1 **a** and **b** are vectors such that

$$\mathbf{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} \quad \text{and} \quad 3\mathbf{a} - 2\mathbf{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$$

Find **b** as a column vector.

$3\underline{a} - 2\underline{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ ↓ substitute $\underline{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

$3\begin{pmatrix} 2 \\ -3 \end{pmatrix} - 2\underline{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ (1)

$2\underline{b} = 3\begin{pmatrix} 2 \\ -3 \end{pmatrix} - \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ (1)

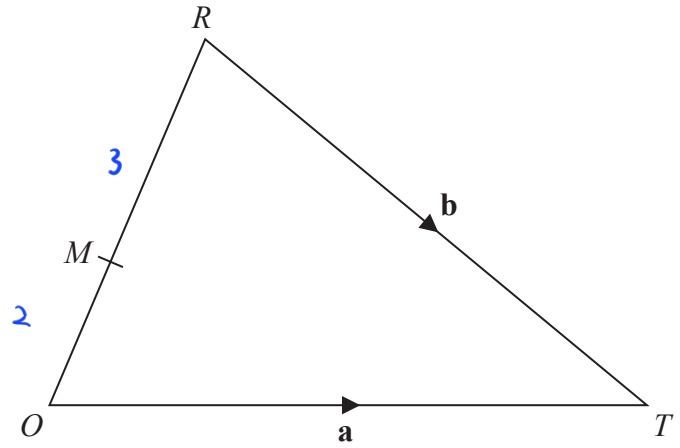
$2\underline{b} = \begin{pmatrix} -2 \\ 8 \end{pmatrix}$

$\underline{b} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ (1)

$\begin{pmatrix} -1 \\ 4 \end{pmatrix}$

(Total for Question 1 is 3 marks)

2 *ORT* is a triangle.



$\overrightarrow{OT} = \mathbf{a}$ $\overrightarrow{RT} = \mathbf{b}$

M is the point on OR such that $OM : MR = 2 : 3$

Express $\overrightarrow{MT}$ in terms of **a** and **b**.
Give your answer in its simplest form.

$\overrightarrow{OR} = \overrightarrow{OT} + \overrightarrow{TR}$

$\overrightarrow{OR} = a - b$ (1)

$\overrightarrow{OM} = \frac{2}{5}(a-b)$ (1) ← 2:3 has 2+3 = 5 parts

$\overrightarrow{MT} = \overrightarrow{MO} + \overrightarrow{OT}$

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

$= -\frac{2}{5}a + \frac{2}{5}b + a$

$= \frac{3}{5}a + \frac{2}{5}b$ (1)

$\frac{3}{5}a + \frac{2}{5}b$

(Total for Question 2 is 4 marks)

3 Given that the vector $a\begin{pmatrix}2\\6\end{pmatrix}+b\begin{pmatrix}8\\2\end{pmatrix}$ is parallel to the vector $\begin{pmatrix}13\\6\end{pmatrix}$

find an expression for b in terms of a.

Method in finding linear equations with term a and b :

$a\begin{pmatrix}2\\6\end{pmatrix}+b\begin{pmatrix}8\\2\end{pmatrix}=k\begin{pmatrix}13\\6\end{pmatrix}$

$(2a+8b=13k)\times 6 \longrightarrow 12a+48b=78k$

$(6a+2b=6k)\times 13 \longrightarrow 78a+26b=78k$ (1)

making the RHS of both equations the same to eliminate k

$-66a+22b=0$

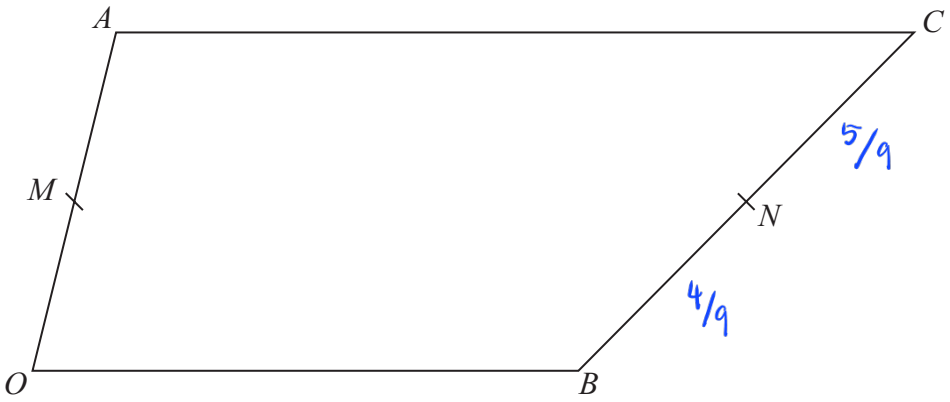
$66a=22b$

$b=3a$ (1)

$b=3a$

(Total for Question 3 is 3 marks)

4 The diagram shows quadrilateral $OACB$.



M is the midpoint of OA.
N is the point on BC such that $BN : NC = 4 : 5$

$\overrightarrow{OA} = \mathbf{a}$ $\overrightarrow{OB} = \mathbf{b}$ $\overrightarrow{AC} = k\mathbf{b}$ where k is a positive integer.

