Vectors – Past Paper Questions

ANSWERS

15.

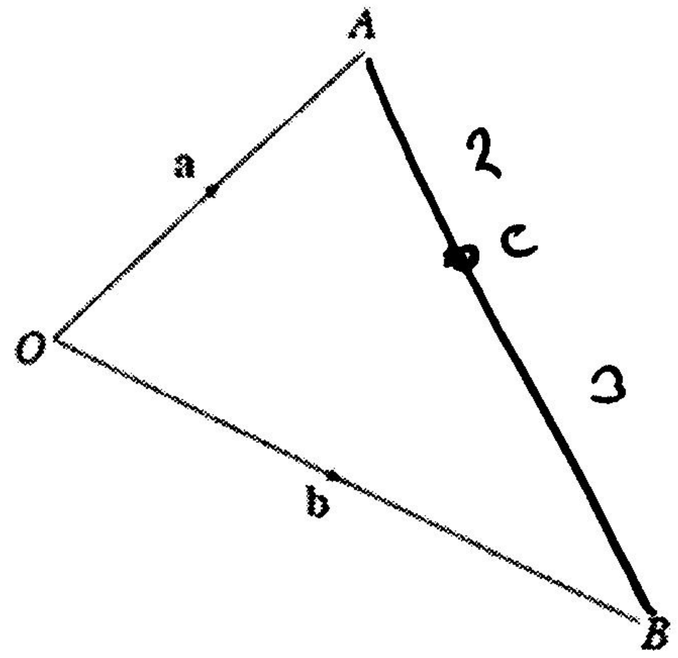

Diagram not drawn to scale.

The point C is the point on AB such that $AC:CB$ is 2:3.
Given that $\mathbf{OA} = \mathbf{a}$ and $\mathbf{OB} = \mathbf{b}$, find $\mathbf{OC}$. Simplify your answer.

$\vec{AB} = -\underline{a} + \underline{b}$ (1)

$\therefore \vec{AC} = \frac{2}{5}(-\underline{a} + \underline{b})$ (1)

$\vec{OC} = \underline{a} + \frac{2}{5}(-\underline{a} + \underline{b})$ (1)

$\vec{OC} = \frac{3}{5}\underline{a} + \frac{2}{5}\underline{b}$

[3]

