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EDEXCEL GCSE (9-1) MATHS: QUESTIONS BY TOPIC

Transformations & Vectors (G3)

GCSE (9-1) Mathematics (1MA1) · Higher tier

42 questions · 133 marks · Mark schemes included

Past papers June 2017 - June 2025 · 2 sub-topics

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HOW TO USE THIS BOOKLET

Questions are grouped by sub-topic and run from the lowest to the highest mark tariff, then oldest paper first.

Click any row below to jump straight to that sub-topic or question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme; < QUESTION brings you back.

A gold bar in the left margin marks exactly where the question sits on the original page.

Diagrams, graphs, grids and tables are printed exactly as they appear in the original papers.

Each question is filed under its main topic; longer questions may also test skills from other topics.

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QUESTIONS

42 questions · 133 marks · 2 sub-topics

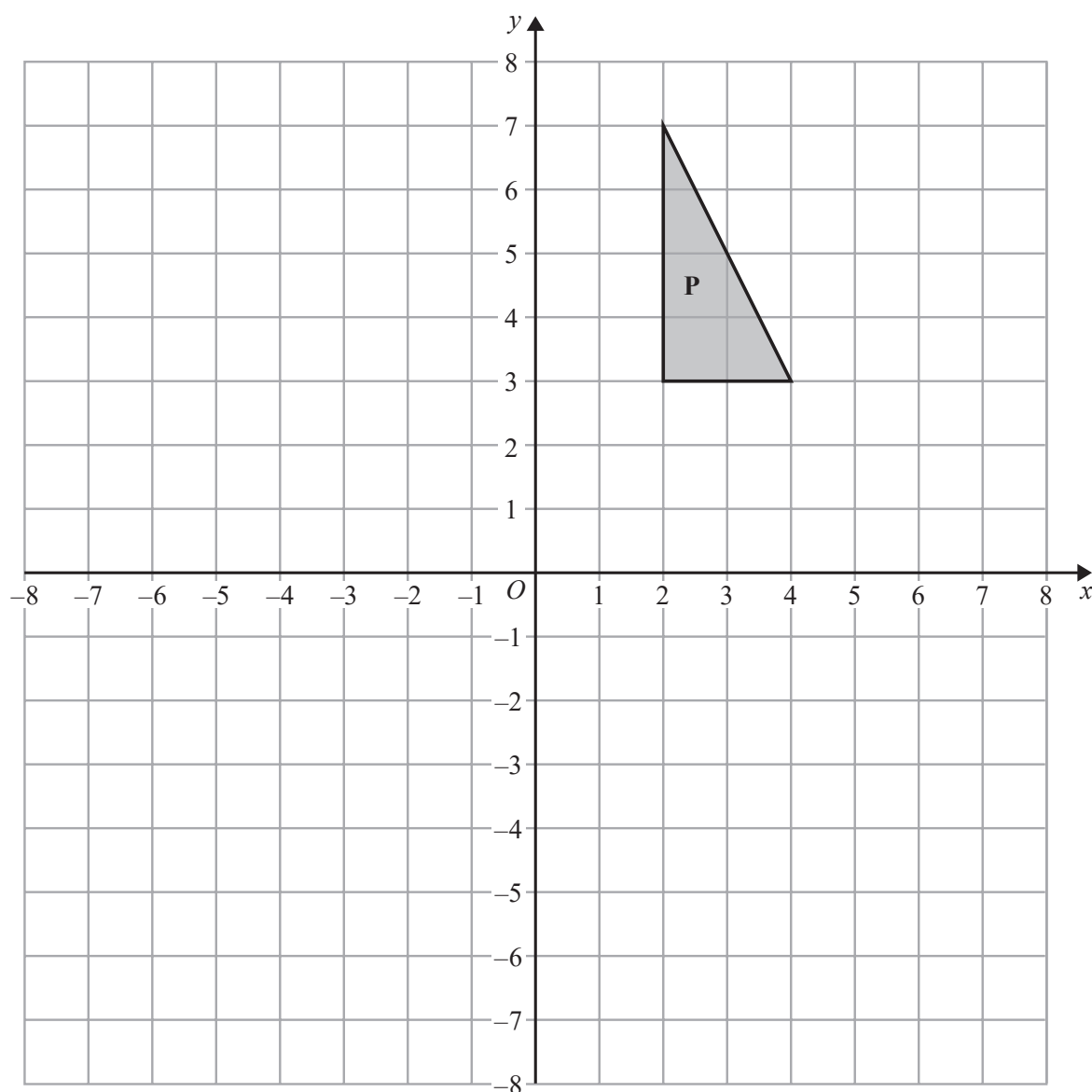
SUB-TOPIC G3a

TRANSFORMATIONS

Sub-topic G3a · 23 questions · 55 marks · lowest tariff first



18

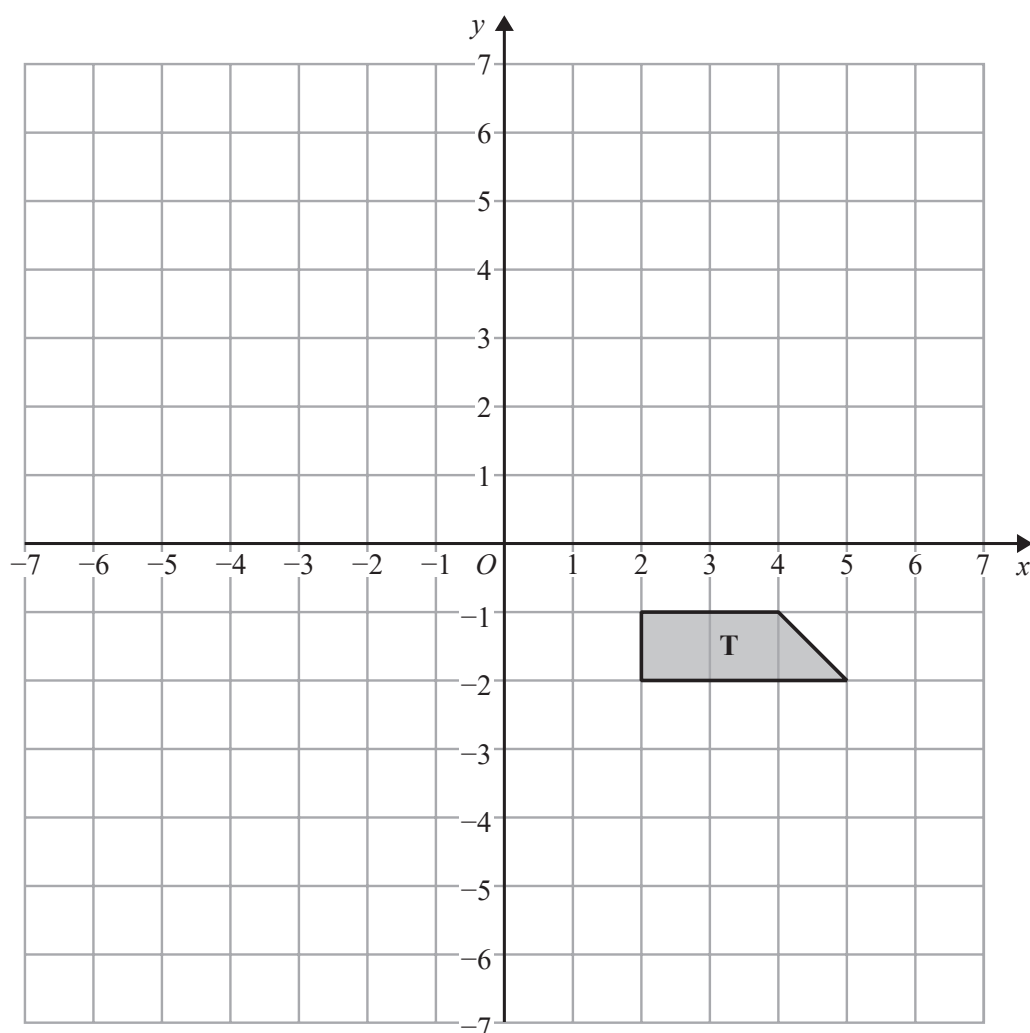


Enlarge shape **P** by scale factor $-\frac{1}{2}$ with centre of enlargement (0, 0).
Label your image **Q**.

(Total for Question 18 is 2 marks)



5



- (a) Rotate trapezium **T** 180° about the origin.
Label the new trapezium **A**.

(1)

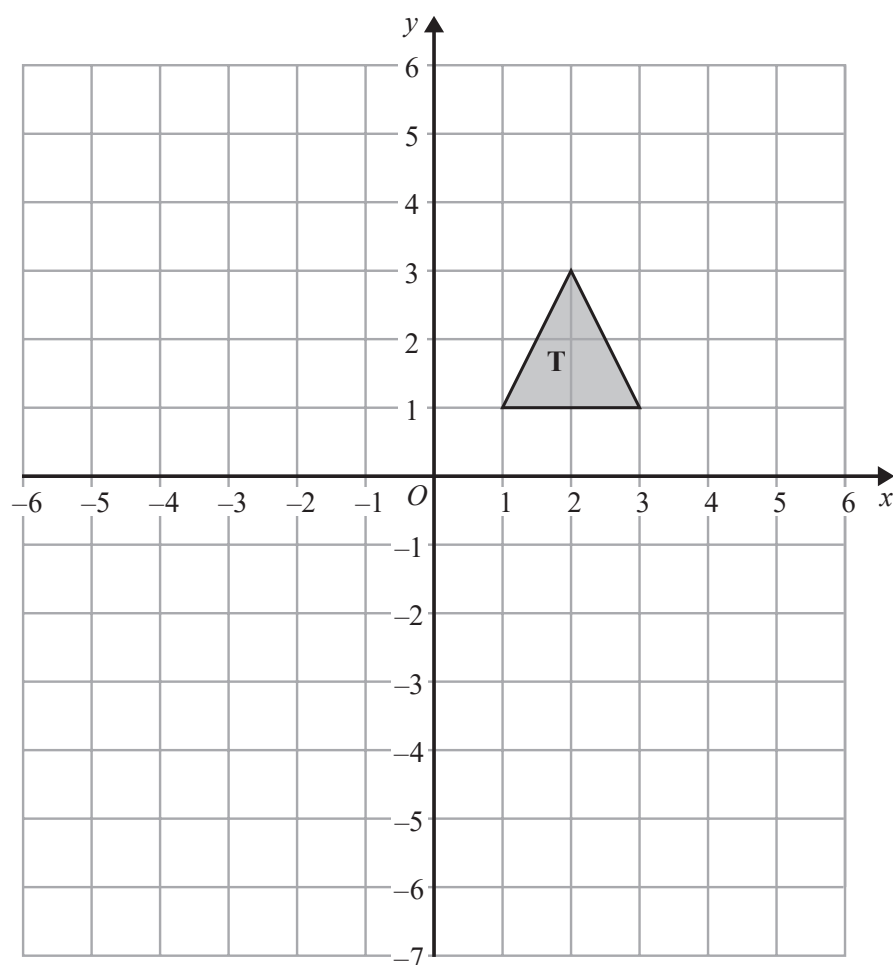
- (b) Translate trapezium **T** by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$
Label the new trapezium **B**.

(1)

(Total for Question 5 is 2 marks)



7



Shape **T** is reflected in the line $x = -1$ to give shape **R**.
Shape **R** is reflected in the line $y = -2$ to give shape **S**.

Describe the **single** transformation that will map shape **T** to shape **S**.

.....

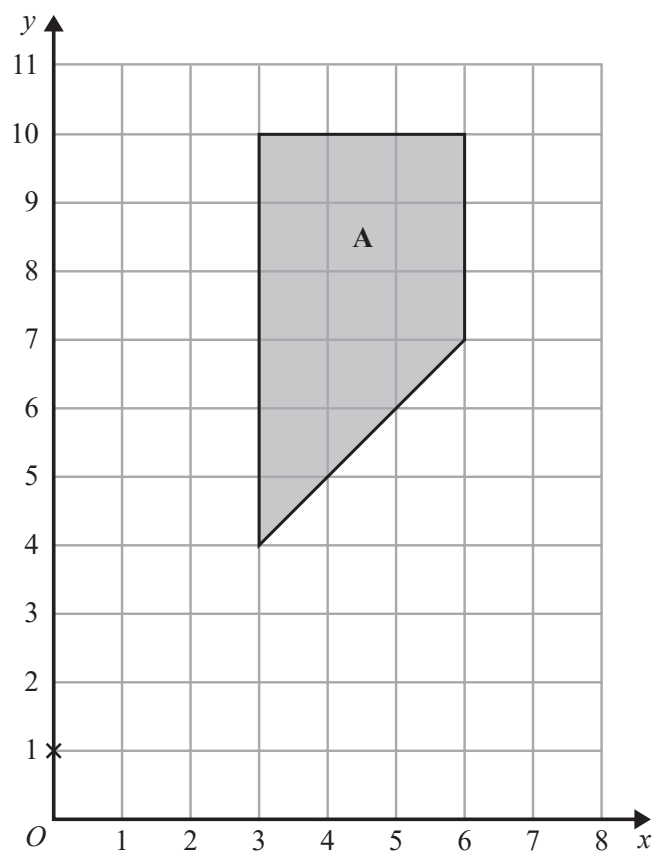
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.....

