Vectors

0580

Objectives:

Student Name: _____

Grade: 10

1 - (0580/21_Summer_2020_Q17) - *Vectors*

**(a) (i)** $\mathbf{m} = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$

Find $3\mathbf{m}$.
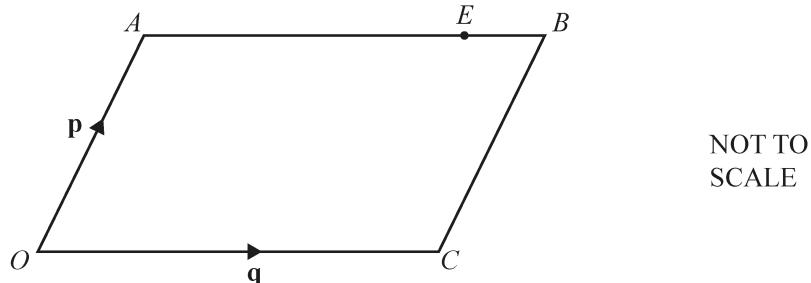
$\begin{pmatrix} \\ \end{pmatrix}$ [1]

(ii) $\overrightarrow{VW} = \begin{pmatrix} 10 \\ -24 \end{pmatrix}$

Find $\left| \overrightarrow{VW} \right|$.

.... [2]

(b)

NOT TO
SCALE
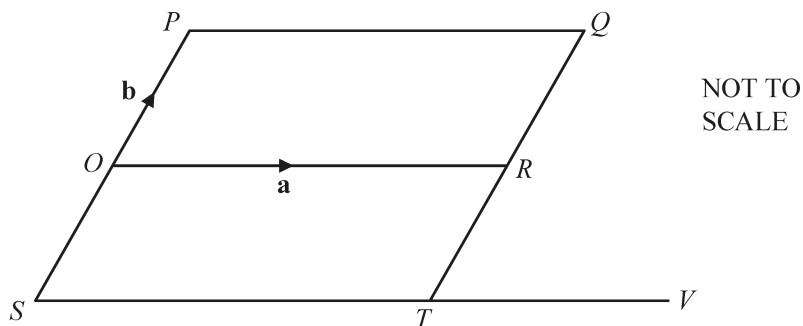
OABC is a parallelogram.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OC} = \mathbf{q}$.
E is the point on *AB* such that *AE* : *EB* = 3 : 1.

Find $\overrightarrow{OE}$, in terms of $\mathbf{p}$ and $\mathbf{q}$, in its simplest form.

$\overrightarrow{OE} = $ .... [2]

2 - (0580/23_Summer_2020_Q21) - *Vectors*

NOT TO SCALE

O is the origin and $OPQR$ is a parallelogram.
SOP is a straight line with $SO = OP$.
TRQ is a straight line with $TR = RQ$.
STV is a straight line and $ST : TV = 2 : 1$.
$\overrightarrow{OR} = \mathbf{a}$ and $\overrightarrow{OP} = \mathbf{b}$.

(a) Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form,

    (i) the position vector of T,

        .... [2]

    (ii) $\overrightarrow{RV}$.

        $\overrightarrow{RV} = $ .... [1]

(b) Show that PT is parallel to RV.

        [2]

3 - (0580/21_Winter_2020_Q9) - *Percentages, Vectors*

(a) Ahmed increases 40 by 300%.

From this list, put a ring around the correct calculation.

$$40 \times 1.300 \qquad 40 \times 3 \qquad 40 \times 400 \qquad 40 \times 4 \qquad 40 \times 300$$

[1]

(b) Ahmed finds the magnitude of the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

From this list, put a ring around the correct calculation.
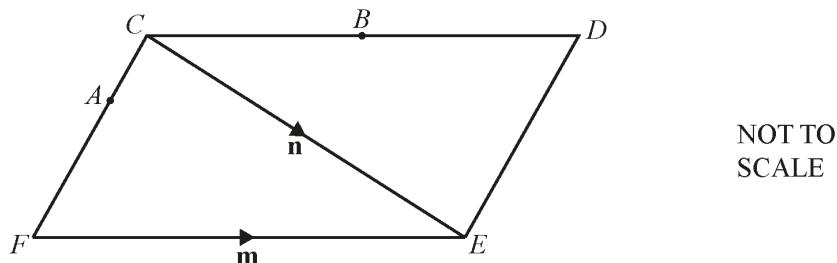
$$\sqrt{2^2 + -3^2} \qquad 2^2 - 3^2 \qquad \sqrt{2^2 - 3^2} \qquad 2^2 + (-3)^2 \qquad \sqrt{2^2 + (-3)^2}$$

[1]

4 ‑ (0580/21_Winter_2020_Q23) ‑ *Vectors*

(a)

The diagram shows a parallelogram *CDEF*.
$\overrightarrow{FE} = \mathbf{m}$ and $\overrightarrow{CE} = \mathbf{n}$.
B is the midpoint of *CD*.
FA = 2AC

Find an expression, in terms of **m** and **n**, for $\overrightarrow{AB}$.
Give your answer in its simplest form.

$\overrightarrow{AB} = $ .... [3]
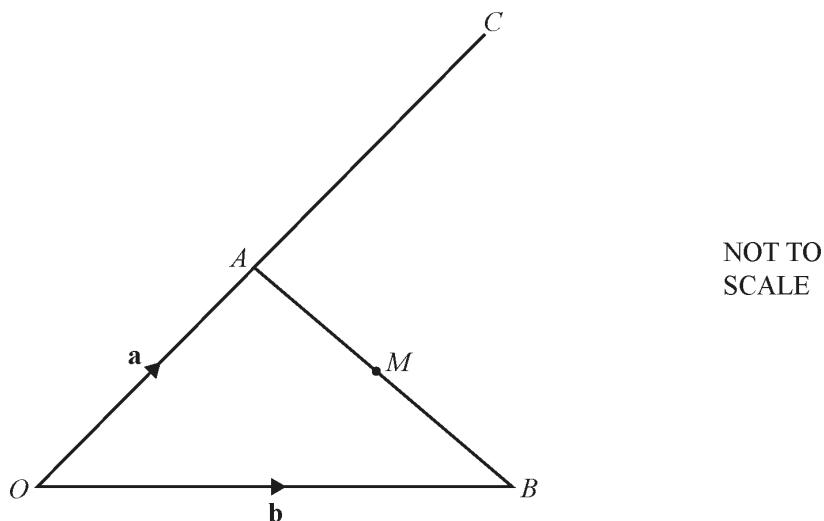
(b) $\overrightarrow{GH} = \frac{5}{6}(2\mathbf{p} + \mathbf{q})$ $\qquad$ $\overrightarrow{JK} = \frac{5}{18}(2\mathbf{p} + \mathbf{q})$

Write down **two** facts about vectors $\overrightarrow{GH}$ and $\overrightarrow{JK}$.

....

.... [2]

5 - (0580/22_Winter_2020_Q22) - *Vectors*

The diagram shows a triangle OAB and a straight line OAC.
$OA : OC = 2 : 5$ and M is the midpoint of AB.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form

(a) $\overrightarrow{AB}$,

$\overrightarrow{AB} =$ .... [1]

(b) $\overrightarrow{MC}$.

$\overrightarrow{MC} =$ .... [3]

6 - (0580/21_Summer_2021_Q5) - *Vectors*

Work out.
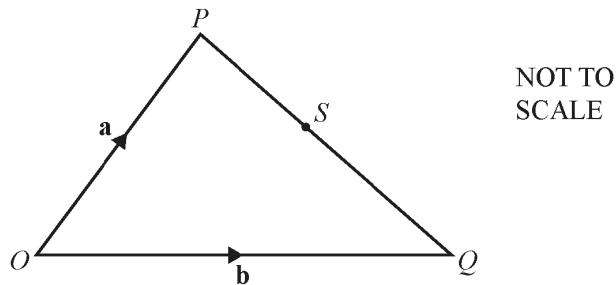
(a) $\begin{pmatrix} 6 \\ -5 \end{pmatrix} + \begin{pmatrix} 8 \\ -1 \end{pmatrix}$

$\begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) $3\begin{pmatrix} -4 \\ 7 \end{pmatrix}$

$\begin{pmatrix} \\ \end{pmatrix}$ [1]

7 - (0580/21_Summer_2021_Q18) - *Vectors*

NOT TO SCALE

S is a point on PQ such that $PS : SQ = 4 : 5$.

