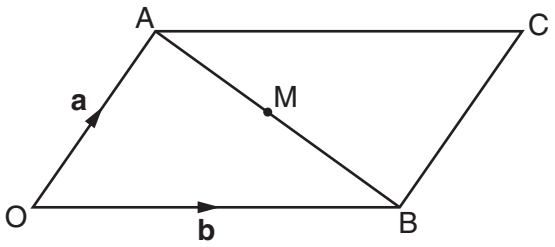
1 OACB is a parallelogram.
$\overrightarrow{OA}$ = **a** and $\overrightarrow{OB}$ = **b**.
M is the midpoint of AB.



Not to scale

(a) Find, in terms of **a** and **b**, these vectors.

(i) $\overrightarrow{OC}$

(a)(i) _____ **[1]**

(ii) $\overrightarrow{AB}$

(ii) _____ **[1]**

(iii) $\overrightarrow{OM}$

(iii) _____ **[2]**

(b) Use your answers to write **two** conclusions about points O, M and C.

(1) _____

_____

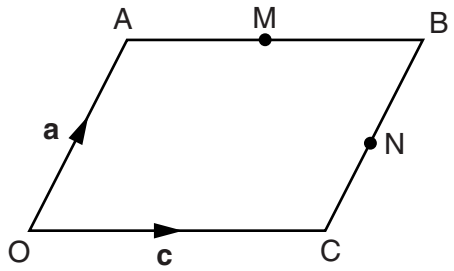
(2) _____

_____ **[2]**

2 (a) Find the resultant of the vectors $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$.

(a) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ **[1]**

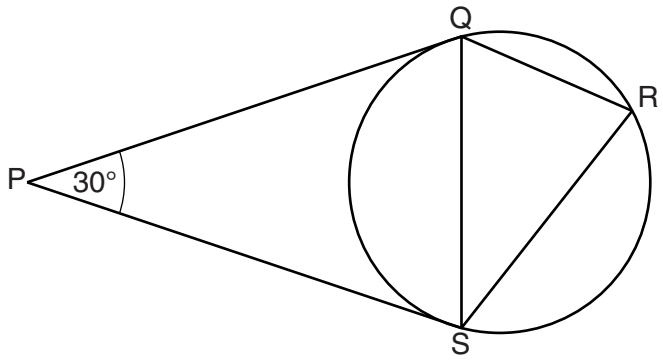
(b) OABC is a parallelogram.
M is the midpoint of AB.
N is the midpoint of BC.
$\overrightarrow{OA}$ = **a** and $\overrightarrow{OC}$ = **c**.



Find $\overrightarrow{MN}$ in terms of **a** and **c**.

(b) _____ **[2]**

3 Q, R and S are points on a circle.
PQ and PS are tangents to the circle.
Angle QPS = 30°.



Not to scale

Calculate the size of angle QRS.
Give a reason for each stage of your working.

_____ ° **[4]**

4 **(a)** Find the resultant of $\begin{pmatrix} 8 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} -2 \\ -5 \end{pmatrix}$.

(a) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ **[1]**

(b) You are given that $\mathbf{p} + \mathbf{q} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$.

Write the following as column vectors.

(i) $\left[\begin{pmatrix} 3 \\ 7 \end{pmatrix} + \mathbf{p}\right] + \mathbf{q}$

