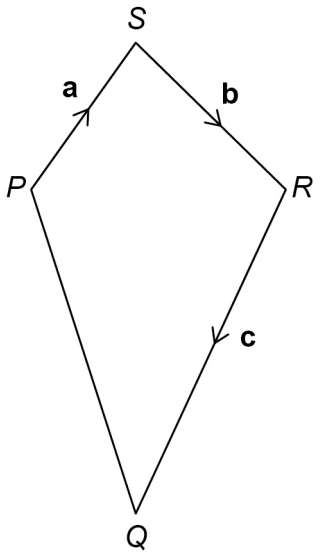
1 Here is quadrilateral $PQRS$.

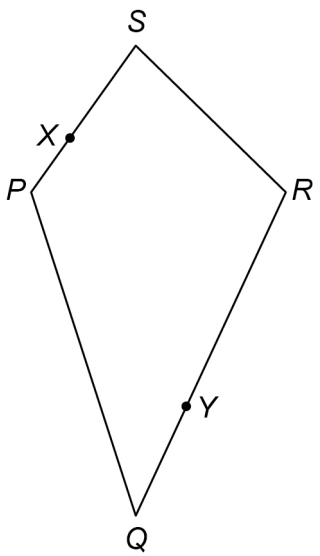
$\overrightarrow{PS} = \mathbf{a}$ $\overrightarrow{SR} = \mathbf{b}$ $\overrightarrow{RQ} = \mathbf{c}$



Not drawn accurately

X is a point on PS where $PX : XS = 1 : 2$

Y is a point on RQ where $RY : YQ = 2 : 1$



Not drawn accurately

Is *XY* parallel to *PQ*?

Show working to support your answer.

[3 marks]

$\overrightarrow{PQ} = \overrightarrow{PS} + \overrightarrow{SR} + \overrightarrow{RQ}$

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

$\overrightarrow{XY} = \overrightarrow{XS} + \overrightarrow{SR} + \overrightarrow{RY}$

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

No. as XY is not a multiple of PQ. (1)

2 In the diagram

$\overrightarrow{DE} = \mathbf{a}$

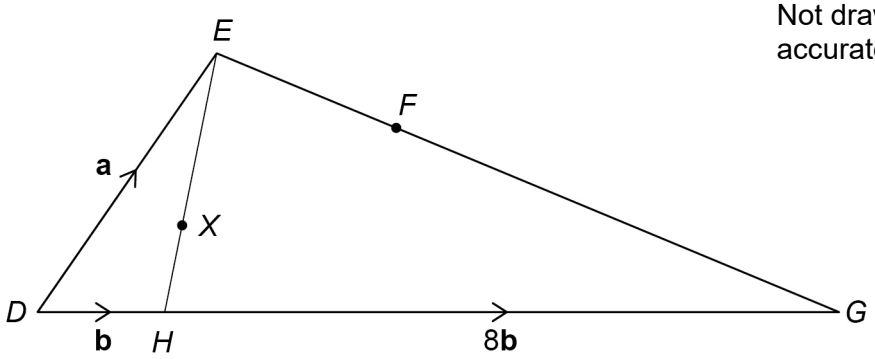
$\overrightarrow{DH} = \mathbf{b}$

$\overrightarrow{HG} = 8\mathbf{b}$

$EX : XH = 3 : 1$

$EF : FG = 1 : 3$

Not drawn accurately



2 (a) Show that $\overrightarrow{DX} = \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$

[2 marks]

$\overrightarrow{EH} = \overrightarrow{ED} + \overrightarrow{DH}$

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

$\overrightarrow{EX} = \frac{3}{4}(\overrightarrow{EH})$

$= \frac{3}{4}(-\underline{a} + \underline{b})$

$\overrightarrow{DX} = \overrightarrow{DE} + \overrightarrow{EX}$ (1)

$= \underline{a} + (-\frac{3}{4}\underline{a} + \frac{3}{4}\underline{b}) = \frac{1}{4}\underline{a} + \frac{3}{4}\underline{b}$ (shown)

2 (b) Is *DXF* a straight line?

Show working to support your answer.

[4 marks]

$\overrightarrow{EG} = \overrightarrow{EH} + \overrightarrow{HG}$

$= -\underline{a} + \underline{b} + 8\underline{b}$

$= -\underline{a} + 9\underline{b}$

$\overrightarrow{EF} = \frac{1}{4}\overrightarrow{EG}$ (1)

$= -\frac{1}{4}\underline{a} + \frac{9}{4}\underline{b}$ (1)

$\overrightarrow{DF} = \overrightarrow{DE} + \overrightarrow{EF}$

$= \underline{a} + (-\frac{1}{4}\underline{a} + \frac{9}{4}\underline{b})$

$= \frac{3}{4}\underline{a} + \frac{9}{4}\underline{b}$ (1)