Find $\overrightarrow{OS}$, in terms of **a** and **b**, in its simplest form.

$\overrightarrow{OS} =$ .... [2]
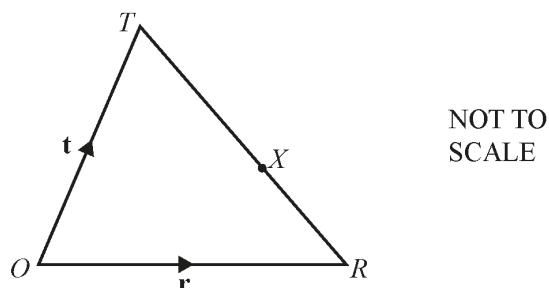
8 - (0580/23_Summer_2021_Q14) - *Vectors*

The magnitude of the vector $\begin{pmatrix} 20 \\ k \end{pmatrix}$ is 29.

Find the value of k.

$k =$ .... [3]

9 - (0580/23_Winter_2021_Q26) - *Vectors*

NOT TO
SCALE

ORT is a triangle.
X is a point on TR so that $TX : XR = 3 : 2$.
O is the origin, $\overrightarrow{OR} = \mathbf{r}$ and $\overrightarrow{OT} = \mathbf{t}$.
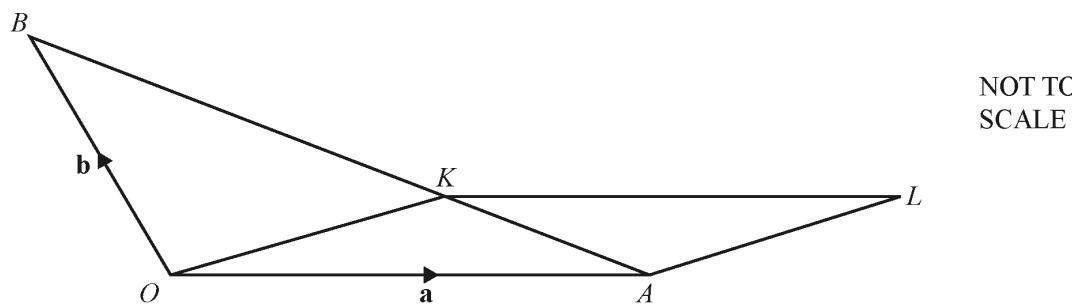
Find the position vector of X.
Give your answer in terms of $\mathbf{r}$ and $\mathbf{t}$ in its simplest form.

.... [3]

10 - (0580/21_Summer_2022_Q26) - *Vectors*

NOT TO
SCALE

The diagram shows a triangle OAB and a parallelogram $OALK$.
The position vector of A is **a** and the position vector of B is **b**.
K is a point on AB so that $AK : KB = 1 : 2$.

Find the position vector of L, in terms of **a** and **b**.
Give your answer in its simplest form.

.... [4]

9

11 - (0580/22_Summer_2022_Q10) - *Vectors*

$$\mathbf{p} = \begin{pmatrix} 2 \\ 8 \end{pmatrix} \qquad \mathbf{q} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$$

(a) Find

(i) $\mathbf{p} - \mathbf{q}$,

$$\begin{pmatrix} \\ \end{pmatrix} \text{ [1]}$$

(ii) $6\mathbf{p}$.

$$\begin{pmatrix} \\ \end{pmatrix} \text{ [1]}$$

(b) Find $|\mathbf{p} - \mathbf{q}|$.

.... [2]

302

10

12 - (0580/22_Summer_2022_Q22) - *Vectors*

NOT TO
SCALE
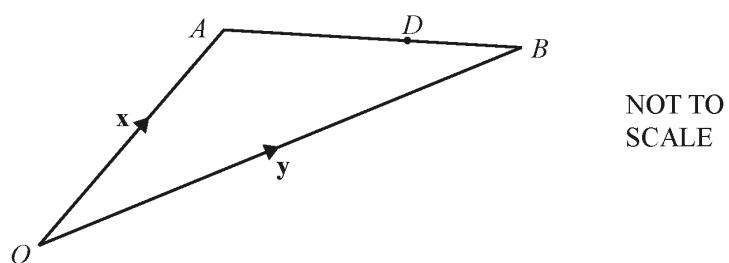
$\overrightarrow{OA} = \mathbf{x}$, $\overrightarrow{OB} = \mathbf{y}$ and $\overrightarrow{OD} = \frac{3}{7}\mathbf{x} + \frac{4}{7}\mathbf{y}$.

Calculate the ratio $AD:DB$.

.... : .... [2]

303

11
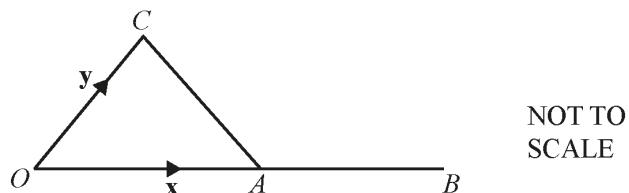
13 - (0580/21_Summer_2023_Q16) - *Vectors*

(a) Find the magnitude of the vector $\begin{pmatrix} -4 \\ 5 \end{pmatrix}$.

.... [2]

(b)

NOT TO
SCALE

The diagram shows a triangle *OAC*.
A is the midpoint of the straight line *OB*.
$\overrightarrow{OA} = \mathbf{x}$ and $\overrightarrow{OC} = \mathbf{y}$.

Find $\overrightarrow{CB}$ in terms of $\mathbf{x}$ and $\mathbf{y}$.

$\overrightarrow{CB} = $ .... [1]

14 - (0580/22_Summer_2023_Q9) - *Vectors*

F is the point $(1, -4)$, $\overrightarrow{FG} = \begin{pmatrix} 8 \\ -3 \end{pmatrix}$ and $\overrightarrow{GH} = \begin{pmatrix} -12 \\ 35 \end{pmatrix}$.

Find

(a) $3\overrightarrow{FG}$

$\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(b) $\overrightarrow{FG} + \overrightarrow{GH}$

$\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(c) the coordinates of the point G

(..................... , ...) [1]

(d) the magnitude of vector $\overrightarrow{GH}$.

... [2]
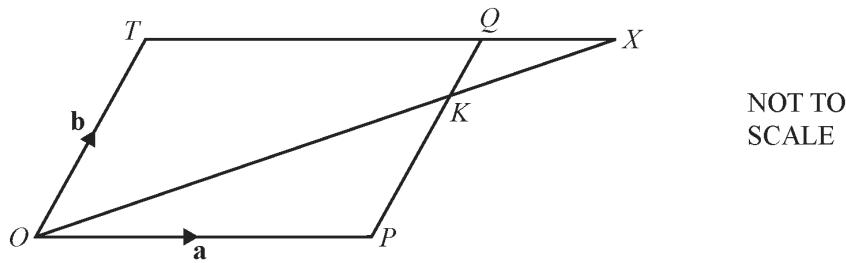
15 - (0580/23_Summer_2023_Q12) - *Vectors*

The position vector of A is $\begin{pmatrix} 5 \\ 3 \end{pmatrix}$ and $\overrightarrow{BA} = \begin{pmatrix} 4 \\ 8 \end{pmatrix}$.

Show that $\left| \overrightarrow{OB} \right| = 5.1$, correct to 1 decimal place.

[3]

16 - (0580/22_Winter_2023_Q26) - *Vectors*

NOT TO
SCALE

The diagram shows a parallelogram $OPQT$.
The position vector of P is **a** and the position vector of T is **b**.