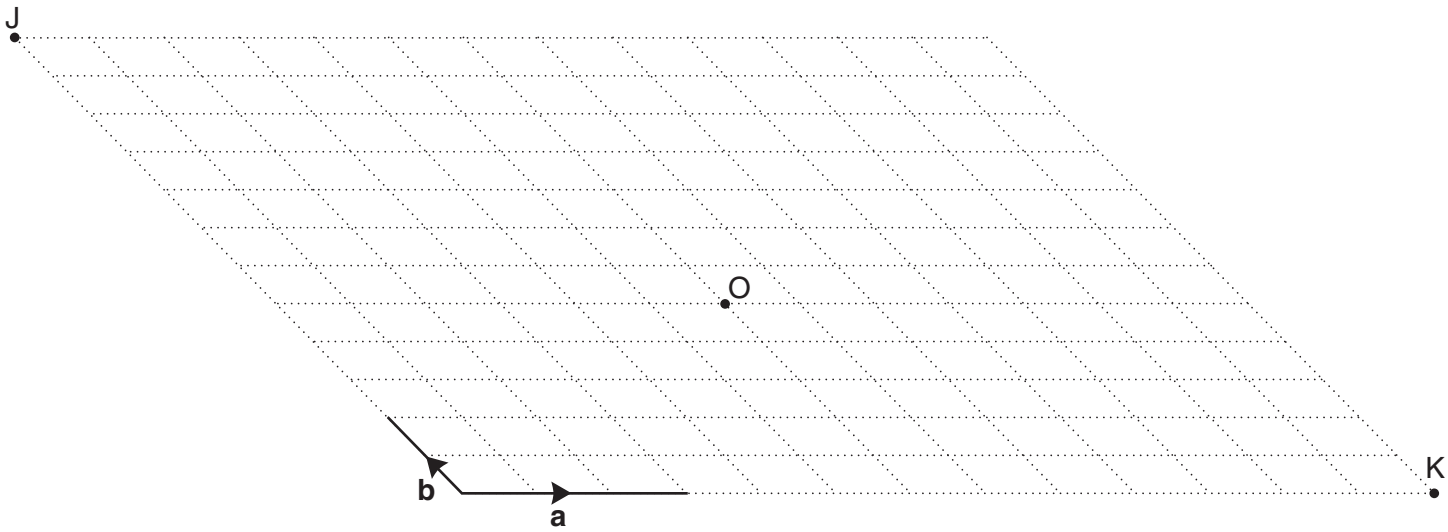
(b)(i) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ **[2]**

(ii) $-4(\mathbf{q} + \mathbf{p})$

(ii) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ **[2]**

5 A wallpaper designer uses this grid to plan the translations of wallpaper designs.

He uses multiples and sums of vectors **a** and **b** to describe the translations.



(a) The centre of a design is translated from O by the vector $2\mathbf{a} + 3\mathbf{b}$.

Mark the image of O with a cross (X) and label it A. **[1]**

(b) The centre of another design is translated from O by the vector $\frac{5}{2}\mathbf{b} - \mathbf{a}$.

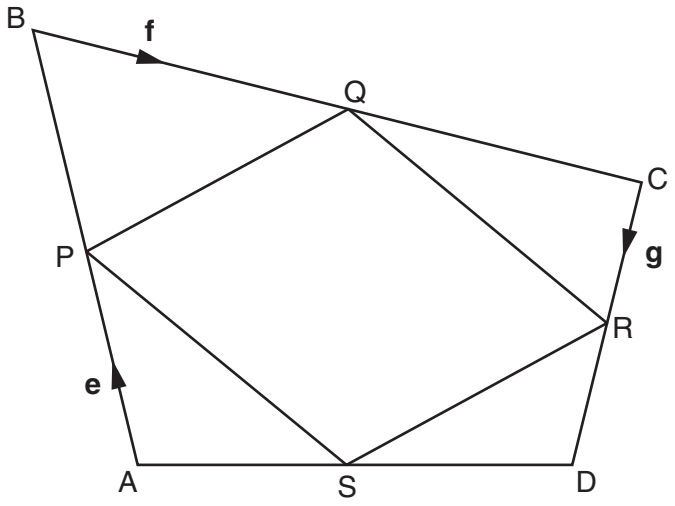
Mark this image of O with a cross (X) and label it B. **[1]**

(c) Find the combination of vectors **a** and **b** that would translate the centre of a design from point J to point K.