(Total for Question 7 is 2 marks)



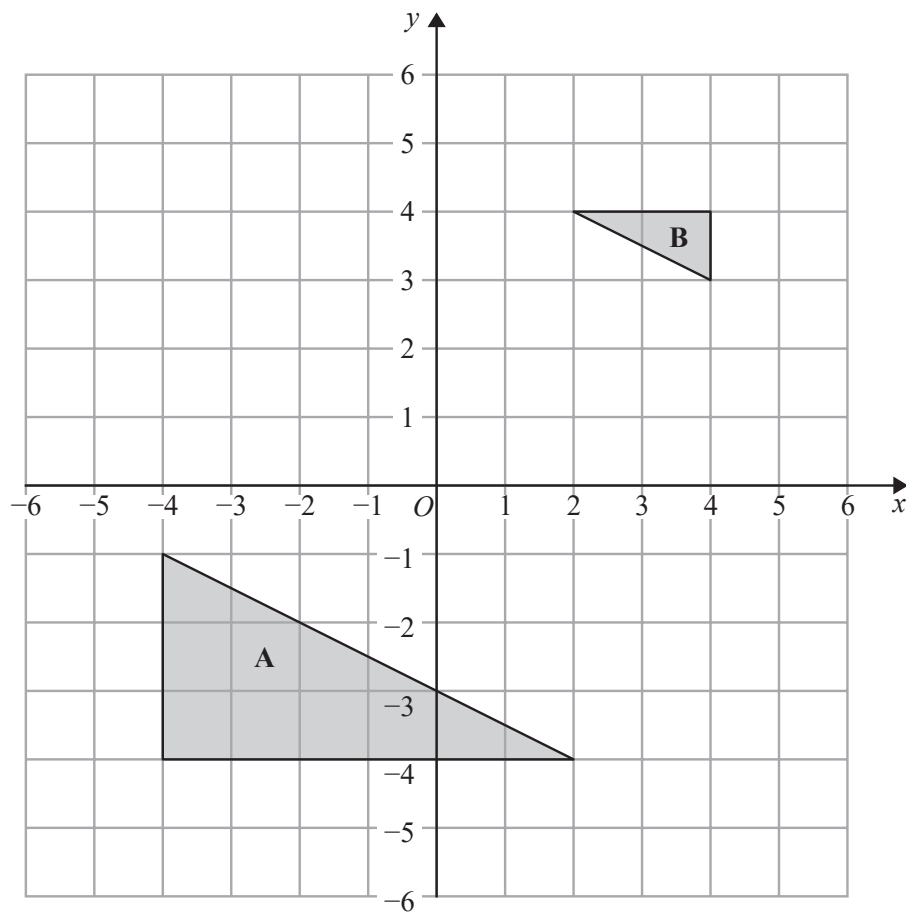
7



Enlarge shape A by scale factor $\frac{1}{3}$ centre (0, 1)

(Total for Question 7 is 2 marks)

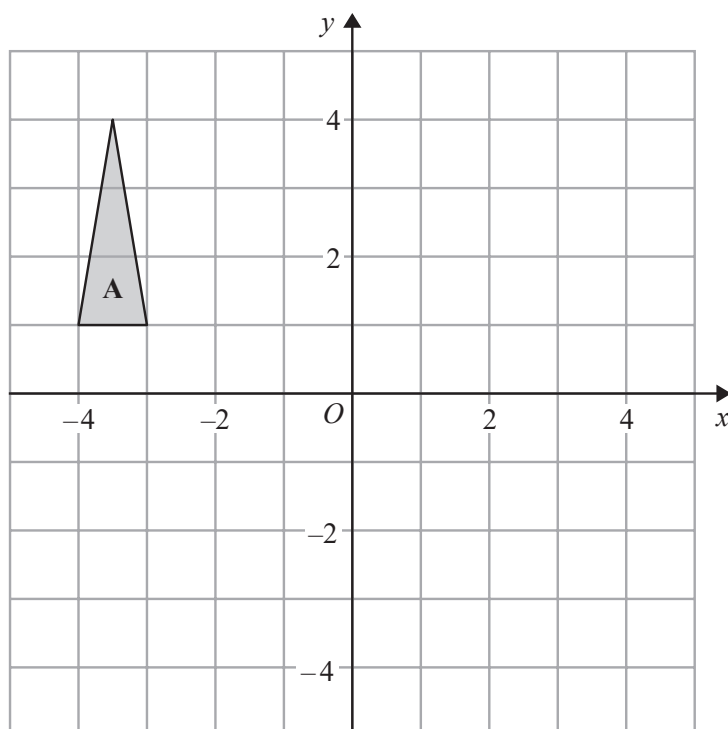
13



Describe fully the single transformation that maps triangle A onto triangle B.

(Total for Question 13 is 2 marks)

20



Triangle **A** is transformed by the combined transformation of a rotation of 180° about the point $(-2, 0)$ followed by a translation with vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

One point on triangle **A** is invariant under the combined transformation.

Find the coordinates of this point.