K is on PQ so that $PK : KQ = 3 : 1$.
The lines OK and TQ are extended to meet at X.

Find the position vector of X in terms of **a** and **b**.
Give your answer in its simplest form.

.... [3]

17 - (0580/23_Winter_2023_Q10) - *Vectors*

$$\overrightarrow{AB} = \begin{pmatrix} 7 \\ -3 \end{pmatrix}$$
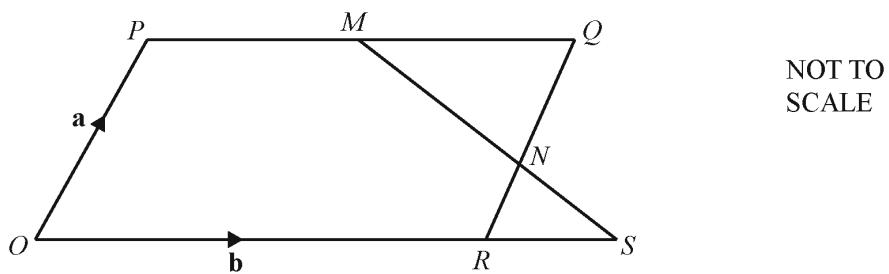
(a) Find $3\overrightarrow{AB}$.

$\begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) Find $\left| \overrightarrow{AB} \right|$.

$\left| \overrightarrow{AB} \right| =$ .... [2]

18 - (0580/22_Summer_2024_Q24) - *Vectors*

NOT TO SCALE

O is the origin and $OPQR$ is a parallelogram.
M is the midpoint of PQ and N divides QR in the ratio $2 : 1$.
$\overrightarrow{OP} = \mathbf{a}$ and $\overrightarrow{OR} = \mathbf{b}$.

(a) Find $\overrightarrow{MN}$.
Give your answer in terms of $\mathbf{a}$ and/or $\mathbf{b}$ and in its simplest form.
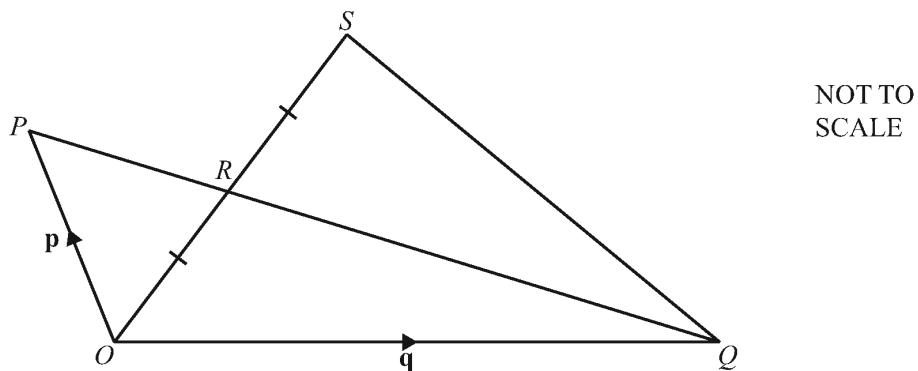
$$\overrightarrow{MN} = \text{...} \quad [2]$$

(b) The lines MN and OR are extended to meet at S.

Find the position vector of S.
Give your answer in terms of $\mathbf{a}$ and/or $\mathbf{b}$ and in its simplest form.

$$\text{...} \quad [3]$$

19 - (0580/23_Summer_2024_Q26) - *Vectors*

NOT TO
SCALE

In the diagram, *O* is the origin.
$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$.
R is the point of intersection of *PQ* and *OS*, with   *PR* : *RQ* = 1 : 2   and *OR* = *RS*.

Find the position vector of *S* in terms of **p** and **q**.
Give your answer in its simplest form.

.... [4]

20 - (0580/21_Winter_2024_Q5) - *Vectors*

Work out.
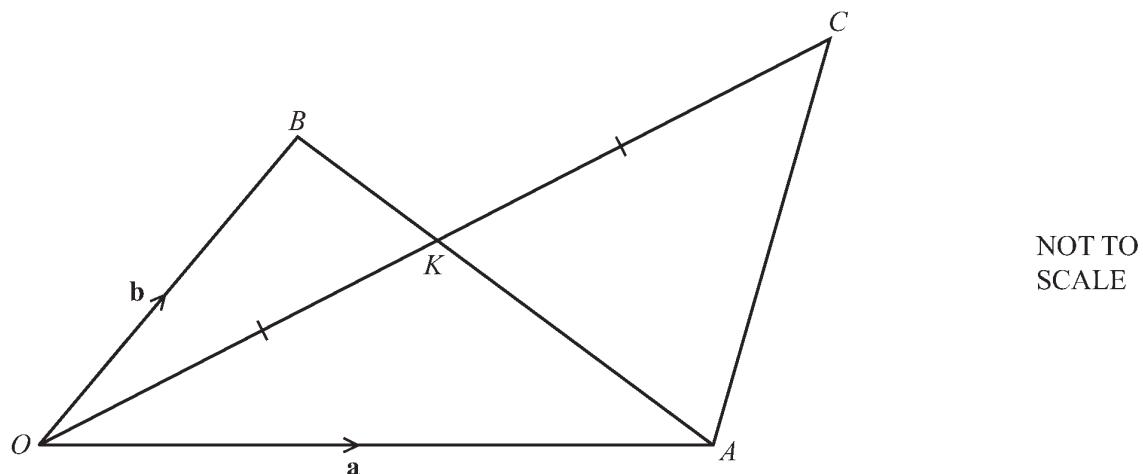
(a) $3\begin{pmatrix} 6 \\ -4 \end{pmatrix}$

$\begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) $\begin{pmatrix} 4 \\ -1 \end{pmatrix} + \begin{pmatrix} -7 \\ 5 \end{pmatrix}$

$\begin{pmatrix} \\ \end{pmatrix}$ [1]

21 ▪ (0580/23_Winter_2024_Q26) ▪ *Vectors*

NOT TO
SCALE

In the diagram, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
$AK : KB = 2 : 1$.
$OK = KC$.

Find $\overrightarrow{AC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

$\overrightarrow{AC} =$ .... [4]

1 - (0580/21_Summer_2020_Q17) - *Vectors*

(a)(i)	$\begin{pmatrix} 15 \\ 21 \end{pmatrix}$	1	
(a)(ii)	26	2	**M1** for $10^2 + (-24)^2$ or better
(b)	$\mathbf{p} + \dfrac{3}{4}\mathbf{q}$	2	**M1** for a correct route or for $\overrightarrow{AE} = \dfrac{3}{4}\mathbf{q}$

2 - (0580/23_Summer_2020_Q21) - *Vectors*

(a)(i)	$\mathbf{a} - \mathbf{b}$ or $-\mathbf{b} + \mathbf{a}$	2	**B1** for a correct route or identifying $\overrightarrow{OT}$
(a)(ii)	$\dfrac{1}{2}\mathbf{a} - \mathbf{b}$ or $-\mathbf{b} + \dfrac{1}{2}\mathbf{a}$	1	
(b)	$\overrightarrow{PT} = \mathbf{a} - 2\mathbf{b}$ oe	**M1**	
	$\overrightarrow{PT} = 2\overrightarrow{RV}$ oe	**A1**	Dep on correct vector *RV* Accept in words

3 - (0580/21_Winter_2020_Q9) - *Percentages, Vectors*

(a)	40×4	1	
(b)	$\sqrt{2^2 + (-3)^2}$	1	

4 - (0580/21_Winter_2020_Q23) - *Vectors*

(a)	$\dfrac{5}{6}\mathbf{m} - \dfrac{1}{3}\mathbf{n}$	3	**B2** for correct unsimplified answer in terms of **m** and **n** e.g. $\dfrac{1}{3}(\mathbf{m} - \mathbf{n}) + \dfrac{1}{2}\mathbf{m}$ or **M1** for a correct route or for $\overrightarrow{FC} = \mathbf{m} - \mathbf{n}$ or $\overrightarrow{CF} = \mathbf{n} - \mathbf{m}$ or better e.g. $\overrightarrow{AC} = \dfrac{1}{3}(\mathbf{m} - \mathbf{n})$
(b)	$\overrightarrow{GH} = 3\overrightarrow{JK}$ oe or $\overrightarrow{GH}$ has a greater magnitude $\overrightarrow{GH}$ and $\overrightarrow{JK}$ are parallel	2	**B1** for each

