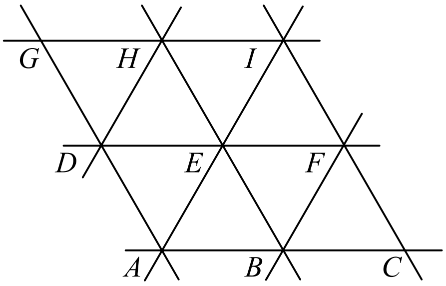
1



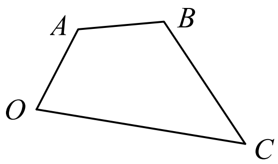
The diagram shows three sets of equally-spaced parallel lines.

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

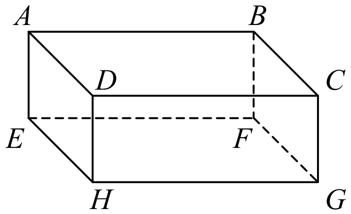


In the quadrilateral shown, $\overrightarrow{OA} = \mathbf{u}$, $\overrightarrow{AB} = \mathbf{v}$ and $\overrightarrow{OC} = \mathbf{w}$.

Find expressions in terms of **u**, **v** and **w** for

a $\overrightarrow{OB}$ **b** $\overrightarrow{AC}$ **c** $\overrightarrow{CB}$

3

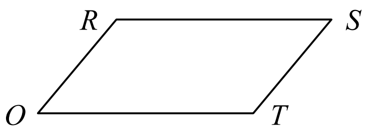


The diagram shows a cuboid.

Given that $\overrightarrow{AB} = \mathbf{p}$, $\overrightarrow{AD} = \mathbf{q}$ and $\overrightarrow{AE} = \mathbf{r}$, find expressions in terms of **p**, **q** and **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 $\overrightarrow{OT} = \mathbf{a} - 2\mathbf{b}$,

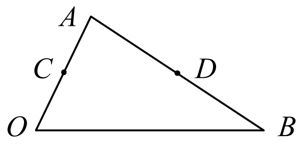
a find expressions in terms of **a** and **b** for

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 **a** and **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 **p** and **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 **m** and **n** are non-parallel vectors.

a Find an expression for $\overrightarrow{BC}$ in terms of **m** and **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 **u** and **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 $\overrightarrow{ON}$.

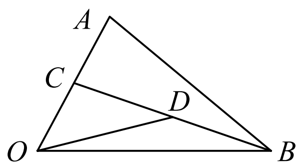
b Prove that C, M and N are collinear.

9 Given that vectors **p** and **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 **a** and **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 $AE : EB = 2 : 1$