12. Vectors **OM**, **ON** and **OP** are shown in the diagram below.

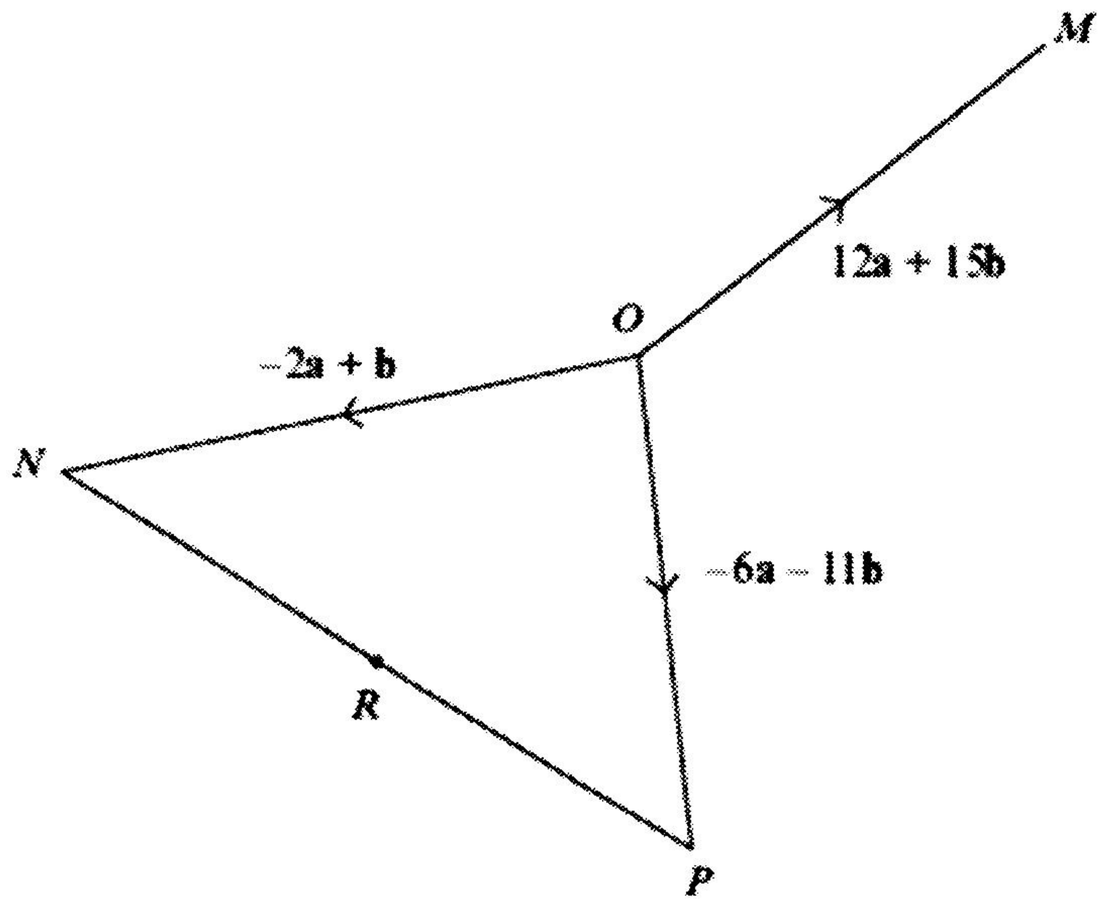

Diagram not drawn to scale

(a) **Find PN in terms of a and b.**

$\overrightarrow{PN} = 6\underline{a} + 11\underline{b} + -2\underline{a} + \underline{b}$ (1)

$\overrightarrow{PN} = 4\underline{a} + 12\underline{b}$ (1)

[2]

(b) **The point *R* is the mid-point of *NP*.**

(i) Find RO in terms of a and b in its simplest form.

$\overrightarrow{RO} = \overrightarrow{RN} + \overrightarrow{NO}$

$= 2\underline{a} + 6\underline{b} + 2\underline{a} - \underline{b}$ (1)

$= 4\underline{a} + 5\underline{b}$ (1)

(ii) Show that OM = *k*RO where *k* is a constant.

$12\underline{a} + 15\underline{b} = k(4\underline{a} + 5\underline{b})$

$\therefore k = 3$ (1)