5 - (0580/22_Winter_2020_Q22) - *Vectors*

(a)	$-\mathbf{a} + \mathbf{b}$	1	

(b)	$2\mathbf{a} - \dfrac{1}{2}\mathbf{b}$	3	**B2** for answer $2\mathbf{a} + p\mathbf{b}$ or $q\mathbf{a} - \dfrac{1}{2}\mathbf{b}$ $q \neq \dfrac{1}{2}$ or correct unsimplified answer in terms of **a** and **b** or **M1** for $\overrightarrow{AC} = \dfrac{3}{2}\mathbf{a}$ or $\overrightarrow{OC} = \dfrac{5}{2}\mathbf{a}$ or correct route If 0 scored **SC1** for answer $\mathbf{a} + \dfrac{1}{2}\mathbf{b}$

6 - (0580/21_Summer_2021_Q5) - *Vectors*

(a)	$\begin{pmatrix} 14 \\ -6 \end{pmatrix}$	1	
(b)	$\begin{pmatrix} -12 \\ 21 \end{pmatrix}$	1	

7 - (0580/21_Summer_2021_Q18) - *Vectors*

$\dfrac{5}{9}\mathbf{a} + \dfrac{4}{9}\mathbf{b}$	2	**M1** for $\dfrac{4}{9}(\mathbf{b} - \mathbf{a})$ or $\dfrac{5}{9}(\mathbf{a} - \mathbf{b})$ or a correct route

8 - (0580/23_Summer_2021_Q14) - *Vectors*

$[\pm]\,21$	3	**M2** for $29^2 - 20^2$ oe or better or **M1** for $20^2 + k^2 = 29^2$ oe

9 - (0580/23_Winter_2021_Q26) - *Vectors*

$\dfrac{3}{5}\mathbf{r} + \dfrac{2}{5}\mathbf{t}$ or $\dfrac{1}{5}(3\mathbf{r} + 2\mathbf{t})$	3	**M2** for $\mathbf{r} + \dfrac{2}{5}(-\mathbf{r} + \mathbf{t})$ oe or $\mathbf{t} + \dfrac{3}{5}(\mathbf{r} - \mathbf{t})$ oe or **M1** for $\overrightarrow{RT} = -\mathbf{r} + \mathbf{t}$ oe or $\overrightarrow{TR} = \mathbf{r} - \mathbf{t}$ **M1** for $\overrightarrow{OR} + \overrightarrow{RX}$ or $\overrightarrow{OT} + \overrightarrow{TX}$ any other correct route.

10 - (0580/21_Summer_2022_Q26) - *Vectors*

	$\frac{5}{3}\mathbf{a} + \frac{1}{3}\mathbf{b}$ final answer	**4**	**M1** for $\overrightarrow{AK} = -\frac{1}{3}\mathbf{a} + \frac{1}{3}\mathbf{b}$ or $\overrightarrow{BK} = \frac{2}{3}\mathbf{a} - \frac{2}{3}\mathbf{b}$
			M1 for $\overrightarrow{AL}$ (or $\overrightarrow{OK}$) = $\mathbf{a}$ + *their* $\overrightarrow{AK}$ oe soi or $\overrightarrow{OK}$ (or $\overrightarrow{AL}$) = $\mathbf{b}$ + *their* $\overrightarrow{AK}$ oe soi or $\overrightarrow{BL}$ = $\mathbf{a}$ + *their* $\overrightarrow{AK}$ oe soi
			M1 for a correct route e.g. $\overrightarrow{OL}$, $\mathbf{a} + \overrightarrow{AL}$, $\mathbf{b} + \overrightarrow{BL}$

11 - (0580/22_Summer_2022_Q10) - *Vectors*

(a)(i)	$\begin{pmatrix} 3 \\ 4 \end{pmatrix}$	**1**	
(a)(ii)	$\begin{pmatrix} 12 \\ 48 \end{pmatrix}$	**1**	
(b)	5	**2**	**M1** for $(their3)^2 + (their4)^2$ or better

12 - (0580/22_Summer_2022_Q22) - *Vectors*

	4 : 3 oe	**2**	**M1** for $\overrightarrow{AD} = -\frac{4}{7}x + \frac{4}{7}y$ oe or $\overrightarrow{DB} = -\frac{3}{7}x + \frac{3}{7}y$ oe

13 - (0580/21_Summer_2023_Q16) - *Vectors*

(a)	6.4[0] or 6.403...	**2**	**M1** for $(-4)^2 + 5^2$ oe
(b)	$2\mathbf{x} - \mathbf{y}$	**1**	

14 - (0580/22_Summer_2023_Q9) - *Vectors*

(a)	$\begin{pmatrix} 24 \\ -9 \end{pmatrix}$	**1**	
(b)	$\begin{pmatrix} -4 \\ 32 \end{pmatrix}$	**1**	
(c)	$(9, -7)$	**1**	
(d)	37	**2**	**M1** for $(-12)^2 + 35^2$ oe

15 - (0580/23_Summer_2023_Q12) - *Vectors*

$\sqrt{1^2 + (-5)^2}$	**M2**	**M1** for $\begin{pmatrix} 1 \\ -5 \end{pmatrix}$ or $(5-4)^2 + (3-8)^2$ or $\sqrt{e^2 + f^2}$ from *their* $\overrightarrow{OB} = \begin{pmatrix} e \\ f \end{pmatrix}$ or *their* $B = (e, f)$ or only $\sqrt{1 + 25}$	
Correct working leading to 5.09[9..]	**A1**	**Dep.** on **M2** or **M1** for only $\sqrt{1 + 25}$	

16 - (0580/22_Winter_2023_Q26) - *Vectors*

	$\mathbf{b} + \dfrac{4}{3}\mathbf{a}$	**3**	**B2** for correct unsimplified answer or $\overrightarrow{QX} = \dfrac{1}{3}\mathbf{a}$ seen or **B1** for a correct route for $\overrightarrow{OX}$ or answer $\mathbf{b} + k\mathbf{a}$ where $k > 1$ or $\overrightarrow{OK} = \mathbf{a} + \dfrac{3}{4}\mathbf{b}$ seen or $\overrightarrow{QX} = \dfrac{1}{3}\overrightarrow{OP}$ or $\overrightarrow{OX} = \dfrac{4}{3} \times \overrightarrow{OK}$

17 - (0580/23_Winter_2023_Q10) - *Vectors*

(a)	$\begin{pmatrix} 21 \\ -9 \end{pmatrix}$	**1**	
(b)	7.62 or 7.615 to 7.616	**2**	**M1** for $(7)^2 + (-3)^2$ oe If 0 scored **SC1** for 22.8 or 22.84 to 22.85

