

(ii) Two different vectors, ${\bf m}$ and ${\bf n}$, are such that $|{\bf m}|=3$ and $|{\bf m}-{\bf n}|=6$

The angle between vector \mathbf{m} and vector \mathbf{n} is 30° Find the angle between vector \mathbf{m} and vector $\mathbf{m} - \mathbf{n}$, giving your answer, in degrees, to one decimal place.

Q6.

Relative to a fixed origin, points P, Q and R have position vectors \mathbf{p} , \mathbf{q} and \mathbf{r} respectively. Given that

- P, Q and R lie on a straight line
- Q lies one third of the way from P to R

show that

$$\mathbf{q} = \frac{1}{3}(\mathbf{r} + 2\mathbf{p})$$

Given that the point A has position vector $3\mathbf{i} - 7\mathbf{j}$ and the point B has position vector $8\mathbf{i} + 3\mathbf{j}$,

(a) find the vector \overrightarrow{AB} .

(2)

(b) Find \overrightarrow{AB} . Give your answer as a simplified surd.

(2)

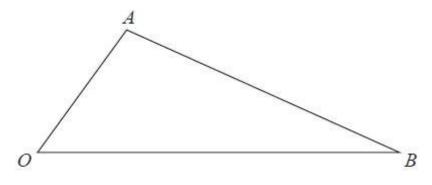


Figure 7

Figure 7 shows a sketch of triangle OAB.

The point C is such that $\overrightarrow{OC} = 2\overrightarrow{OA}$.

The point M is the midpoint of AB.

The straight line through C and M cuts OB at the point N.

Given
$$\overrightarrow{OA} = \mathbf{a}$$
 and $\overrightarrow{OB} = \mathbf{b}$

(a) Find \overrightarrow{CM} in terms of **a** and **b**

(2)

$$\overrightarrow{ON} = \left(2 - \frac{3}{2}\lambda\right)\mathbf{a} + \frac{1}{2}\lambda\mathbf{b}, \text{ where } \lambda$$
(b) Show that

is a scalar constant.

(c) Hence prove that ON: NB = 2:1

(2)

(2)

Q9.

Relative to a fixed origin O,

- A is the point with position vector 12i
- B is the point with position vector 16j
- C is the point with position vector (50i + 136j)
- D is the point with position vector (22i + 24j)
- (a) Show that AD is parallel to BC.

(2)

Points *A*, *B*, *C* and *D* are used to model the vertices of a running track in the shape of a quadrilateral. Runners complete one lap by running along all four sides of the track.

The lengths of the sides are measured in metres.

Given that a particular runner takes exactly 5 minutes to complete 2 laps,

(b) calculate the average speed of this runner, giving the answer in kilometres per hour.

(4)

Q10.

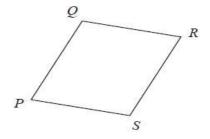


Figure 3

Figure 3 shows a sketch of a parallelogram PQRS.

Given that

$$\overrightarrow{PQ} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$$

$$QR = 5i - 2k$$

- (a) show that parallelogram *PQRS* is a rhombus.
- (b) Find the exact area of the rhombus *PQRS*.

(4)

(2)

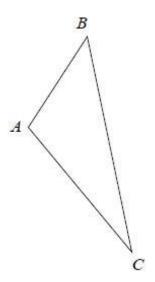


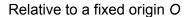
Figure 2

Figure 2 shows a sketch of a triangle ABC.

Given
$$\overrightarrow{AB} = 2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$$
 and $\overrightarrow{BC} = \mathbf{i} - 9\mathbf{j} + 3\mathbf{k}$, show that $\angle BAC = 105.9^{\circ}$ to one decimal place.

(5)

Q13.



- point A has position vector 10i 3j
- point B has position vector –8i + 9j
- point C has position vector –2i + pj where p is a constant
- (a) Find \overrightarrow{AB}

(2)

(b) Find \overrightarrow{AB} giving your answer as a fully simplified surd.

(2)

Given that points A, B and C lie on a straight line,

- (c) (i) find the value of p,
 - (ii) state the ratio of the area of triangle AOC to the area of triangle AOB.

(3)

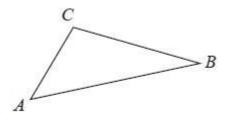


Figure 1

Figure 1 shows a sketch of triangle ABC.

Given that

•
$$\overrightarrow{AB} = -3\mathbf{i} - 4\mathbf{j} - 5\mathbf{k}$$

•
$$\overrightarrow{BC} = \mathbf{i} + \mathbf{j} + 4\mathbf{k}$$

(a) find
$$\overrightarrow{AC}$$

(2)

(b) show that
$$\cos ABC = \frac{9}{10}$$

(3)

Q15.

Relative to a fixed origin O

- point A has position vector 2i + 5j 6k
- point B has position vector 3i 3j 4k
- point C has position vector 2i 16j + 4k
- (a) Find \overrightarrow{AB}

(2)

(b) Show that quadrilateral *OABC* is a trapezium, giving reasons for your answer.

(2)