Vectors (H)

A collection of 9-1 Maths GCSE Sample and Specimen questions from AQA, OCR, Pearson-Edexcel and WJEC Eduqas.

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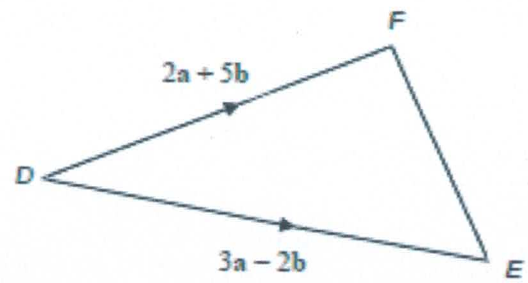
Total Marks:	

1. Vectors **DF** and DE **are** shown in the diagram below.



Line **PQ** is 3 times the length of line EF.

PQ is in the opposite direction to EF.

Find **PQ** in the form **m**a + **n**b.

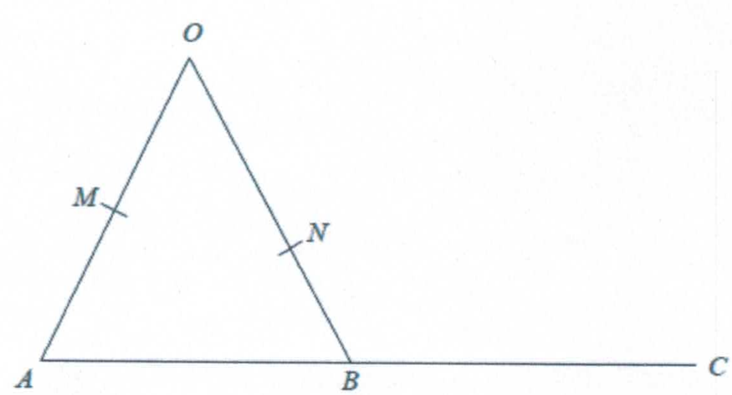
$\overrightarrow{PQ} = 3\overrightarrow{FE}$

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

$= 3\underline{a} - 21\underline{b}$

[4]

2.



OMA, *ONB* and *ABC* are straight lines.
M is the midpoint of *OA*.
B is the midpoint of *AC*.

$\overrightarrow{OA} = 6\mathbf{a}$

$\overrightarrow{OB} = 6\mathbf{b}$

$\overrightarrow{ON} = k\mathbf{b}$ where k is a scalar quantity.

Given that *MNC* is a straight line, find the value of *k*.

$\overrightarrow{MN} = -3\underline{a} + k\underline{b}$

$\overrightarrow{MC} = \overrightarrow{MA} + 2\overrightarrow{AB}$

$= 3\underline{a} - 12\underline{a} + 12\underline{b}$

$= -9\underline{a} + 12\underline{b}$

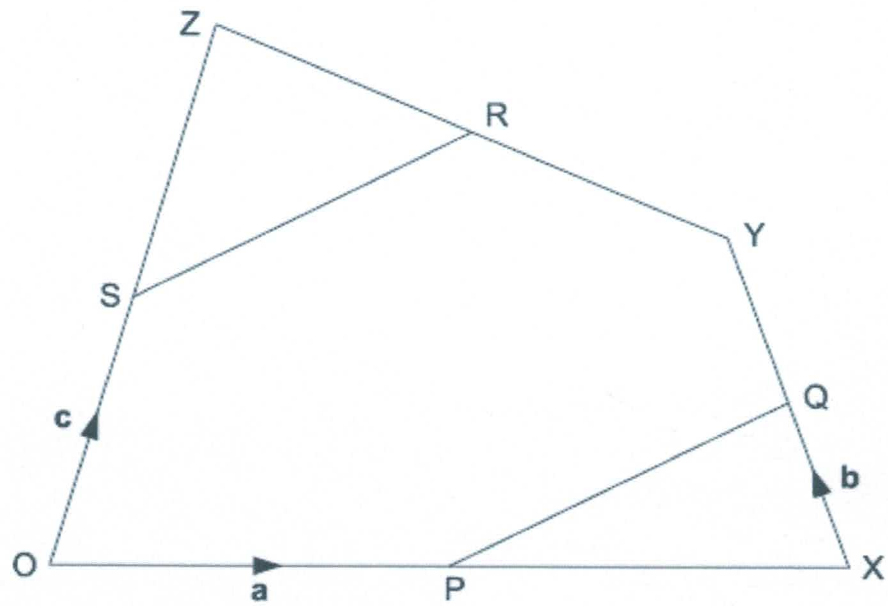
Since on a straight line $\overrightarrow{MN} = -3\underline{a} + k\underline{b}$

$\uparrow \div 3 \quad \uparrow \div 3 \quad k = 4$

$\overrightarrow{MC} = -9\underline{a} + 12\underline{b}$

[5]

3. P, Q, R and S are the midpoints of OX, XY, YZ and OZ respectively.



$\overrightarrow{OP}$= **a**, $\overrightarrow{XQ}$= **b** and $\overrightarrow{OS}$= **c**.