18 - (0580/22_Summer_2024_Q24) - *Vectors*

(a)	$\dfrac{1}{2}\mathbf{b} - \dfrac{2}{3}\mathbf{a}$	**2**	**B1** for answer $\dfrac{1}{2}\mathbf{b} + k\mathbf{a}$ or $j\mathbf{b} - \dfrac{2}{3}\mathbf{a}$ or correct unsimplified in terms of **a** and **b**
(b)	$\dfrac{5}{4}\mathbf{b}$	**3**	**M2** for $\overrightarrow{RS} = \dfrac{1}{4}\mathbf{b}$ oe or $\overrightarrow{MS} = \dfrac{3}{2}\left(\dfrac{1}{2}\mathbf{b} - \dfrac{2}{3}a\right)$ oe or $\overrightarrow{NS} = \dfrac{1}{2}\left(\dfrac{1}{2}\mathbf{b} - \dfrac{2}{3}a\right)$ oe or **M1** for a correct route in terms of vertices and/or **a** and/or **b** or **B1** for answer $j\mathbf{b}$ where $j > 1$ or $\overrightarrow{RS} = \dfrac{1}{2}\overrightarrow{MQ}$, $\overrightarrow{RS} = \dfrac{1}{4}\overrightarrow{OR}$, oe $\overrightarrow{NS} = \dfrac{1}{2}\overrightarrow{MN}$, $\overrightarrow{MS} = \dfrac{3}{2}\overrightarrow{MN}$ $\overrightarrow{NS} = \dfrac{1}{3}\overrightarrow{MS}$

19 - (0580/23_Summer_2024_Q26) - *Vectors*

$\dfrac{4}{3}\mathbf{p} + \dfrac{2}{3}\mathbf{q}$ oe	**4**	**B3** for correct unsimplified answer or for $\overrightarrow{OR} = \mathbf{p} + \dfrac{1}{3}\mathbf{q} - \dfrac{1}{3}\mathbf{p}$ oe or **M2** for $\overrightarrow{PR} = \dfrac{1}{3}(-\mathbf{p} + \mathbf{q})$ oe or $\overrightarrow{QR} = \dfrac{2}{3}(-\mathbf{q} + \mathbf{p})$ oe or **M1** for $\overrightarrow{PQ} = -\mathbf{p} + \mathbf{q}$ oe or $\overrightarrow{QP} = -\mathbf{q} + \mathbf{p}$ oe or a correct route from O to S.

20 - (0580/21_Winter_2024_Q5) - *Vectors*

(a)	$\begin{pmatrix} 18 \\ -12 \end{pmatrix}$	**1**
(b)	$\begin{pmatrix} -3 \\ 4 \end{pmatrix}$	**1**

$-\dfrac{1}{3}\mathbf{a} + \dfrac{4}{3}\mathbf{b}$ oe final simplified answer	4	**B3** for correct unsimplified answer or **B2** for $\overrightarrow{OK}$ or $\overrightarrow{KC} = \dfrac{1}{3}\mathbf{a} + \dfrac{2}{3}\mathbf{b}$ oe or **M1** for $\overrightarrow{AK} = \dfrac{2}{3}(-\mathbf{a} + \mathbf{b})$ oe or $\overrightarrow{BK} = \dfrac{1}{3}(-\mathbf{b} + \mathbf{a})$ oe or a correct vector route for $\overrightarrow{AC}$ along lines in diagram

1 - (0580/42_Summer_2020_Q2) - *Vectors*

(a) $\mathbf{p} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -2 \\ 7 \end{pmatrix}$

    (i)   Find $2\mathbf{p} + \mathbf{q}$.

$$\begin{pmatrix} & \\ & \end{pmatrix}$$ [2]

    (ii)   Find $|\mathbf{p}|$.

.... [2]

(b) A is the point (4, 1) and $\overrightarrow{AB} = \begin{pmatrix} -3 \\ 1 \end{pmatrix}$.

    Find the coordinates of B.
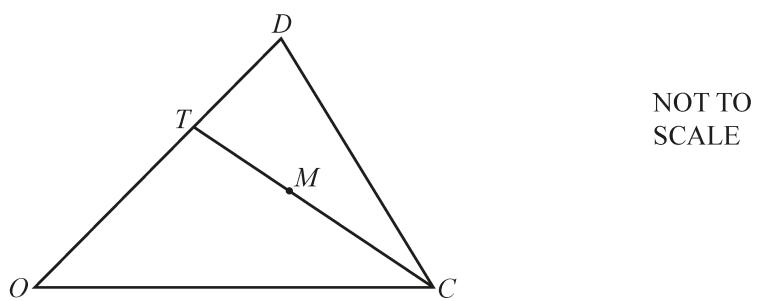
(...................... , ...) [1]

(c)   The line $y = 3x - 2$ crosses the y-axis at G.

    Write down the coordinates of G.

(...................... , ...) [1]

(d)

NOT TO
SCALE

In the diagram, O is the origin, $OT = 2TD$ and M is the midpoint of TC.
$\overrightarrow{OC} = \mathbf{c}$ and $\overrightarrow{OD} = \mathbf{d}$.

Find the position vector of M.
Give your answer in terms of $\mathbf{c}$ and $\mathbf{d}$ in its simplest form.

.... [3]

2 ‑ (0580/43_Winter_2020_Q8) ‑ *Vectors*

(a) $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

Find

(i) $\overrightarrow{AC}$,

$$\overrightarrow{AC} = \begin{pmatrix} \\ \end{pmatrix} \quad [2]$$
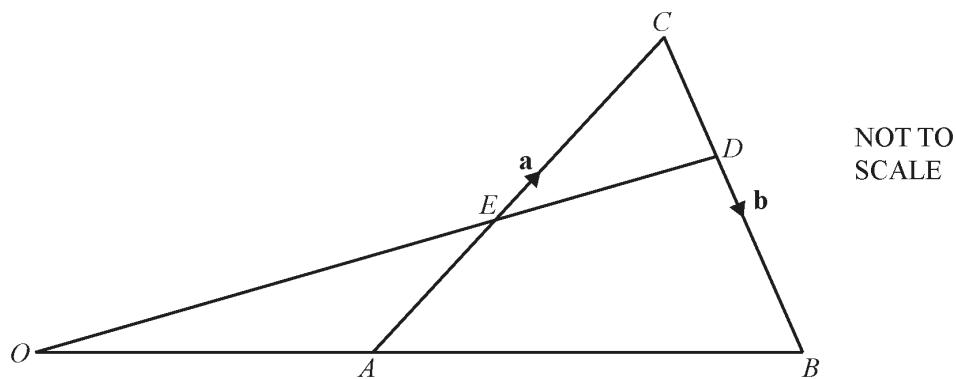
(ii) $\overrightarrow{BD}$,

$$\overrightarrow{BD} = \begin{pmatrix} \\ \end{pmatrix} \quad [2]$$

(iii) $\left| \overrightarrow{BC} \right|$.

.... [2]

(b)

In the diagram, OAB and OED are straight lines.
O is the origin, A is the midpoint of OB and E is the midpoint of AC.
$\overrightarrow{AC} = \mathbf{a}$ and $\overrightarrow{CB} = \mathbf{b}$.

Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form

(i) $\overrightarrow{AB}$,

$\overrightarrow{AB} = $ .... [1]

(ii) $\overrightarrow{OE}$,

$\overrightarrow{OE} = $ .... [2]

(iii) the position vector of D.

.... [3]

3 - (0580/42_Summer_2021_Q5) - *Vectors*

(a) $\quad \mathbf{a} = \begin{pmatrix} -3 \\ 8 \end{pmatrix} \qquad \mathbf{b} = \begin{pmatrix} 2 \\ -5 \end{pmatrix}$

    (i)   Find

        (a) $\quad \mathbf{b} - \mathbf{a}$,

$$\begin{pmatrix} \\ \end{pmatrix} \quad [1]$$

        (b) $\quad 2\mathbf{a} + \mathbf{b}$,

$$\begin{pmatrix} \\ \end{pmatrix} \quad [2]$$

        (c) $\quad |\mathbf{b}|$.

.... [2]
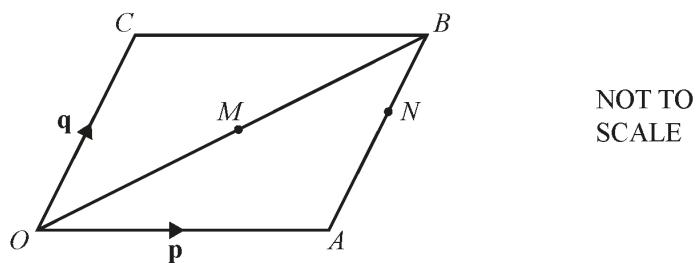
    (ii) $\quad \mathbf{a} + k\mathbf{b} = \begin{pmatrix} 13 \\ m \end{pmatrix}$,   where k and m are integers.