(a) Express $\overrightarrow{MN}$ in terms of k, **a** and **b**.
Give your answer in its simplest form.

$\overrightarrow{BC} = \overrightarrow{BO} + \overrightarrow{OA} + \overrightarrow{AC}$

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

$\overrightarrow{MN} = \overrightarrow{MA} + \overrightarrow{AC} + \overrightarrow{CN}$

$= \frac{1}{2}(\overrightarrow{OA}) + \overrightarrow{AC} + \frac{5}{9}(-\overrightarrow{BC})$

$= \frac{1}{2}\underline{a} + k\underline{b} + \frac{5}{9}(\underline{b} - \underline{a} - k\underline{b})$ (1)

(1)

$= \frac{1}{2}\underline{a} - \frac{5}{9}\underline{a} + k\underline{b} + \frac{5}{9}\underline{b} - \frac{5}{9}k\underline{b}$

$= -\frac{1}{18}\underline{a} + \left(\frac{5}{9} + \frac{4}{9}k\right)\underline{b}$

$= \frac{1}{18}(8k\underline{b} + 10\underline{b} - \underline{a})$ (1)

$\frac{1}{18}(8k\underline{b} + 10\underline{b} - \underline{a})$

(4)

(b) Is MN parallel to OB?
Give a reason for your answer.

No. Because MN and OB are not multiple of each other. (1)

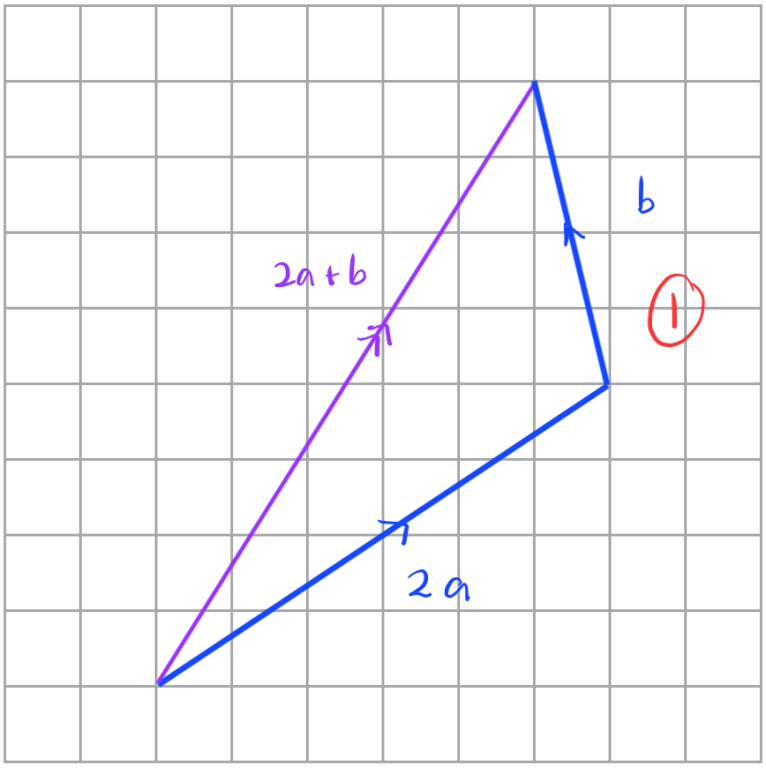
(1)

(Total for Question 4 is 5 marks)

5 $\mathbf{a} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$

On the grid below, draw and label the vector $2\mathbf{a} + \mathbf{b}$ (1)

$2a+b = 2\begin{pmatrix} 3 \\ 2 \end{pmatrix} + \begin{pmatrix} -1 \\ 4 \end{pmatrix} = \begin{pmatrix} 6 \\ 4 \end{pmatrix} + \begin{pmatrix} -1 \\ 4 \end{pmatrix} = \begin{pmatrix} 5 \\ 8 \end{pmatrix} \begin{matrix} x \\ y \end{matrix}$ (1)



(1)

1 box = 1 unit

(Total for Question 5 is 3 marks)