Show that PQ is parallel to SR.

$\overrightarrow{PX} = \vec{a}$

$\overrightarrow{XQ} = \vec{b}$

$\therefore \overrightarrow{PQ} = \vec{a} + \vec{b}$

$\overrightarrow{ZY} = -2\vec{c} + 2\vec{a} + 2\vec{b}$

$\overrightarrow{ZR} = \frac{1}{2}(-2\vec{c} + 2\vec{a} + 2b)$

$= -\vec{c} + \vec{a} + \vec{b}$

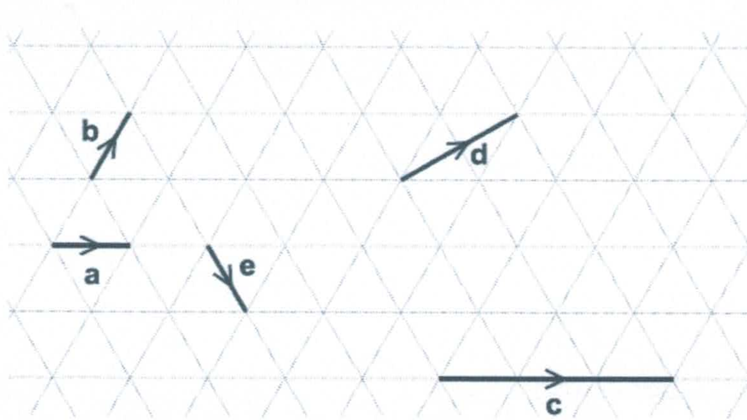
$\overrightarrow{SR} = \overrightarrow{SZ} + \overrightarrow{ZR} = \vec{c} - \vec{c} + \vec{a} + \vec{b}$

$= \vec{a} + \vec{b}$

$\therefore \overrightarrow{PQ}$ parallel to $\overrightarrow{SR}$

[5]

4. Vectors a, b, c, d and e are drawn on an isometric grid.



Write each of the vectors c, d and e in terms of a and/or b.

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c = $3\vec{a}$

d = $\vec{a}+\vec{b}$

e = $\vec{a}-\vec{b}$

[3]

5. $\mathbf{a} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

Circle the vector **a** – **b**

[1]

$\begin{pmatrix} -3 \\ -5 \end{pmatrix}$ $\begin{pmatrix} 7 \\ 1 \end{pmatrix}$

$\begin{pmatrix} 3 \\ 1 \end{pmatrix}$ $\begin{pmatrix} 7 \\ -5 \end{pmatrix}$

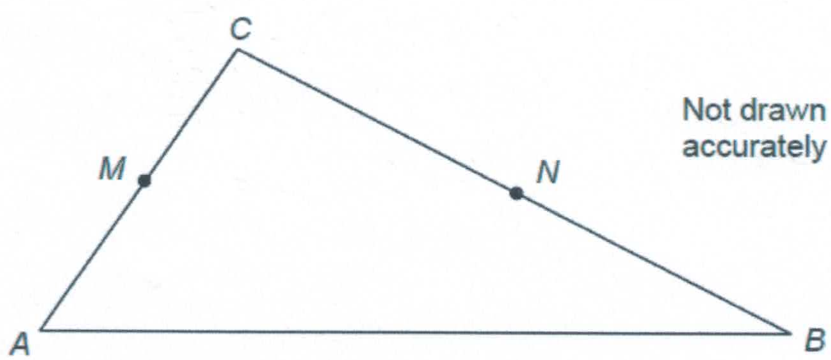
6. In triangle *ABC*

M is the midpoint of *AC*

N is the point on *BC* where *BN* : *NC* = 2 : 3

$\overrightarrow{AC} = 2\mathbf{a}$

$\overrightarrow{AB} = 3\mathbf{b}$



a) Work out $\overrightarrow{MN}$ in terms of **a** and **b**.

Give your answer in its simplest form.

