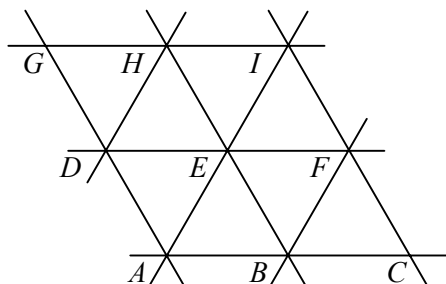


1

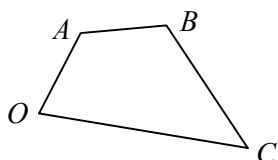


The diagram shows three sets of equally-spaced parallel lines.

Given that $\overrightarrow{AC} = \mathbf{p}$ and that $\overrightarrow{AD} = \mathbf{q}$, express the following vectors in terms of \mathbf{p} and \mathbf{q} .

- | | | | | | |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| a \overrightarrow{CA} | b \overrightarrow{AG} | c \overrightarrow{AB} | d \overrightarrow{DF} | e \overrightarrow{HE} | f \overrightarrow{AF} |
| g \overrightarrow{AH} | h \overrightarrow{DC} | i \overrightarrow{CG} | j \overrightarrow{IA} | k \overrightarrow{EC} | l \overrightarrow{IB} |

2

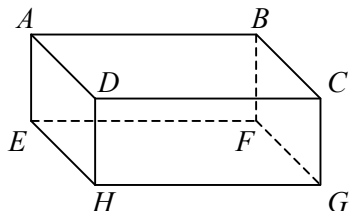


In the quadrilateral shown, $\overrightarrow{OA} = \mathbf{u}$, $\overrightarrow{AB} = \mathbf{v}$ and $\overrightarrow{OC} = \mathbf{w}$.

Find expressions in terms of \mathbf{u} , \mathbf{v} and \mathbf{w} for

- | | | |
|-------------------------|-------------------------|-------------------------|
| a \overrightarrow{OB} | b \overrightarrow{AC} | c \overrightarrow{CB} |
|-------------------------|-------------------------|-------------------------|

3

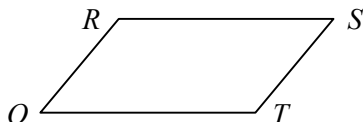


The diagram shows a cuboid.

Given that $\overrightarrow{AB} = \mathbf{p}$, $\overrightarrow{AD} = \mathbf{q}$ and $\overrightarrow{AE} = \mathbf{r}$, find expressions in terms of \mathbf{p} , \mathbf{q} and \mathbf{r} for

- | | | | | | |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| a \overrightarrow{BC} | b \overrightarrow{AF} | c \overrightarrow{DE} | d \overrightarrow{AG} | e \overrightarrow{GB} | f \overrightarrow{BH} |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|

4



The diagram shows parallelogram $ORST$.

Given that $\overrightarrow{OR} = \mathbf{a} + 2\mathbf{b}$ and that $\overrightarrow{OT} = \mathbf{a} - 2\mathbf{b}$,

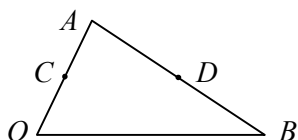
a find expressions in terms of \mathbf{a} and \mathbf{b} for

- | | |
|-------------------------|--------------------------|
| i \overrightarrow{OS} | ii \overrightarrow{TR} |
|-------------------------|--------------------------|

Given also that $\overrightarrow{OA} = \mathbf{a}$ and that $\overrightarrow{OB} = \mathbf{b}$,

b copy the diagram and show the positions of the points A and B .

5



The diagram shows triangle OAB in which $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

The points C and D are the mid-points of OA and AB respectively.

a Find and simplify expressions in terms of \mathbf{a} and \mathbf{b} for

- i** \overrightarrow{OC} **ii** \overrightarrow{AB} **iii** \overrightarrow{AD} **iv** \overrightarrow{OD} **v** \overrightarrow{CD}

b Explain what your expression for \overrightarrow{CD} tells you about \overrightarrow{OB} and \overrightarrow{CD} .

6 Given that vectors \mathbf{p} and \mathbf{q} are not parallel, state whether or not each of the following pairs of vectors are parallel.

- a** $2\mathbf{p}$ and $3\mathbf{p}$ **b** $(\mathbf{p} + 2\mathbf{q})$ and $(2\mathbf{p} - 4\mathbf{q})$ **c** $(3\mathbf{p} - \mathbf{q})$ and $(\mathbf{p} - \frac{1}{3}\mathbf{q})$
d $(\mathbf{p} - 2\mathbf{q})$ and $(4\mathbf{q} - 2\mathbf{p})$ **e** $(\frac{3}{4}\mathbf{p} + \mathbf{q})$ and $(6\mathbf{p} + 8\mathbf{q})$ **f** $(2\mathbf{q} - 3\mathbf{p})$ and $(\frac{3}{2}\mathbf{q} - \mathbf{p})$

7 The points O, A, B and C are such that $\overrightarrow{OA} = 4\mathbf{m}$, $\overrightarrow{OB} = 4\mathbf{m} + 2\mathbf{n}$ and $\overrightarrow{OC} = 2\mathbf{m} + 3\mathbf{n}$, where \mathbf{m} and \mathbf{n} are non-parallel vectors.

a Find an expression for \overrightarrow{BC} in terms of \mathbf{m} and \mathbf{n} .

The point M is the mid-point of OC .

b Show that AM is parallel to BC .

8 The points O, A, B and C are such that $\overrightarrow{OA} = 6\mathbf{u} - 4\mathbf{v}$, $\overrightarrow{OB} = 3\mathbf{u} - \mathbf{v}$ and $\overrightarrow{OC} = \mathbf{v} - 3\mathbf{u}$, where \mathbf{u} and \mathbf{v} are non-parallel vectors.

The point M is the mid-point of OA and the point N is the point on AB such that $AN : NB = 1 : 2$

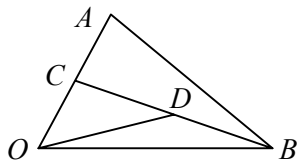
a Find \overrightarrow{OM} and \overrightarrow{ON} .

b Prove that C, M and N are collinear.

9 Given that vectors \mathbf{p} and \mathbf{q} are not parallel, find the values of the constants a and b such that

- a** $a\mathbf{p} + 3\mathbf{q} = 5\mathbf{p} + b\mathbf{q}$ **b** $(2\mathbf{p} + a\mathbf{q}) + (b\mathbf{p} - 4\mathbf{q}) = \mathbf{0}$
c $4a\mathbf{q} - \mathbf{p} = b\mathbf{p} - 2\mathbf{q}$ **d** $(2a\mathbf{p} + b\mathbf{q}) - (a\mathbf{q} - 6\mathbf{p}) = \mathbf{0}$

10



The diagram shows triangle OAB in which $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

The point C is the mid-point of OA and the point D is the mid-point of BC .

a Find an expression for \overrightarrow{OD} in terms of \mathbf{a} and \mathbf{b} .

b Show that if the point E lies on AB then \overrightarrow{OE} can be written in the form $\mathbf{a} + k(\mathbf{b} - \mathbf{a})$, where k is a constant.

Given also that OD produced meets AB at E ,

c find \overrightarrow{OE} ,

d show that $AE : EB = 2 : 1$