        Find the value of k and the value of m.

$k = $ ....

$m = $ .... [3]

(b)

OABC is a parallelogram and *O* is the origin.
M is the midpoint of *OB*.
N is the point on *AB* such that *AN* : *NB* = 3 : 2.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OC} = \mathbf{q}$.

(i) Find, in terms of **p** and **q**, in its simplest form.

    (a) $\overrightarrow{OB}$

$$\overrightarrow{OB} = \text{...} \quad [1]$$

    (b) $\overrightarrow{CM}$

$$\overrightarrow{CM} = \text{...} \quad [2]$$

    (c) $\overrightarrow{MN}$

$$\overrightarrow{MN} = \text{...} \quad [2]$$

(ii) *CB* and *ON* are extended to meet at *D*.

Find the position vector of *D* in terms of **p** and **q**.
Give your answer in its simplest form.

$$\text{...} \quad [3]$$

4 ▪ (0580/43_Summer_2021_Q4) ▪ *Lines, Vectors*

(a) A is the point $(1, 5)$ and B is the point $(3, 9)$.
M is the midpoint of AB.

(i) Find the coordinates of M.

(...................... , ...) [2]

(ii) Find the equation of the line that is perpendicular to AB and passes through M.
Give your answer in the form $y = mx + c$.

$y =$ .... [4]

(b) The position vector of P is $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and the position vector of Q is $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$.

(i) Find the vector $\overrightarrow{PQ}$.
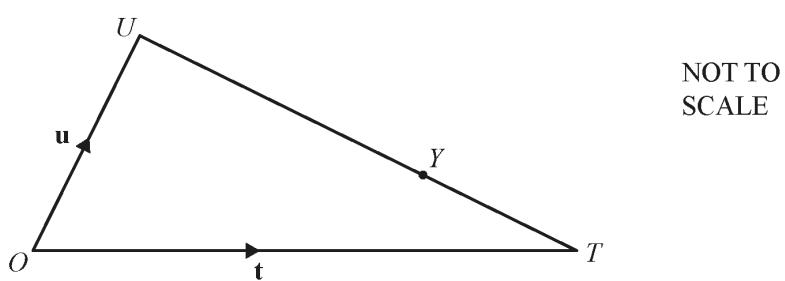
$\begin{pmatrix} \\ \end{pmatrix}$ [2]

(ii) R is the point such that $\overrightarrow{PR} = 3\overrightarrow{PQ}$.

Find the position vector of R.

$\begin{pmatrix} \\ \end{pmatrix}$ [2]

(c)

$\overrightarrow{OT}$ = **t**, $\overrightarrow{OU}$ = **u** and $UY = 2YT$.

(i) Find $\overrightarrow{OY}$ in terms of **t** and **u**.
Give your answer in its simplest form.

$\overrightarrow{OY}$ = ... [2]

(ii) Z is on OT and YZ is parallel to UO.

Find $\overrightarrow{OZ}$ in terms of **t** and/or **u**.
Give your answer in its simplest form.

$\overrightarrow{OZ}$ = ... [1]

1 - (0580/42_Summer_2020_Q2) - *Vectors*

(a)(i)	$\begin{pmatrix} 6 \\ 17 \end{pmatrix}$	2	**B1** for each
(a)(ii)	6.4[0] or 6.403...	2	**M1** for $4^2 + 5^2$
(b)	(1, 2)	1	
(c)	(0, –2)	1	

(d)	$\frac{1}{2}\mathbf{c} + \frac{1}{3}\mathbf{d}$	3	**B2** for correct unsimplified answer or **M1** for $\overrightarrow{CT} = -\mathbf{c} + \frac{2}{3}\mathbf{d}$ oe or $\overrightarrow{TC} = \mathbf{c} - \frac{2}{3}\mathbf{d}$ oe or for correct route

2 - (0580/43_Winter_2020_Q8) - *Vectors*

(a)(i)	$\begin{pmatrix} 4 \\ 4 \end{pmatrix}$	2	**B1** for $\begin{pmatrix} 4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 4 \end{pmatrix}$
(a)(ii)	$\begin{pmatrix} -4 \\ 8 \end{pmatrix}$	2	**B1** for $\begin{pmatrix} -4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 8 \end{pmatrix}$
(a)(iii)	5.39 or 5.385..	2	**M1** for $(-2)^2 + 5^2$ oe
(b)(i)	$\mathbf{a} + \mathbf{b}$	1	
(b)(ii)	$\frac{3}{2}\mathbf{a} + \mathbf{b}$	2	**M1** for a correct route, e.g. $\overrightarrow{OA} + \overrightarrow{AE}$
(b)(iii)	$2\mathbf{a} + \frac{4}{3}\mathbf{b}$	3	**M2** for unsimplified $\overrightarrow{OD}$ or for $\frac{4}{3}\mathbf{b}$ or **M1** for $\overrightarrow{OD}$ attempted in terms of **a** and **b** or for $\overrightarrow{CD} = \frac{1}{3}\mathbf{b}$ or $\overrightarrow{DB} = \frac{2}{3}\mathbf{b}$ seen

3 - (0580/42_Summer_2021_Q5) - *Vectors*

(a)(i)(a)	$\begin{pmatrix} 5 \\ -13 \end{pmatrix}$ final answer	1	
(a)(i)(b)	$\begin{pmatrix} -4 \\ 11 \end{pmatrix}$ final answer	2	**B1** for answer $\begin{pmatrix} -4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 11 \end{pmatrix}$ or $\begin{pmatrix} -6 \\ 16 \end{pmatrix}$ seen
(a)(i)(c)	5.39 or 5.385…	2	**M1** for $2^2 + ([-]5)^2$
(a)(ii)	$[k =]\ 8$ $[m =] -32$	3	**B2** for $k = 8$ or $m = -32$ or **M1** for $-3 + 2k = 13$ oe or for $m = -5 \times$ *their* $k + 8$ correctly evaluated
(b)(i)(a)	$\mathbf{p} + \mathbf{q}$ final answer	1	
(b)(i)(b)	$\frac{1}{2}\mathbf{p} - \frac{1}{2}\mathbf{q}$ or $\frac{1}{2}(\mathbf{p} - \mathbf{q})$ or $\frac{\mathbf{p}-\mathbf{q}}{2}$ final answer	2	**M1** for unsimplified answer or any correct vector route for $\overrightarrow{CM}$, e.g. $-\mathbf{q} + \frac{1}{2}$ *their* **(b)(i)(a)**
(b)(i)(c)	$\frac{1}{2}\mathbf{p} + \frac{1}{10}\mathbf{q}$ or $\frac{5\mathbf{p}+\mathbf{q}}{10}$ final answer	2	**M1** for unsimplified answer or any correct vector route for $\overrightarrow{MN}$
(b)(ii)	$\frac{5}{3}\mathbf{p} + \mathbf{q}$ or $\frac{5\mathbf{p}+3\mathbf{q}}{3}$ final answer	3	**B2** for unsimplified correct answer OR **M1** for $\mathbf{p} + \frac{3}{5}\mathbf{q}$ seen **B1** for final answer of form $k\mathbf{p} + \mathbf{q}$ $(k > 1)$ or final answer $\frac{5}{3}\mathbf{p} + j\mathbf{q}$ oe (any j)