$\overrightarrow{MN} = \overrightarrow{MC} + \overrightarrow{CN}$

$\overrightarrow{MC} = \vec{a}$

$\overrightarrow{CN} = \frac{3}{5}\overrightarrow{CB}$

$\overrightarrow{CB} = -2\vec{a} + 3\vec{b}$

$\overrightarrow{CN} = -\frac{6}{5}\vec{a} + \frac{9}{5}\vec{b}$

$\therefore \overrightarrow{MN} = -\frac{\vec{a}}{5} + \frac{9}{5}\vec{b}$

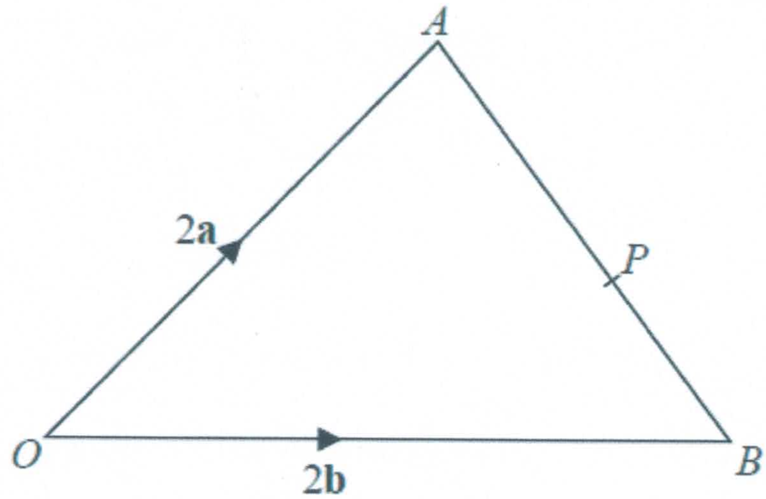
[3]

b) Use your answer to part (a) to explain why *MN* is not parallel to *AB*.

MN has an $\vec{a}$ component. $\overrightarrow{AB}$ does not.

[1]

7.



OAB is a triangle.

P is the point on AB such that $AP : PB = 5:3$

$\overrightarrow{OA} = 2a$

$\overrightarrow{OB} = 2b$

$\overrightarrow{OP} = k(3a + 5b)$ where k is a scalar quantity.

Find the value of k.

$\overrightarrow{OP} = \overrightarrow{OB} + \overrightarrow{BP}$

$\overrightarrow{OB} = 2\underline{b}$

$\overrightarrow{BP} = \frac{3}{8}\overrightarrow{BA} = \frac{3}{8}(-2\underline{b} + 2\underline{a})$

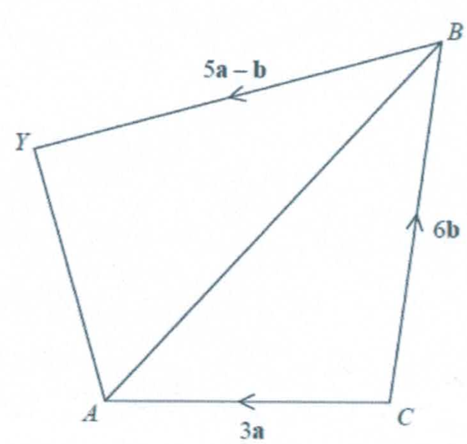
$= -\frac{3}{4}\underline{b} + \frac{3}{4}\underline{a}$

$\therefore \overrightarrow{OP} = 2\underline{b} - \frac{3}{4}\underline{b} + \frac{3}{4}a = \frac{1}{4}(3a + 5b)$

$\therefore k = \frac{1}{4}$.

[4]

8.



$CAYB$ is a quadrilateral.