(c) _____ **[3]**

6 ABCD is a quadrilateral.
The midpoints of AB, BC, CD and DA are P, Q, R and S respectively.

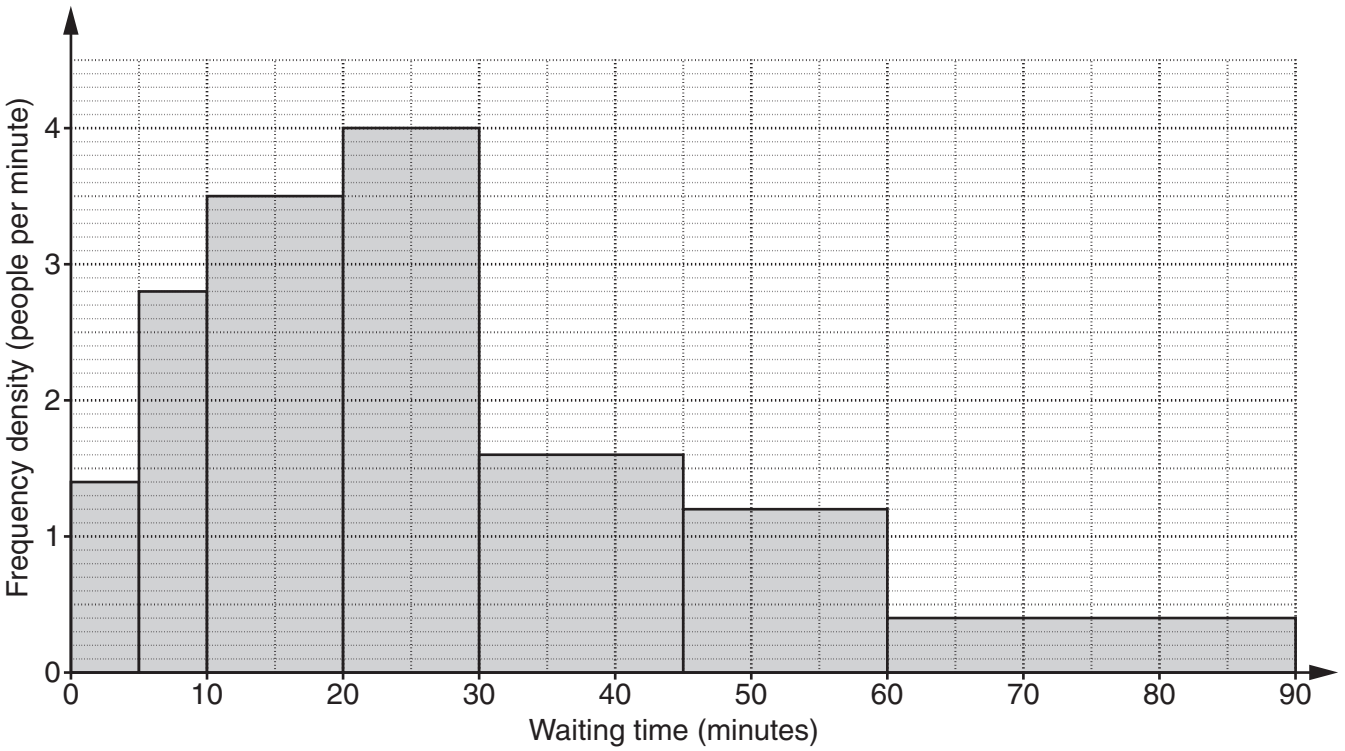
$\overrightarrow{AB} = 2\mathbf{e}$, $\overrightarrow{BC} = 2\mathbf{f}$ and $\overrightarrow{CD} = 2\mathbf{g}$.



Not to scale

By first finding the vector $\overrightarrow{AD}$ in terms of **e**, **f** and **g**, prove that PQRS is a parallelogram. **[5]**

7 This histogram summarises the times that patients waited one morning in a hospital out-patients department.



The hospital's target is that fewer than $\frac{1}{3}$ of their patients wait for more than 30 minutes.

Show whether the hospital achieved the target on this morning. **[4]**