**1** *OAB* is a triangle.

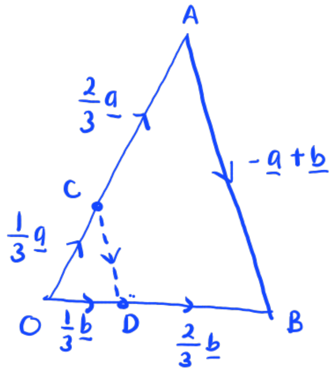
$\overrightarrow{OA} = \mathbf{a}$ $\quad\overrightarrow{OB} = \mathbf{b}$

The point $C$ lies on $OA$ such that $OC : CA = 1 : 2$
The point $D$ lies on $OB$ such that $OD : DB = 1 : 2$

Using a vector method, prove that $ABDC$ is a trapezium.

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

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




$\overrightarrow{CD} = \overrightarrow{CA} + \overrightarrow{AB} + \overrightarrow{BD}$

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

$= \frac{2}{3}\underline{a} - \underline{a} + \underline{b} - \frac{2}{3}\underline{b}$

$= -\frac{1}{3}\underline{a} + \frac{1}{3}\underline{b}$

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

$= \frac{1}{3}(\overrightarrow{AB})$ (1)

$\therefore$ since $\overrightarrow{AB}$ and $\overrightarrow{CD}$ are parallel,

ABDC is a trapezium. (1)

**(Total for Question 1 is 3 marks)**

**2** The diagram shows triangle $OAB$ with $OA$ extended to $E$

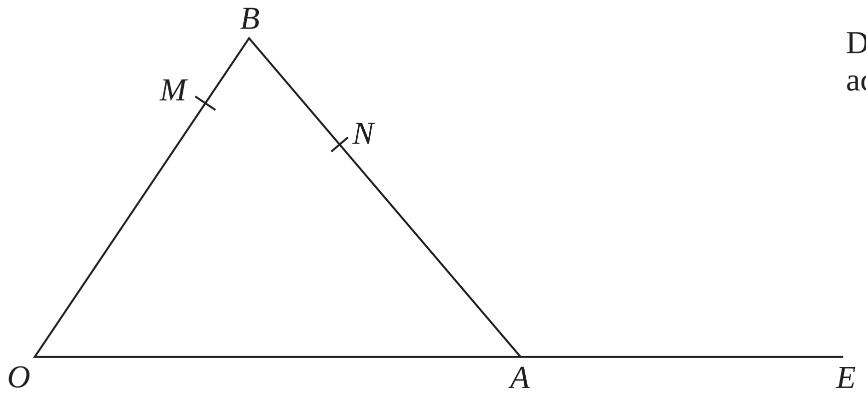



Diagram **NOT** accurately drawn

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

$M$ is the point on $OB$ such that $OM : MB = 4 : 1$
$N$ is the point on $AB$ such that $AN : NB = 3 : 2$
$OA : AE = 5 : 3$

(b) Use a vector method to show that *MNE* is a straight line.

$\overrightarrow{ME} = \overrightarrow{MO} + \overrightarrow{OA} + \overrightarrow{AE}$

$= \frac{4}{5}(\overrightarrow{BO}) + \underline{a} + \frac{3}{5}\underline{a}$

$= \frac{4}{5} - \underline{b} + \frac{8}{5}\underline{a}$

$= \frac{8}{5}\underline{a} - \frac{4}{5}\underline{b} = 4\left(\frac{2}{5}\underline{a} - \frac{1}{5}b\right)$ (1)

$\overrightarrow{NE} = \overrightarrow{NA} + \overrightarrow{AE}$

$= \frac{3}{5}(\overrightarrow{BA}) + \frac{3}{5}\underline{a}$ (1)

$= \frac{3}{5}(-\underline{b} + \underline{a}) + \frac{3}{5}\underline{a}$

$= \frac{6}{5}\underline{a} - \frac{3}{5}b = 3\left(\frac{2}{5}\underline{a} - \frac{1}{5}b\right)$

$\overrightarrow{ME} = \frac{4}{3}\overrightarrow{NE}$ (1)

(3)

**(Total for Question 2 is 3 marks)**