The points A, B and C lie on a plane so that

$$\overrightarrow{AB} = 2\mathbf{i} + 7\mathbf{j} \quad \text{and} \quad \overrightarrow{AC} = 4\mathbf{i} - 5\mathbf{j},$$

where $\mathbf{i}$ and $\mathbf{j}$ are mutually perpendicular unit vectors lying on the same plane.

The point D lies on the straight line segment BC, so that $|BD|:|DC| = 1:2$.

a) Determine a simplified expression, in terms of $\mathbf{i}$ and $\mathbf{j}$, for $\overrightarrow{BD}$.

b) Show that the $|\overrightarrow{AD}|$ is approximately 4 units.

Relative to a fixed origin O, the point A has coordinates $(2,-3)$.

The point B is such so that $\overrightarrow{AB} = 3\mathbf{i} - 7\mathbf{j}$, where $\mathbf{i}$ and $\mathbf{j}$ are mutually perpendicular unit vectors lying on the same plane.

Determine the distance of B from O.

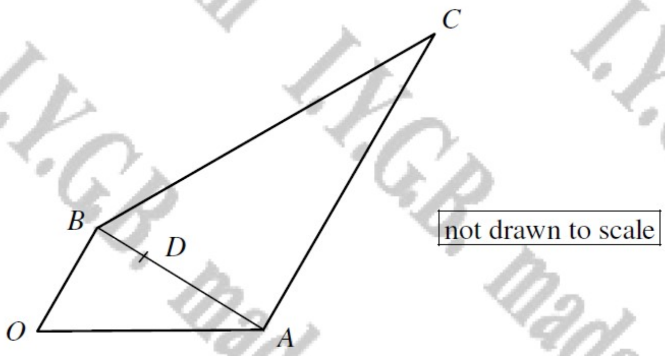
The following information is given for four points which lie on the same plane.

$$\overrightarrow{OA} = \mathbf{i} + 4\mathbf{j}, \qquad \overrightarrow{OB} = 5\mathbf{i} + 5\mathbf{j} \qquad \text{and} \qquad \overrightarrow{CB} = -\mathbf{i} + 6\mathbf{j},$$

a) Find the vector $\overrightarrow{AB}$ and hence state its length

b) Determine the length of $\overrightarrow{AC}$.

c) Calculate the size of the angle ABC.



The figure above shows a trapezium $OBCA$ where OB is parallel to AC.

The point D lies on BA so that $BD : DA = 1 : 2$.

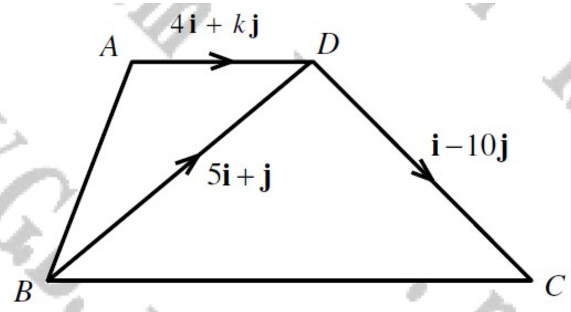
It is further given that $\overrightarrow{OA} = 7\mathbf{i} - 4\mathbf{j}$, $\overrightarrow{OB} = 3\mathbf{i} + 2\mathbf{j}$ and $\overrightarrow{AC} = 2\,\overrightarrow{OB}$, where $\mathbf{i}$ and $\mathbf{j}$ are mutually perpendicular unit vectors lying on the same plane.

a) Determine simplified expressions, in terms of $\mathbf{i}$ and $\mathbf{j}$, for each of the vectors $\overrightarrow{OC}$, $\overrightarrow{AB}$, $\overrightarrow{AD}$ and $\overrightarrow{OD}$.

b) Deduce, showing your reasoning, that O, D and C are collinear and state the ratio of $OC : OD$.

c) Show that $\measuredangle OBA = 90°$ and hence find the area of the trapezium $OBCA$.

d) State the size of the angle $\measuredangle ABC$.



The figure above shows a trapezium $ABCD$, where AD is parallel to BC.

The following information is given for this trapezium.

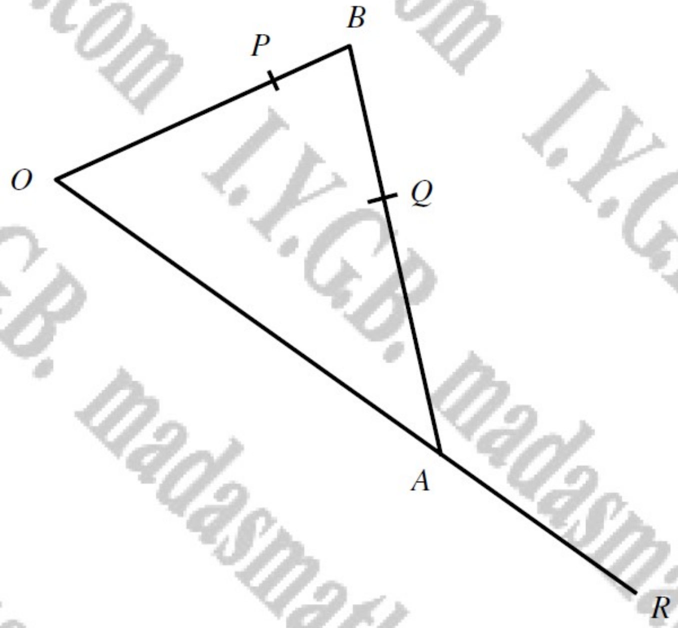
$$\overrightarrow{BD} = 5\mathbf{i} + \mathbf{j}, \quad \overrightarrow{DC} = \mathbf{i} - 10\mathbf{j} \quad \text{and} \quad \overrightarrow{AD} = 4\mathbf{i} + k\mathbf{j},$$