19. The diagram shows vectors **OA**, **OB** and **OC**.

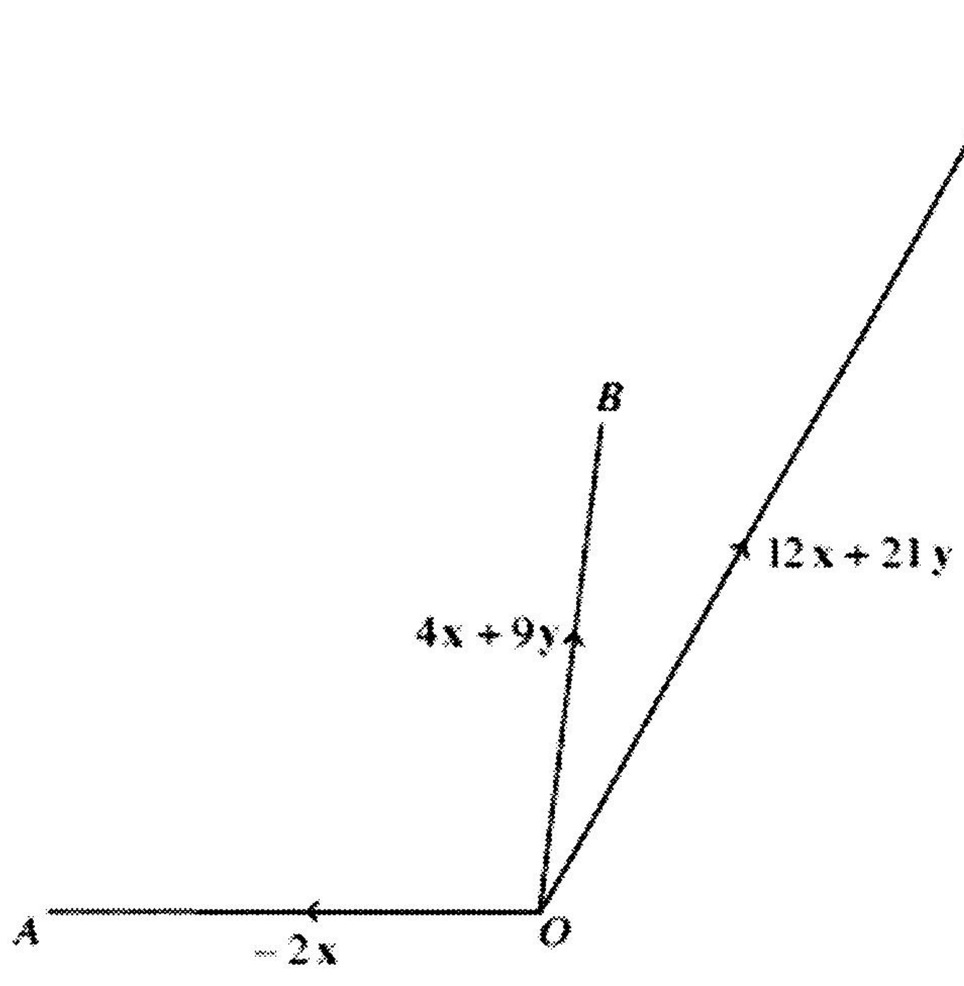

Diagram not drawn to scale.

You are given that $\mathbf{OA} = -2\mathbf{x}$, $\mathbf{OB} = 4\mathbf{x} + 9\mathbf{y}$ and $\mathbf{OC} = 12\mathbf{x} + 21\mathbf{y}$.
Show that the points A, B and C lie on a straight line and find the ratio $AB : BC$.

$\vec{AB} = +2\underline{x} + 4\underline{x} + 9\underline{y}$

$= 6\underline{x} + 9\underline{y}$ (1)

$\vec{BC} = -4\underline{x} - 9\underline{y} + 12\underline{x} + 21\underline{y}$

$= 8\underline{x} + 12\underline{y}$ (1)

So $\vec{BC} = \frac{4}{3}(\vec{AB})$ (1) so parallel

and in straight line. (1)

[4]

13. The diagram shows a quadrilateral $OABC$.

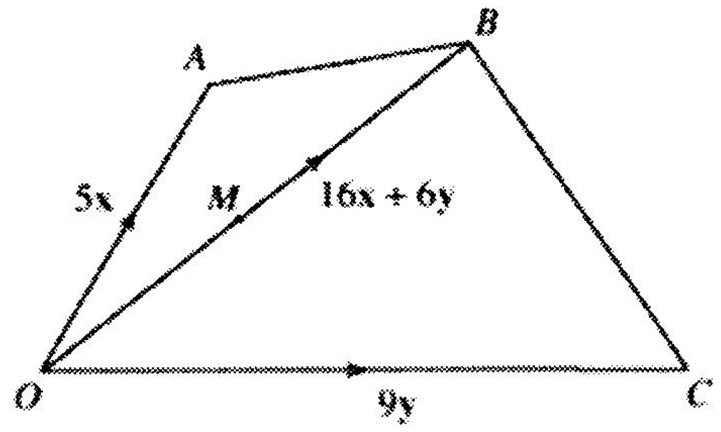

Diagram not drawn to scale.

In the quadrilateral $OABC$, the vectors **OA**, **OB** and **OC** are given by $\mathbf{OA} = 5\mathbf{x}$, $\mathbf{OB} = 16\mathbf{x} + 6\mathbf{y}$ and $\mathbf{OC} = 9\mathbf{y}$.
Given that M is the midpoint of OB, express **each** of the following in terms of x and y in their simplest form.

(a) **OM**

$8\underline{x} + 3\underline{y}$ (1)

[1]

(b) **AC**

$-5\underline{x} + 9\underline{y}$ (1)

[1]

14.