4 - (0580/43_Summer_2021_Q4) - *Lines, Vectors*

(a)(i)	(2, 7)	2	**B1** for each coordinate

(a)(ii)	$-\dfrac{1}{2}x + 8$ oe	4	Correct equivalent in different form scores 3 marks. **M1** for gradient of $AB = \dfrac{9-5}{3-1}$ or $\dfrac{4}{2}$ or 2 **M1 dep** for gradient $p = -\dfrac{1}{their\ grad\ of\ AB}$ **M1 (dep** on previous M1) for substitution of *their* midpoint into $y = (their\ p)x + c$ oe where *their* $p \neq 0$
(b)(i)	$\begin{pmatrix} 0 \\ 2 \end{pmatrix}$	2	**B1** for $\begin{pmatrix} 0 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 2 \end{pmatrix}$
(b)(ii)	$\begin{pmatrix} -2 \\ 9 \end{pmatrix}$	2	**FT** *their* $\overrightarrow{PQ}$ **B1FT** for $\begin{pmatrix} 0 \\ 6 \end{pmatrix}$
(c)(i)	$\dfrac{2}{3}\mathbf{t} + \dfrac{1}{3}\mathbf{u}$ or $\dfrac{1}{3}(2\mathbf{t} + \mathbf{u})$ final answer	2	**M1** for $\overrightarrow{UY} = \dfrac{2}{3}(\mathbf{t} - \mathbf{u})$ oe or $\overrightarrow{TY} = \dfrac{1}{3}(\mathbf{u} - \mathbf{t})$ oe or correct route soi
(c)(ii)	$\dfrac{2}{3}\mathbf{t}$ cao	1	

5 - (0580/41_Winter_2021_Q7) - *Transformatoin, Vectors*

(a)(i)(a)	Shape at (–2, 1) (–4, 1) (–4, 7) (0, 7)	2	**B1** for 3 correct points or for enlargement SF2 from any centre
(a)(i)(b)	Shape at (2, –2) (2, –3) (5, –1) (5, –3)	3	**B2** for correct orientation but wrong position or for 3 correct points or **B1** for $y = x - 1$ drawn
(a)(ii)	Rotation 90 [anticlockwise] oe (0, 0) oe	3	**B1** for each
(b)	$\dfrac{3}{4}\mathbf{p} + \dfrac{1}{2}\mathbf{q}$ or $\dfrac{1}{4}(3\mathbf{p} + 2\mathbf{q})$ or $\dfrac{3p + 2q}{4}$ final answer	3	**M2** for $AM = \overrightarrow{AM} = \dfrac{1}{2}\left(-\mathbf{p} + \mathbf{q} + \dfrac{1}{2}\mathbf{p}\right)$ oe or **M1** for correct route for $\overrightarrow{AB}$ oe soi by $-½\,\mathbf{p} + \mathbf{q}$ or for $\overrightarrow{OM}$ soi

6 - (0580/42_Winter_2021_Q9) - *Vectors*

(a)(i)	(3, 1)	1	
(a)(ii)	$\begin{pmatrix} -10 \\ 15 \end{pmatrix}$	1	
(a)(iii)	3.61 or 3.605 to 3.606	2	**M1** for $(-2)^2 + 3^2$ oe
(b)(i)(a)	$\frac{1}{2}\mathbf{c}$	1	
(b)(i)(b)	$\mathbf{a} + \frac{1}{2}\mathbf{c}$ oe	1	FT **a** + *their* (b)(i)(a)
(b)(ii)(a)	$\overrightarrow{OP} = \frac{1}{3}(2\mathbf{a} + \mathbf{c})$ oe and $\overrightarrow{OQ} = \frac{1}{2}(2\mathbf{a} + \mathbf{c})$ oe OR $\overrightarrow{OP} = \frac{2}{3}(\mathbf{a} + \frac{1}{2}\mathbf{c})$ OR $\overrightarrow{PQ} = \frac{1}{3}(\mathbf{a} + \frac{1}{2}\mathbf{c})$ **and** correct comment e.g. have the same base vector or that they are multiples of one another **and** they share a common point OR e.g. $\overrightarrow{OQ} = 1.5\overrightarrow{OP}$, $2\overrightarrow{PQ} = \overrightarrow{OP}$	2	**B1** for $\overrightarrow{OP}$ or $\overrightarrow{PQ}$ factorised or for correct multiplicative statement on relationship without factorised vectors e.g. $\overrightarrow{OQ} = 1.5\overrightarrow{OP}$, $\frac{2}{3}\overrightarrow{OQ} = \overrightarrow{OP}$, $2\overrightarrow{PQ} = \overrightarrow{OP}$, $1.5\left(\frac{2}{3}\mathbf{a} + \frac{1}{3}\mathbf{c}\right) = \mathbf{a} + \frac{1}{2}\mathbf{c}$
(b)(ii)(b)	1.5 oe	1	

7 - (0580/41_Winter_2022_Q6) - *Vectors*

(a)(i)	$\begin{pmatrix} -3 \\ 3 \end{pmatrix}$	1	
(a)(ii)	$\begin{pmatrix} 3 \\ 2 \end{pmatrix}$	1	
(a)(iii)	3.61 or 3.605 to 3.606	2	**M1** for $2^2 + 3^2$ oe
(b)	(6, 1)	2	**B1** for each

| (c) | $\dfrac{2}{7}\mathbf{g} + \dfrac{3}{14}\mathbf{h}$ | 4 | **B3** for correct unsimplified expression for $\overrightarrow{MK}$

or **B2** for $[\overrightarrow{MK} =]\dfrac{2}{7}\mathbf{g} + k\mathbf{h}$

or $[\overrightarrow{MK} =]\ k\mathbf{g} + \dfrac{3}{14}\mathbf{h}$

or $\overrightarrow{HK} = \dfrac{2}{7}(\mathbf{g} - \mathbf{h})$ oe

or $\overrightarrow{GK} = \dfrac{5}{7}(\mathbf{h} - \mathbf{g})$ oe

or **M1** for correct route for $\overrightarrow{MK}$ |

8 - (0580/42_Winter_2022_Q11) - *Vectors*

(a)	2.5 and – 2.5 oe	3	**M2** for $1681m^2 = \dfrac{42025}{4}$ oe or **M1** for $(9m)^2 + (40m)^2$ oe
(b)(i)(a)	$\mathbf{c} - \mathbf{a}$ final answer	1	
(b)(i)(b)	$\dfrac{3}{4}\mathbf{a}$ final answer	1	
(b)(i)(c)	$\mathbf{c} + \dfrac{3}{4}\mathbf{a}$ final answer	1	**FT** $\mathbf{c}$ + *their* **(b)(i)(b)**, must be a vector in terms of $\mathbf{a}$ and/or $\mathbf{c}$ in its simplest form
(b)(ii)	$\mathbf{a} + \dfrac{4}{3}\mathbf{c}$ oe	2	**B1** for $[\overrightarrow{BQ} =]\ \dfrac{1}{3}\mathbf{c}$ or $[\overrightarrow{AQ} =]\ \dfrac{4}{3}\mathbf{c}$ or **M1** for a correct route or for answer $\mathbf{a} + k\mathbf{c}$ oe, where $k > 1$

9 - (0580/43_Winter_2022_Q10) - *Vectors*

(a)(i)	2**a** drawn correctly with direction arrow	1	
(a)(ii)	$\mathbf{a} - \mathbf{b}$ drawn correctly with direction arrow	2	**B1** for $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ seen or implied or **M1** for correctly drawing *their* $\mathbf{a} - \mathbf{b}$ with an arrow
(b)(i)(a)	$\mathbf{q} + \dfrac{3}{4}\mathbf{p}$ final answer	1	
(b)(i)(b)	$\mathbf{q} - \dfrac{1}{4}\mathbf{p}$ final answer	2	**M1** for a correct route
(b)(i)(c)	$\dfrac{13}{24}\mathbf{p} - \dfrac{2}{3}\mathbf{q}$ final answer	3	**M2** for $\dfrac{3}{8}\mathbf{p} - \dfrac{2}{3}$ (*their* **(b)(i)(b)**) oe or for $-\dfrac{3}{8}\mathbf{p} - \mathbf{q} + \mathbf{p} + \dfrac{1}{3}$ (*their* **(b)(i)(b)**) oe or **M1** for a correct route or for $[\overrightarrow{BN} =]\ -\dfrac{2}{3}$ (*their* **(b)(i)(b)**) or $[\overrightarrow{AN} =]\ \dfrac{1}{3}$ (*their* **(b)(i)(b)**) or final answer $k\mathbf{p} - \dfrac{2}{3}\mathbf{q}$ oe or $\dfrac{13}{24}\mathbf{p} - k\mathbf{q}$ oe
(b)(ii)	$\dfrac{19}{16}\mathbf{p}$ oe final answer	2	**M1** for $\overrightarrow{AG} = \dfrac{3}{8}\mathbf{p} \div 2$ soi or for answer $k\mathbf{p}$ oe