where k is an integer.

a) Use vector algebra to show that $k = -6$.

b) Find the length of $\overrightarrow{AB}$.

c) Calculate the size of the angle ABD.



The figure above shows a triangle OAB, where O is a fixed origin.

- The point A has coordinates $(6,-8)$.
- The point P, whose coordinates are $(4,1)$, lies on OB so that $OP:PB=4:1$.
- The point Q lies on AB so that $AQ : QB = 3:2$
- The side OA is extended to the point R so that $OA:AR=5:3$.

a) Use vector methods to determine the coordinates of Q.

b) Determine expressions, in terms of $\mathbf{i}$ and $\mathbf{j}$, for the vectors $\overrightarrow{PQ}$ and $\overrightarrow{QR}$.

c) Deduce, showing your reasoning, that P, Q and R are collinear and state the ratio of $PQ:QR$.

Relative to a fixed origin O on a horizontal plane, the points A and B have respective position vectors $3\mathbf{i}-2\mathbf{j}$ and $5\mathbf{i}+4\mathbf{j}$.

The point C lies on the same plane as A and B so that $\overrightarrow{AB} : \overrightarrow{BC} = 2:5$.

a) Find the position vector of C.

The point D lies on the same plane as A and B so that A, B and D are collinear.

b) Given that $|BD| = 6\sqrt{10}$, determine the possible position vectors of D.

Relative to a fixed origin O, the points A and B have position vectors $3\mathbf{i}-9\mathbf{j}$ and $2\mathbf{i}+10\mathbf{j}$, respectively.

The point M is the midpoint of OB and the point N lies on OA so that $\overrightarrow{OA} = 3\overrightarrow{ON}$.

The point P is the point of intersection of AM and BN.

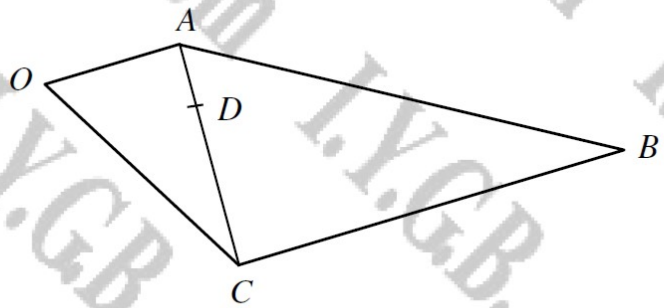
Determine the ratio $\overrightarrow{NP} : \overrightarrow{PB}$.

Relative to a fixed origin O, the point A has coordinates $(-2,4)$.

The point B is such so that $\overrightarrow{BA} = 5\mathbf{i} - \mathbf{j}$, where $\mathbf{i}$ and $\mathbf{j}$ are mutually perpendicular unit vectors lying on the same plane.

a) Determine the distance of B from O.

b) Calculate the angle OAB.



The figure above shows a trapezium $OABC$, where O is a fixed origin.

The position vectors of A and C are $12\mathbf{i}+4\mathbf{j}$ and $18\mathbf{i}-21\mathbf{j}$, respectively.

CB is parallel to OA, so that $\left|\overline{CB}\right| = 2\left|\overline{OA}\right|$.

The point D lies on AC so that $AD:DC = 1:2$.

a) Find a simplified expression, in terms of $\mathbf{i}$ and $\mathbf{j}$, for the position vector of D.

b) Show that that O, D and B are collinear and state the ratio of $OD:DB$.

The points A, B and P lie on the x-y plane, where the point O is the origin.

It is further given that

$$|OA| = 4, \quad |OB| = 6 \quad \text{and} \quad \measuredangle AOB = 40°.$$

If $\overrightarrow{OP} = 2\left(\overrightarrow{OA}\right) - 3\left(\overrightarrow{OB}\right)$ determine the distance of P from the origin and the angle between $\overrightarrow{OP}$ and $\overrightarrow{OA}$.

The points $A(-1,4)$, $B(2,3)$ and $C(8,1)$ lie on the x-y plane, where O is the origin.

a) Show that A, B and C are collinear.

The point D lies on BC so that $\overrightarrow{BD} : \overrightarrow{BC} = 2:3$.

b) Find the coordinates of D.

The straight line OB is extended to the point P, so that $\overrightarrow{AP}$ is parallel to $\overrightarrow{OC}$.

c) Determine the coordinates of P.