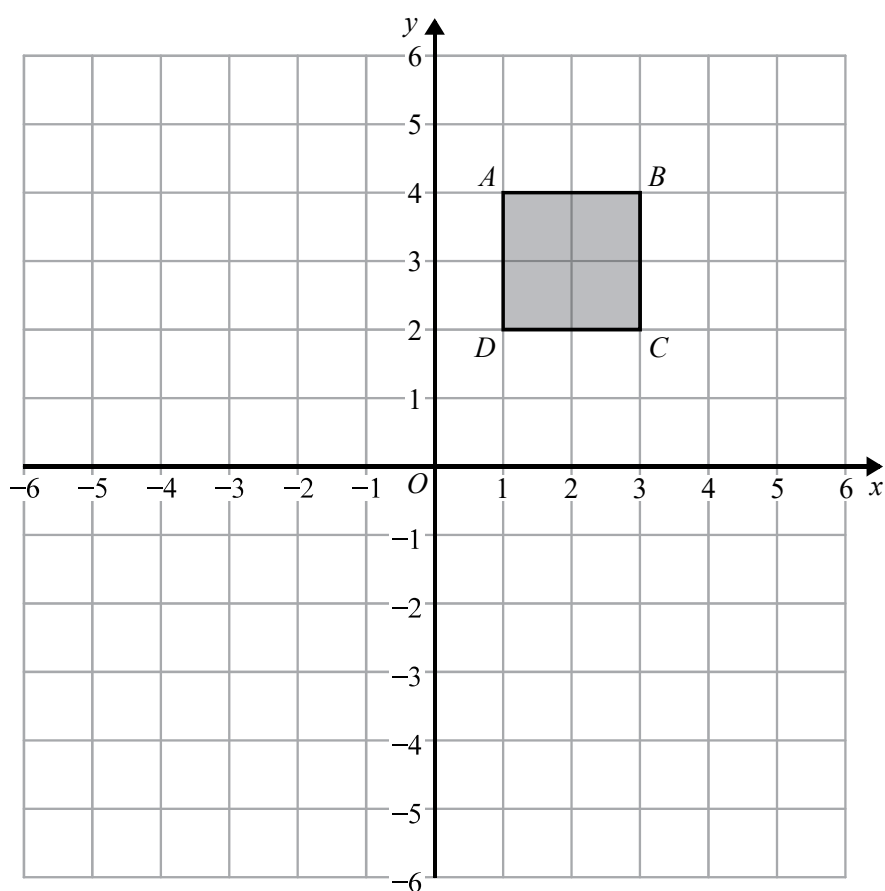
(..... , ...)

(Total for Question 20 is 2 marks)

TOTAL FOR PAPER IS 80 MARKS



24



Square $ABCD$ is transformed by a combined transformation of a reflection in the line $x = -1$ followed by a rotation.

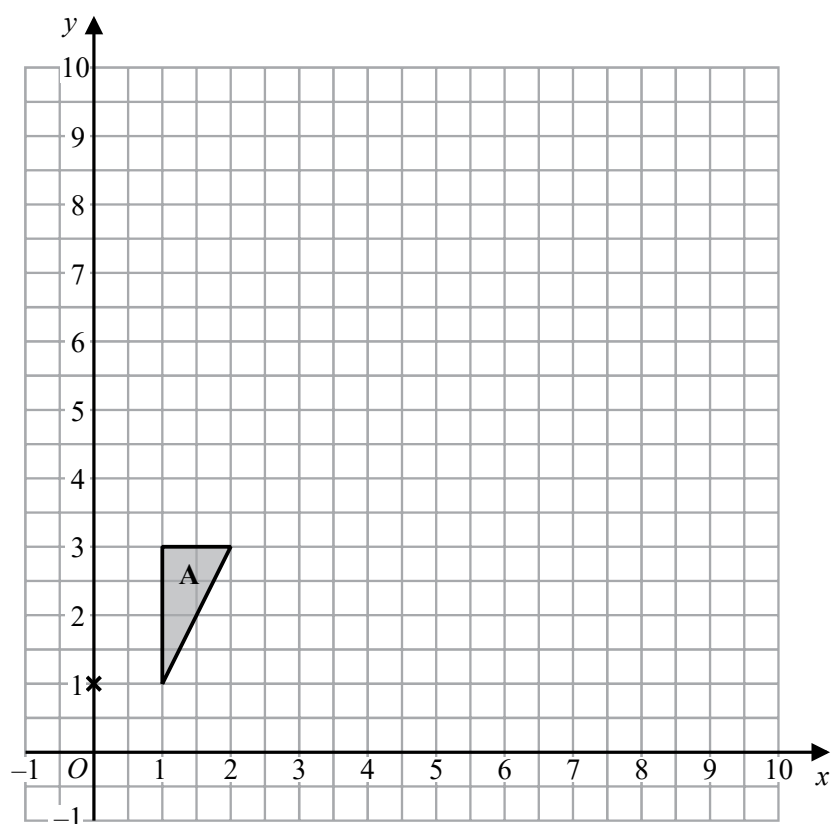
Under the combined transformation, two vertices of the square $ABCD$ are invariant.

Describe fully one possible rotation.

(Total for Question 24 is 2 marks)



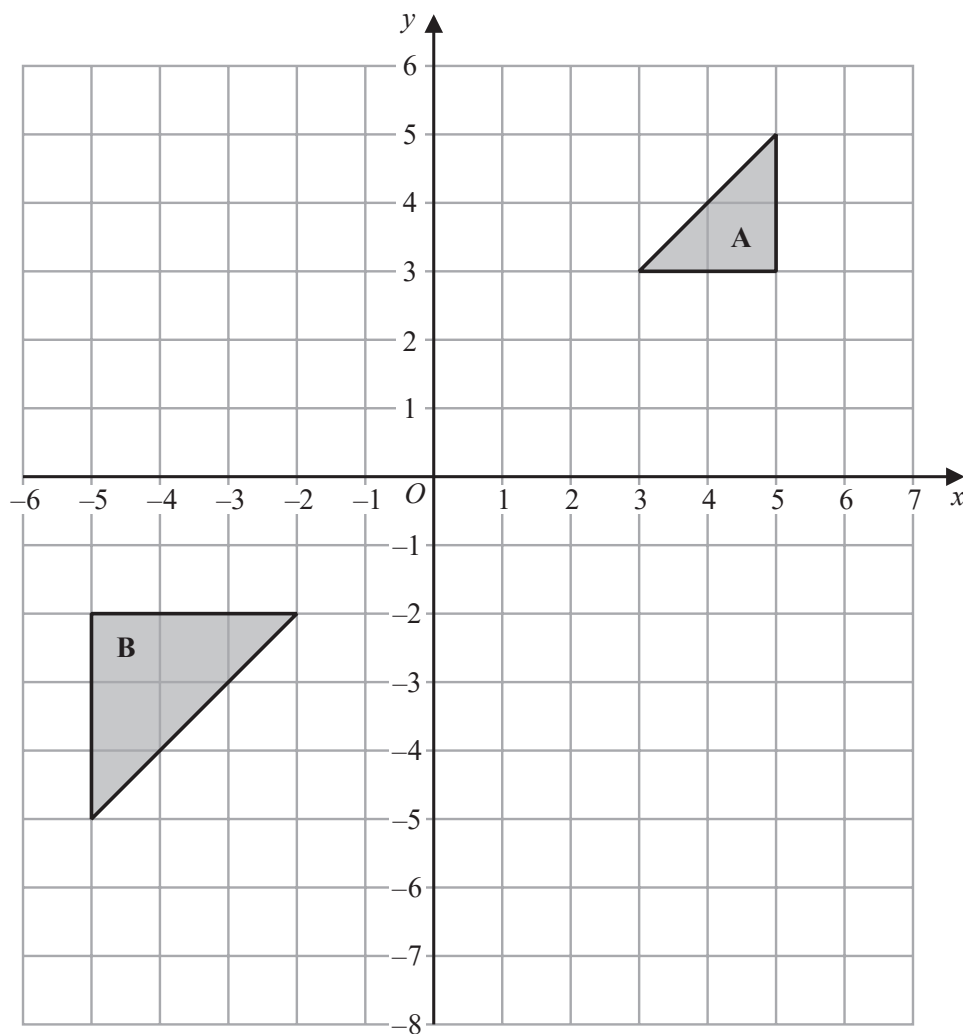
9



Enlarge triangle A by scale factor 2.5 with centre (0, 1)