10 - (0580/41_Winter_2023_Q10) - *Vectors*

(a)(i)	(15, 6)	**2**	**B1** for each
(a)(ii)	$\begin{pmatrix} 3 \\ 24 \end{pmatrix}$	**1**	
(a)(iii)	13.6 or 13.60…	**2**	**M1** for $(-11)^2 + 8^2$ oe
(b)(i)	$\mathbf{a} + \dfrac{3}{5}(\mathbf{b} - \mathbf{a})$ or $\mathbf{b} + \dfrac{2}{5}(\mathbf{a} - \mathbf{b})$ leading to $\dfrac{2}{5}\mathbf{a} + \dfrac{3}{5}\mathbf{b}$ with no errors	**M3**	**M2** for $[\overrightarrow{MR} =] \dfrac{3}{5}(\mathbf{b} - \mathbf{a})$ oe or $[\overrightarrow{NR} =] \dfrac{2}{5}(\mathbf{a} - \mathbf{b})$ oe or **M1** for $\overrightarrow{MN} = \mathbf{b} - \mathbf{a}$ or $\overrightarrow{NM} = \mathbf{a} - \mathbf{b}$ or a correct route for $\overrightarrow{OR}$
(b)(ii)(a)	$k = 5$, $c = 10$	**4**	**B2** for $c = 10$ or **M1** for $c(\dfrac{2}{5}\mathbf{a} + \dfrac{3}{5}\mathbf{b}) = \mathbf{b} + 4\mathbf{a} + k\mathbf{b}$ oe or for $\dfrac{2}{5}c = 4$ and **M1** for $\dfrac{3}{5} \times$ *their* $c = k + 1$
(b)(ii)(b)	$3\mathbf{a} + 6\mathbf{b}$ final answer	**1**	**FT** $3\mathbf{a} + (their\ k + 1)\mathbf{b}$

11 - (0580/42_Winter_2023_Q12) - *Vectors, Lines*

(a)(i)	$\begin{pmatrix} 2 \\ 5 \end{pmatrix}$	**1**	
(a)(ii)	$\begin{pmatrix} -6 \\ 4 \end{pmatrix}$	**1**	
(b)	$[y =] -\dfrac{2}{3}x + \dfrac{19}{3}$ oe	**3**	**M1** for gradient $= \dfrac{1-5}{8-2}$ oe **M1** for substituting (8, 1) or (2, 5) into $y =$ *their* $mx + c$
(c)	$[y =] \dfrac{3}{2}x - \dfrac{9}{2}$ oe	**4**	**B1** for (5, 3) oe **M1** for gradient $= -\dfrac{1}{their\ \text{gradient of } AB}$ **M1** substituting *their* midpoint into $y =$ *their* $mx + c$
(d)	$\dfrac{65}{6}$ oe	**2**	**M1** for *their* $\dfrac{19}{3} -$ *their* $-\dfrac{9}{2}$ oe

(a)(i)	$\begin{pmatrix} 4 \\ -12 \end{pmatrix}$	2	B1 for each
(a)(ii)	$1^2 + 7^2$	M1	
	$5^2 + ([-]5)^2$	M1	
	Both $\sqrt{50}$ oe	A1	With no errors seen If M0M0A0 scored SC1 for $\sqrt{50}$ oe for each
(a)(iii)	44.4 or 44.42[8…] to 44.435	2	FT *their* (a)(ii) correct to 3sf or better M1 for $2 \times \pi \times their \sqrt{50}$ oe
(a)(iv)	(3, 1)	2	B1 for each
(a)(v)	$[y =] \dfrac{1}{3}x$	4	B3 for a correct equation in the wrong form as final answer Or B2 for 1/3 stated or used as perpendicular gradient OR M1 for [grad *PQ*] = $\dfrac{7--5}{1-5}$ oe M1 for $\dfrac{-1}{their \, \mathrm{grad}\, PQ}$ M1dep for substituting *their*(a)(iv) or (0,0) into $y = their \, mx + c$ oe dep on the 2nd M1 or B2
(b)	$\dfrac{3}{5}\mathbf{a} + \dfrac{2}{5}\mathbf{b}$ final answer	4	B3 for an unsimplified correct answer or B2 for $AM = \dfrac{2}{5}(\boldsymbol{b} - \boldsymbol{a})$ soi or $BM = \dfrac{3}{5}(\boldsymbol{a} - \boldsymbol{b})$ soi or B1 for $AB = \mathbf{b} - \mathbf{a}$ or $BA = \mathbf{a} - \mathbf{b}$ or for a correct route for *OM* or for correct diagram

13 - (0580/42_Winter_2024_Q6) - *Vectors*

(a)	$\begin{pmatrix} 4 \\ -3 \end{pmatrix}$	2	**B1** for $\begin{pmatrix} 6 \\ -10 \end{pmatrix}$ or answer $\begin{pmatrix} 4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -3 \end{pmatrix}$
(b)(i)	(−4, −1)	1	
(b)(ii)	7.21 or 7.211…	2	**M1** for $(-6)^2 + 4^2$
(c)(i)(a)	2**c** − **a**	1	
(c)(i)(b)	**c** − **a**	1	
(c)(i)(c)	$\dfrac{1}{5}$ (**a** + 8**c**) final answer	2	**M1** for $[\overrightarrow{AP} =]\ \dfrac{4}{5} \times their(2\mathbf{c} - \mathbf{a})$ or $[\overrightarrow{BP} =]\ \dfrac{1}{5} \times - their\ (2\mathbf{c} - \mathbf{a})$ or for a correct vector route using the lines on the diagram
(c)(i)(d)	$\dfrac{4}{5}$ (− **a** + **c**) final answer	2	**M1** for $[\overrightarrow{QP} =] - \dfrac{4}{5}\mathbf{c} + \dfrac{4}{5} \times their(2\mathbf{c} - \mathbf{a})$ or for a correct vector route
(c)(ii)	[*QP* is] parallel [to *CB*] $QP = \dfrac{4}{5} CB$ oe	2	**Dep both statements** consistent with *their* **(c)(i)(b)** and *their* **(c)(i)(d)** and both vectors in terms of **a** and **c** **B1** for each dep on statement consistent with *their* **(c)(i)(b)** and *their* **(c)(i)(d)** and both vectors in terms of **a** and **c**

14 - (0580/43_Winter_2024_Q2) - *Vectors, Transformatoin*

(a)(i)	(1, 6)	2	**B1** for each
(a)(ii)	$\begin{pmatrix} -4 \\ -2 \end{pmatrix}$	1	
(a)(iii)	(15, 13)	2	**FT** *their* (a)(ii) **M1** for $\begin{pmatrix} 12 \\ 6 \end{pmatrix}$ or $\begin{pmatrix} -12 \\ -6 \end{pmatrix}$ seen or for −1 + 16 and 5 + 8 seen
(b)(i)	Image at (4, 1), (5, −1), (7, −1), (7, 1)	2	**B1** for rotation 180° but incorrect position
(b)(ii)	Image at (1, 3), (−1, 3), (−1, 6), (1, 5)	2	**B1** for correct orientation but incorrect position or for drawing line *y* = *x* + 2

(b)(iii)	Enlargement [centre] (3, 3) [factor] $-\dfrac{1}{2}$	**3**	**B1** for each