$\overrightarrow{CA} = 3\mathbf{a}$

$\overrightarrow{CB} = 6\mathbf{b}$

$\overrightarrow{BY} = 5\mathbf{a} - \mathbf{b}$

X is the point on AB such that $AX : XB = 1 : 2$

Prove that $\overrightarrow{CX} = \frac{2}{5}\overrightarrow{CY}$

$\overrightarrow{CX} = \overrightarrow{CA} + \overrightarrow{AX}$

$= \overrightarrow{CA} + \frac{1}{3}\overrightarrow{AB}$

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

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

$= 5\underline{a} + 5\underline{b}$

$\therefore \overrightarrow{CX} = \frac{2}{5}\overrightarrow{CY}$

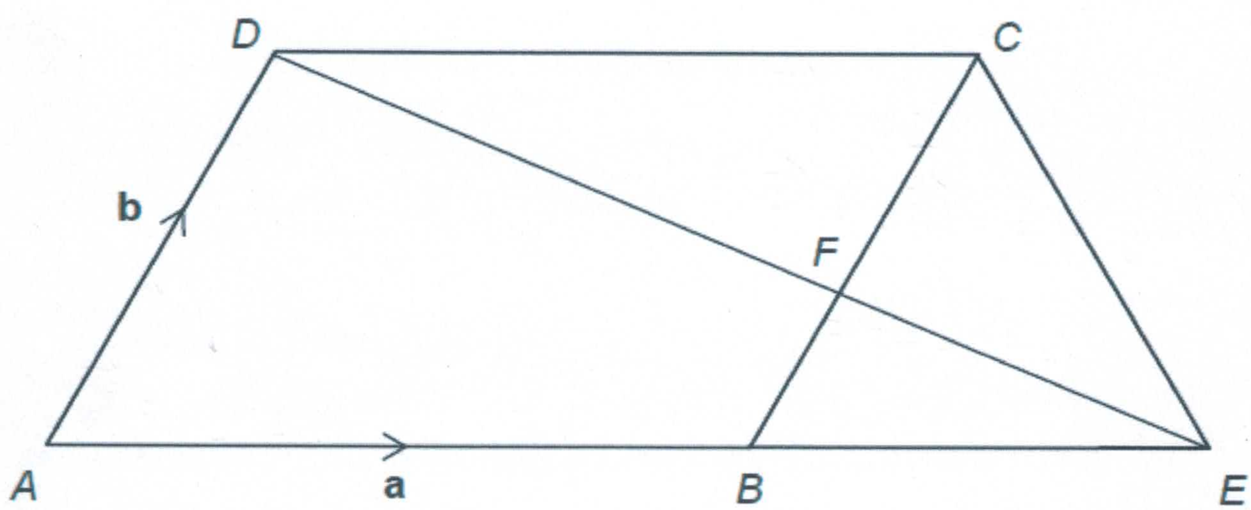
[5]

9. $ABCD$ is a parallelogram.

ABE is a straight line and $AB : BE = 3 : 2$

BC and ED intersect at F.

$\overrightarrow{AB} = \mathbf{a}$ and $\overrightarrow{AD} = \mathbf{b}$



a) Work out $\overrightarrow{ED}$ in terms of **a** and **b**.
Give your answer in its simplest form.

$\overrightarrow{ED} = \overrightarrow{EB} + \overrightarrow{BA} + \overrightarrow{AD}$

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

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

[3]

b) Deduce $\overrightarrow{EF}$ in terms of **a** and **b**.

$\overrightarrow{EF} = \frac{2}{5}\overrightarrow{ED}$

[2]

$\therefore \overrightarrow{EF} = \frac{2}{5}\left(-\frac{5}{3}\underline{a} + \underline{b}\right) = -\frac{2}{3}\underline{a} + \frac{2}{5}\underline{b}$

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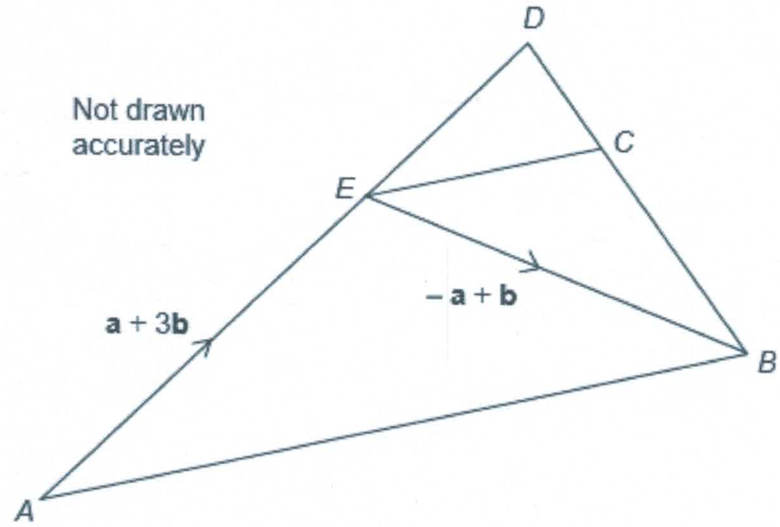
10. AED is a straight line.



$\overrightarrow{AE} = \mathbf{a} + 3\mathbf{b}$

$\overrightarrow{EB} = -\mathbf{a} + \mathbf{b}$

a) Work out the vector $\overrightarrow{AB}$ $= \overrightarrow{AE} + \overrightarrow{EB} = \underline{a} + 3\underline{b} - \underline{a} + b$

$= 4\underline{b}$

[1]

b) Also $\overrightarrow{ED} = \frac{1}{3}\overrightarrow{AE}$ and $\overrightarrow{DC} = -\frac{1}{3}\mathbf{a}$

Prove that $\overrightarrow{EC}$ is parallel to $\overrightarrow{AB}$.

$\overrightarrow{EC} = \overrightarrow{ED} + \overrightarrow{DC}$

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

[3]

$= 3\underline{b}$

$\overrightarrow{AB} = 4\underline{b}$

Both only have $\underline{b}$ components

$\therefore$ parallel.