(Total for Question 9 is 2 marks)

15



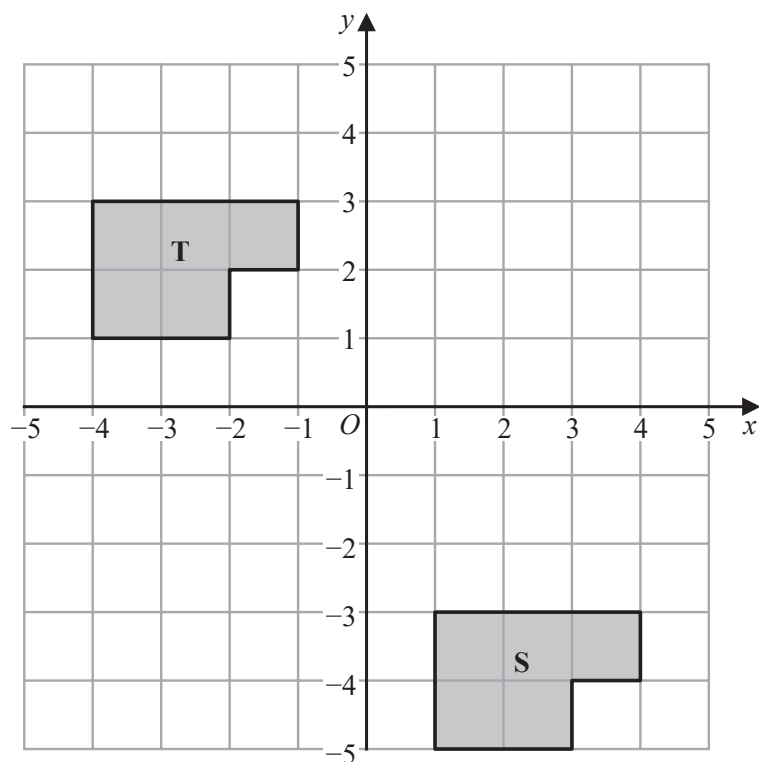
Describe fully the single transformation that maps triangle A onto triangle B.

.....

.....

(Total for Question 15 is 2 marks)

2



Describe fully the single transformation that maps shape S onto shape T.

.....

.....

.....

(Total for Question 2 is 2 marks)

3 The length of a football pitch is 90 metres, correct to the nearest metre.

Complete the error interval for the length of the football pitch.

..... m $\leq$ length < m

(Total for Question 3 is 2 marks)

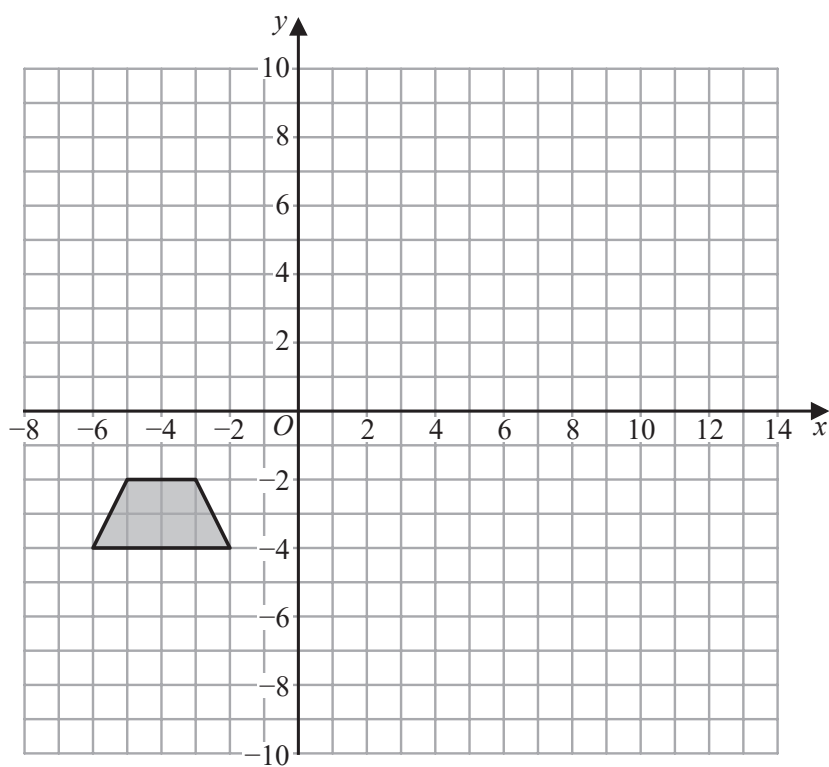


- 12 The equation of the line L_1 is $y = 2x + 3$
The equation of the line L_2 is $5y - 10x + 4 = 0$

Show that these two lines are parallel.

(Total for Question 12 is 2 marks)