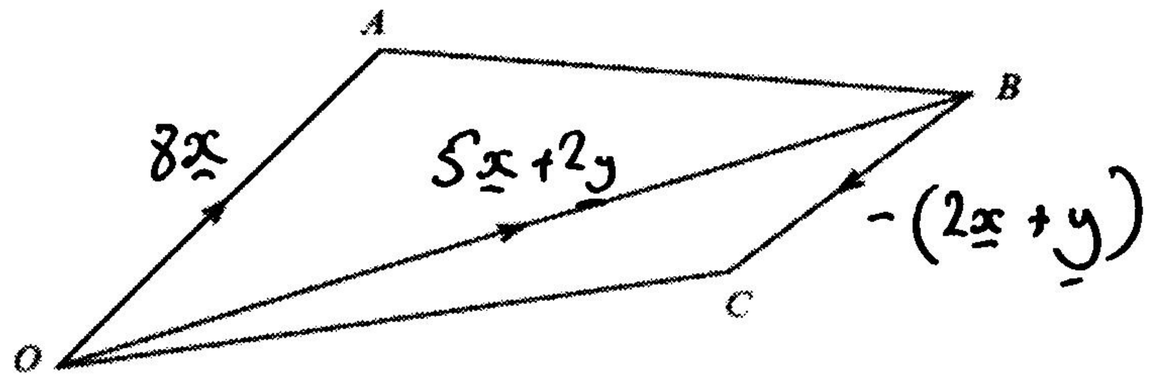

Diagram not drawn to scale

The vectors **OA**, **OB** and **BC** are given by
$\mathbf{OA} = 8\mathbf{x}$, $\mathbf{OB} = 5\mathbf{x} + 2\mathbf{y}$ and $\mathbf{BC} = -(2\mathbf{x} + \mathbf{y})$.
Express each of the following in terms of x and y in their simplest form.

(a) **AB**

$-8\underline{x} + 5\underline{x} + 2\underline{y}$ (1)

$= -3\underline{x} + 2\underline{y}$ (1)

[2]

(b) **OC**

$5\underline{x} + 2\underline{y} - (2\underline{x} + \underline{y})$ (1)

$= 3\underline{x} + \underline{y}$ (1)

[2]

13. Vectors **OK**, **OL** and **OM** are shown in the diagram below.

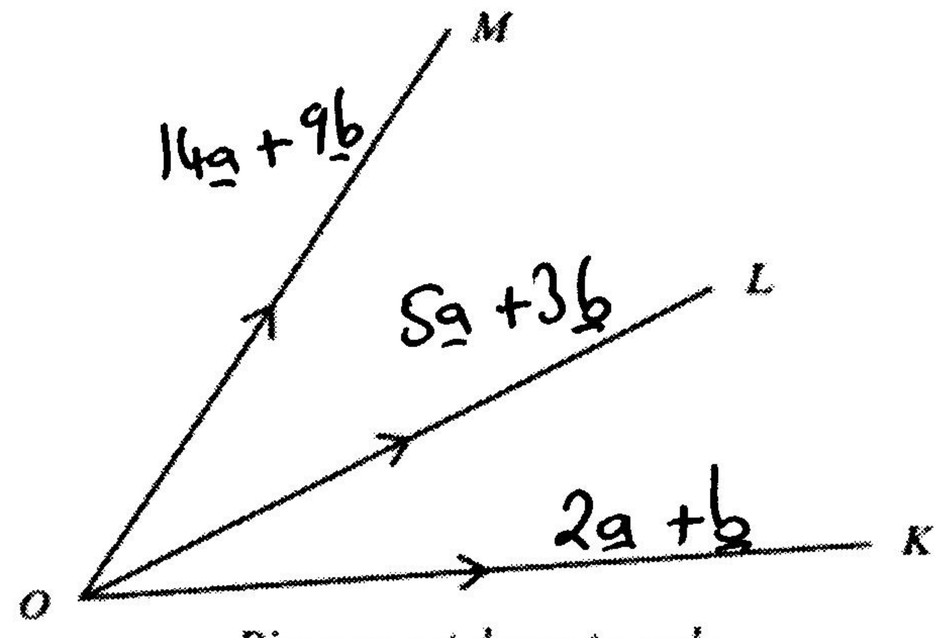

Diagram not drawn to scale

Given that **OK** = 2**a** + **b**, **OL** = 5**a** + 3**b** and **OM** = 14**a** + 9**b**,

(a) express each of the following in terms of **a** and **b** in their simplest form.

(i) **KL**

$-2\underline{a} - \underline{b} + 5\underline{a} + 3\underline{b}$

$= 3\underline{a} + 2\underline{b}$ (1)

(ii) **LM**

$-5\underline{a} - 3\underline{b} + 14\underline{a} + 9\underline{b}$ (1)

$= 9\underline{a} + 6\underline{b}$ (1)

[3]

(b) show that **KM** = *p***KL** where *p* is a constant.

$\vec{KM} = -2\underline{a} - \underline{b} + 14\underline{a} + 9\underline{b}$

$= 12\underline{a} + 8\underline{b}$ (1)

$12\underline{a} + 8\underline{b} = p(3\underline{a} + 2\underline{b})$

So $p = 4$ (1)

[2]

(c) explain fully the geometrical implication of your answer in part *(b)*.

$\vec{KL}$ is parallel to $\vec{KM}$ (1)

and is ⅓ its length (1)

[2]