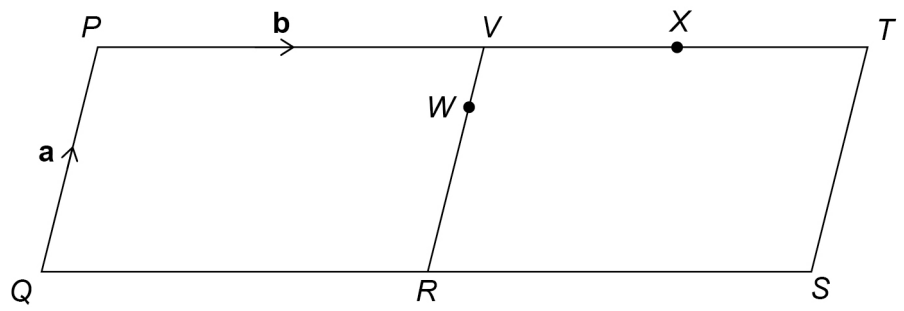
$\overrightarrow{DF} = 3(\frac{1}{4}\underline{a} + \frac{3}{4}\underline{b})$

$\overrightarrow{DF} = 3(\overrightarrow{DX})$ (1)

Yes, DXF is a straight line.

3 Two congruent parallelograms, *PQRV* and *VRST*, are joined.

Not drawn accurately



$\overrightarrow{QP} = \mathbf{a}$ $\overrightarrow{PV} = \mathbf{b}$

X is the midpoint of *VT*.

VW : *WR* = 1 : 2

Prove that *Q*, *W* and *X* lie on a straight line.

[3 marks]

$\overrightarrow{QW} = \overrightarrow{QP} + \overrightarrow{PV} + \overrightarrow{VW}$

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

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

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

$\overrightarrow{QX} = \overrightarrow{QP} + \overrightarrow{PV} + \overrightarrow{VX}$

$= \underline{a} + \underline{b} + \frac{1}{2}(\overrightarrow{VT})$

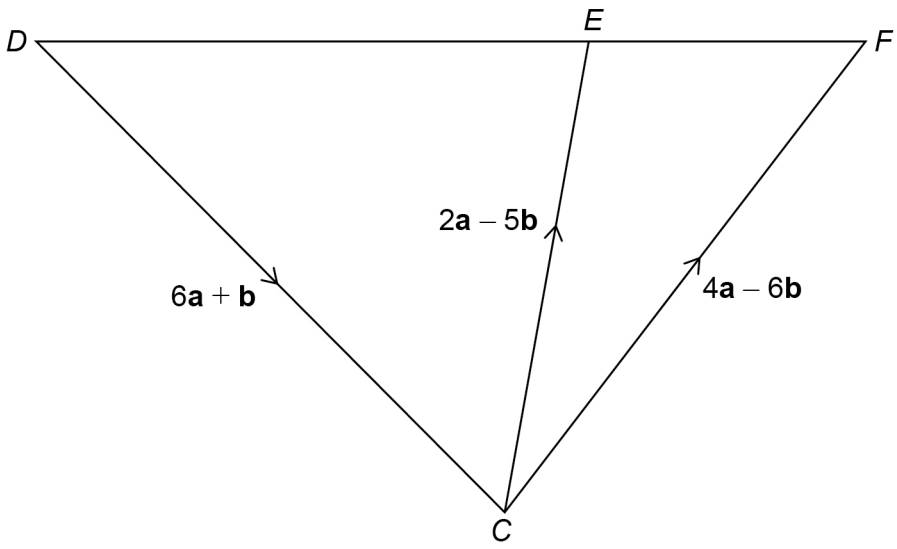
$= \underline{a} + \underline{b} + \frac{1}{2}\underline{b}$

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

$\overrightarrow{QW} = \frac{3}{2}(\frac{2}{3}\underline{a} + \underline{b}) = \underline{a} + \frac{3}{2}\underline{b} = \overrightarrow{QX}$

$\overrightarrow{QW} = \frac{3}{2}\overrightarrow{QX}$ (1)

4



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Prove that *DEF* is a straight line.

[4 marks]

$\overrightarrow{DE} = \overrightarrow{DC} + \overrightarrow{CE}$

$= 6\underline{a} + \underline{b} + 2\underline{a} - 5\underline{b}$

$= 8\underline{a} - 4\underline{b}$

$= 4(2\underline{a} - \underline{b})$ ✓(1)

$\overrightarrow{DF} = \overrightarrow{DC} + \overrightarrow{CF}$

$= 6\underline{a} + \underline{b} + 4\underline{a} - 6\underline{b}$

$= 10\underline{a} - 5\underline{b}$ ✓(1)

$= 5(2\underline{a} - \underline{b})$ ✓(1)

$\frac{\overrightarrow{DE}}{\overrightarrow{DF}} = \frac{4(2\underline{a} - \underline{b})}{5(2\underline{a} - \underline{b})} = \frac{4}{5}$ ✓(1)

Hence, $\overrightarrow{DE}$ and $\overrightarrow{DF}$ are parallel to each other.