13

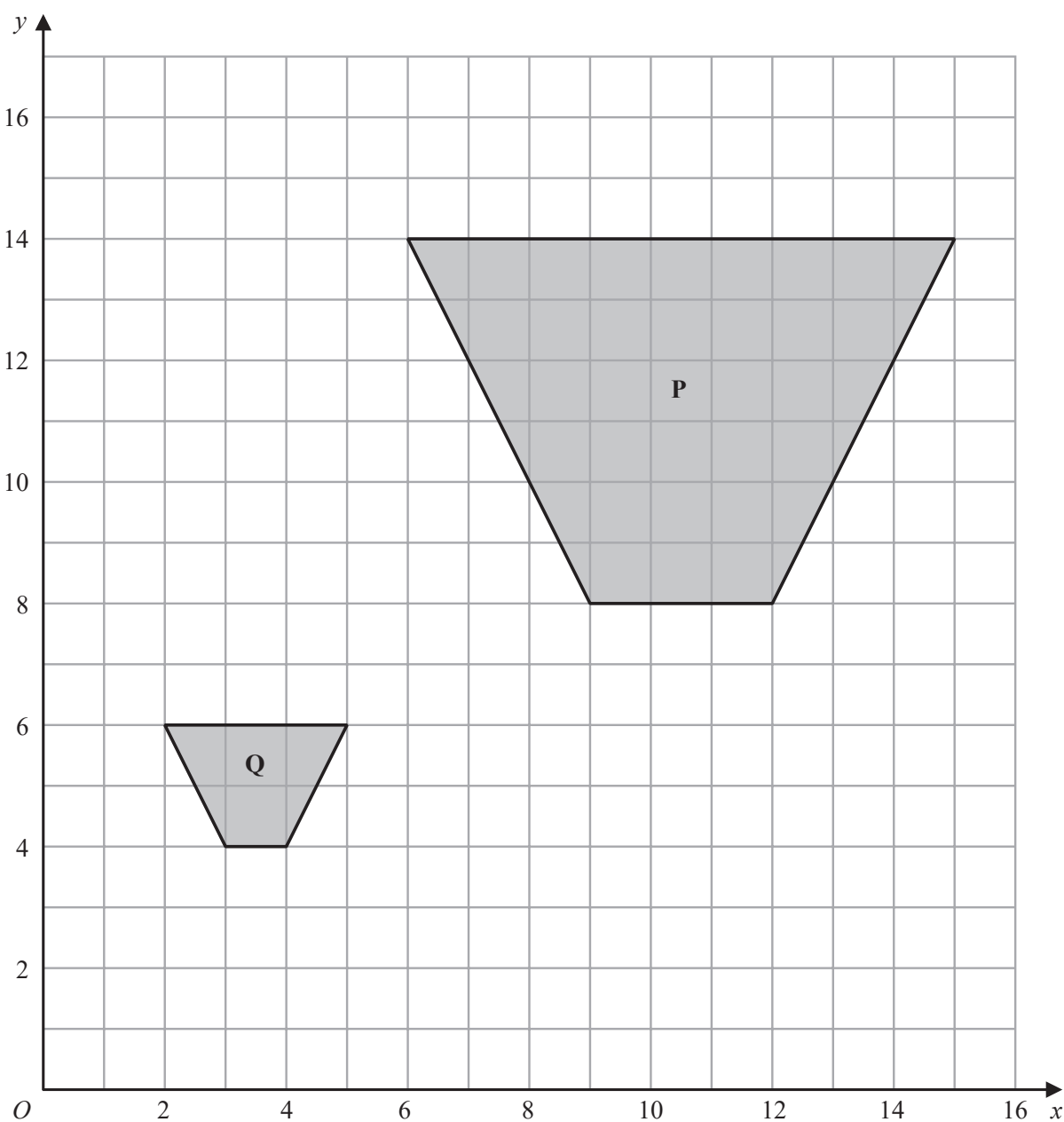


Enlarge the shaded shape by scale factor -2 with centre of enlargement $(0, 0)$

(Total for Question 13 is 2 marks)



11



Describe fully the single transformation that maps shape **P** onto shape **Q**.

.....

.....

.....

(Total for Question 11 is 2 marks)



- 18 Shape A is reflected in the line with equation $x = 2$ to give shape B.
Shape B is reflected in the line with equation $x = 6$ to give shape C.

Describe fully the **single** transformation that maps shape A onto shape C.

(Total for Question 18 is 2 marks)

- 19 There are only blue counters, red counters and green counters in a box.

The probability that a counter taken at random from the box will be blue is 0.4
The ratio of the number of red counters to the number of green counters is 7 : 8

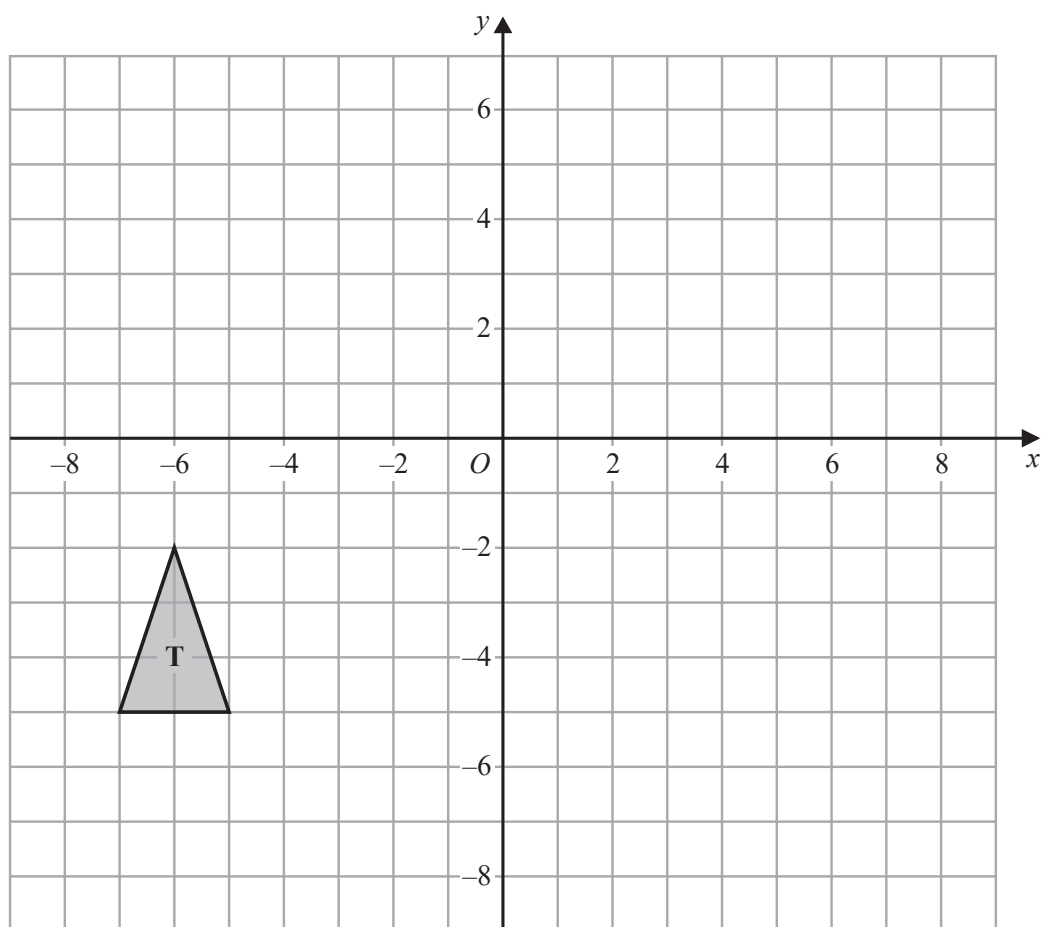
Sameena takes at random a counter from the box.
She records its colour and puts the counter back in the box.
Sameena does this a total of 50 times.

Work out an estimate for the number of times she takes a green counter.

(Total for Question 19 is 3 marks)



16

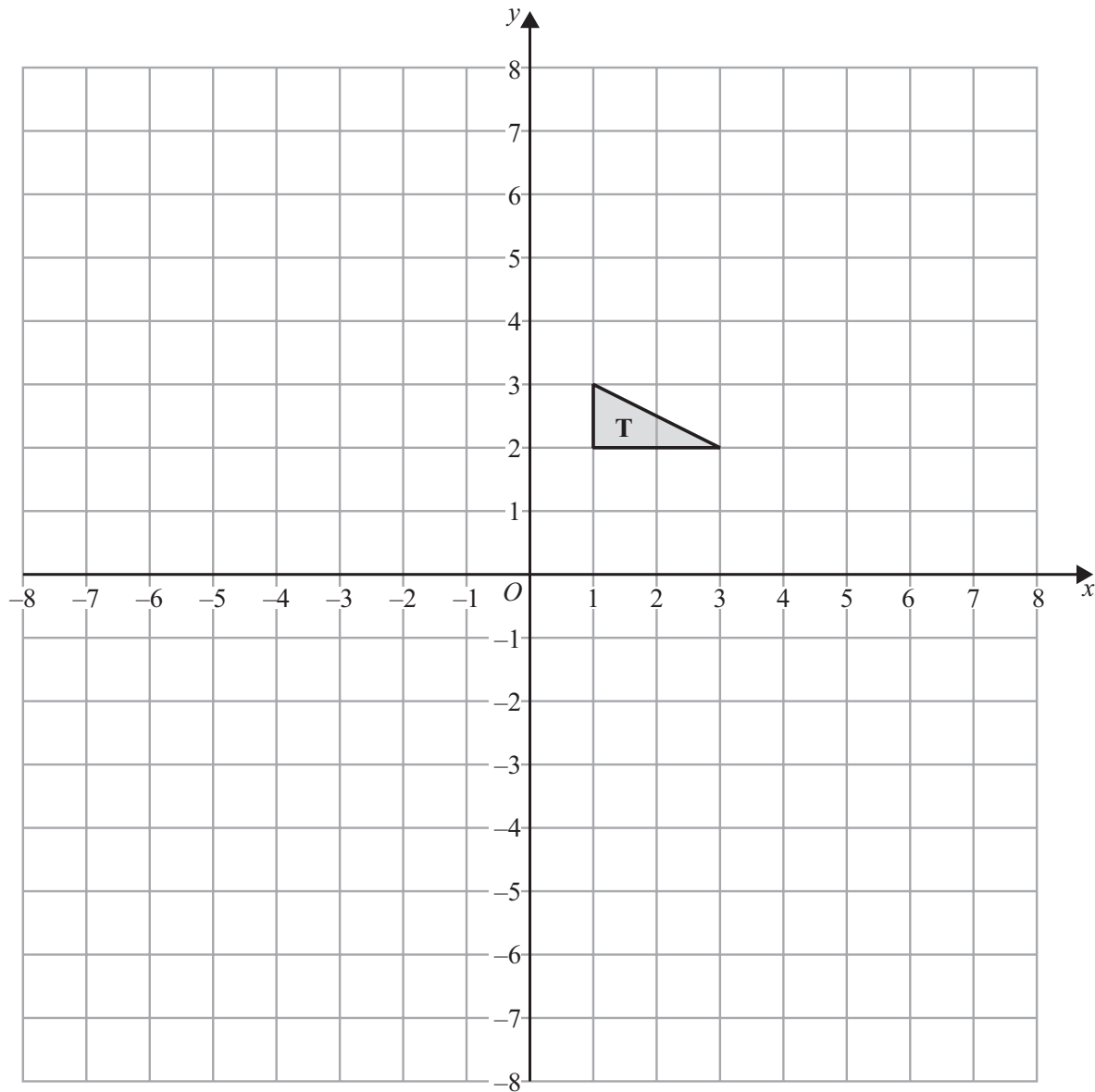


On the grid, enlarge triangle **T** by scale factor -2 with centre of enlargement $(-2, -2)$

(Total for Question 16 is 2 marks)



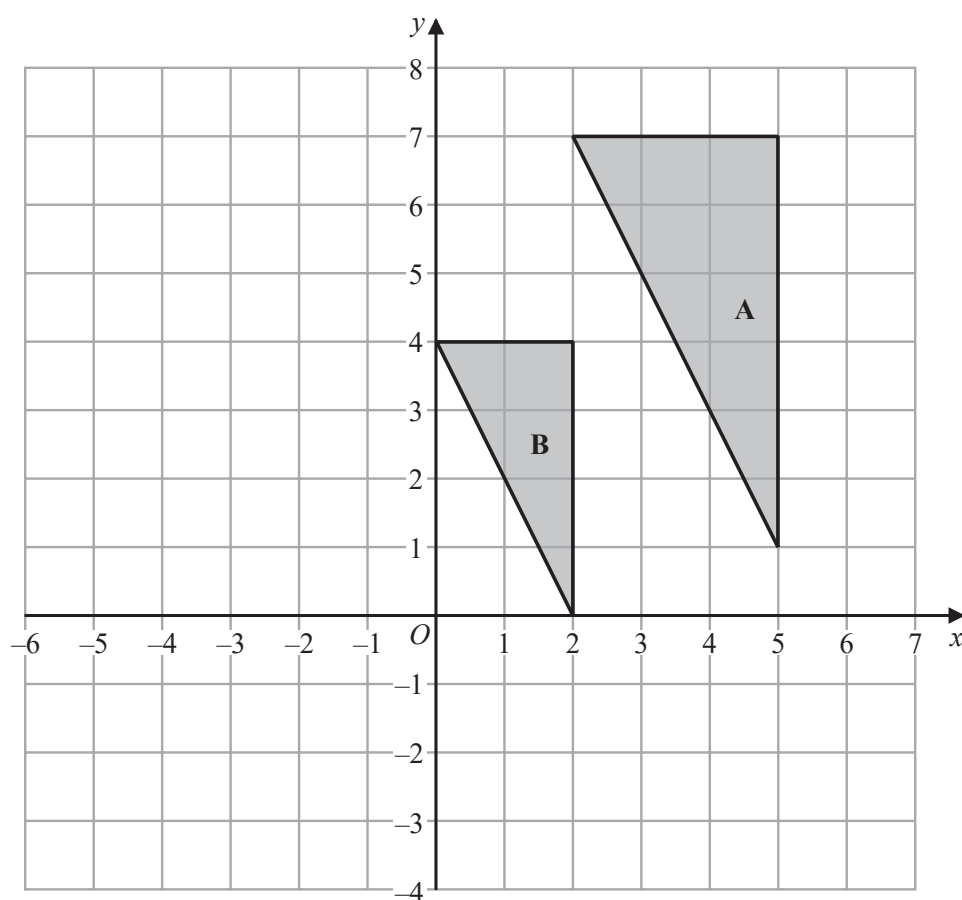
12 The diagram shows triangle T drawn on a grid.



Enlarge triangle T by scale factor -2 with centre of enlargement $(0, 0)$

(Total for Question 12 is 2 marks)

11



Describe fully the single transformation that maps triangle A onto triangle B.

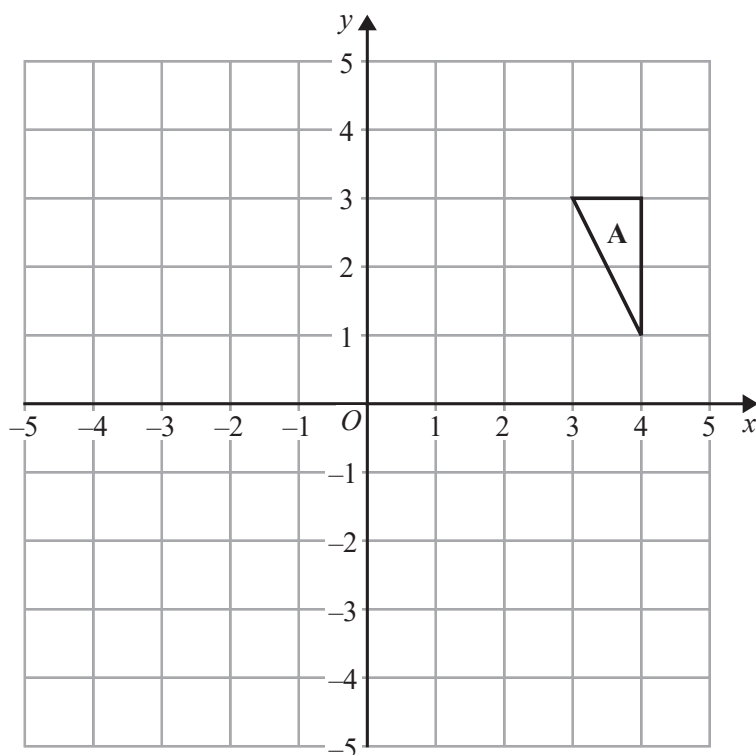
.....

.....

.....

(Total for Question 11 is 2 marks)

- 9 The diagram shows triangle **A** drawn on a grid.



Kyle reflects triangle **A** in the x -axis to get triangle **B**.
He then reflects triangle **B** in the line $y = x$ to get triangle **C**.

Amy reflects triangle **A** in the line $y = x$ to get triangle **D**.
She is then going to reflect triangle **D** in the x -axis to get triangle **E**.

Amy says that triangle **E** should be in the same position as triangle **C**.

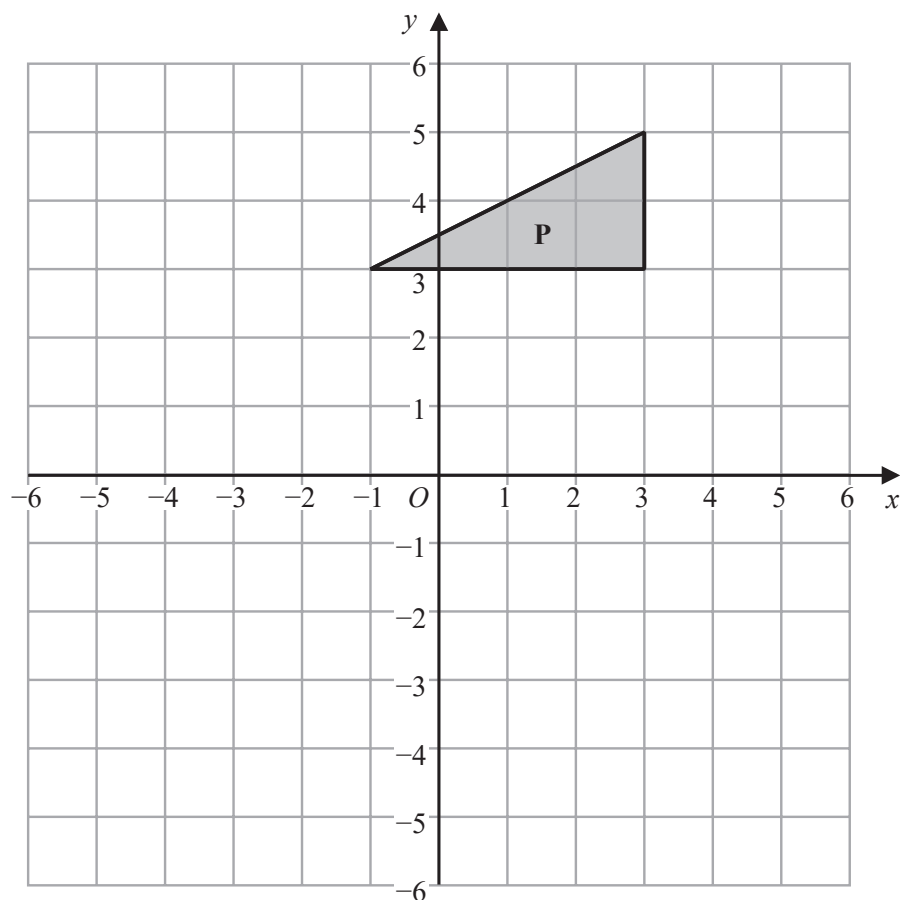
Is Amy correct?

You must show how you get your answer.

(Total for Question 9 is 3 marks)



8



Triangle **P** is reflected in the line $y = -x$ to give triangle **Q**.

Triangle **Q** is reflected in the line $x = -1$ to give triangle **R**.

Describe fully the single transformation that maps triangle **R** to triangle **P**.

(Total for Question 8 is 3 marks)

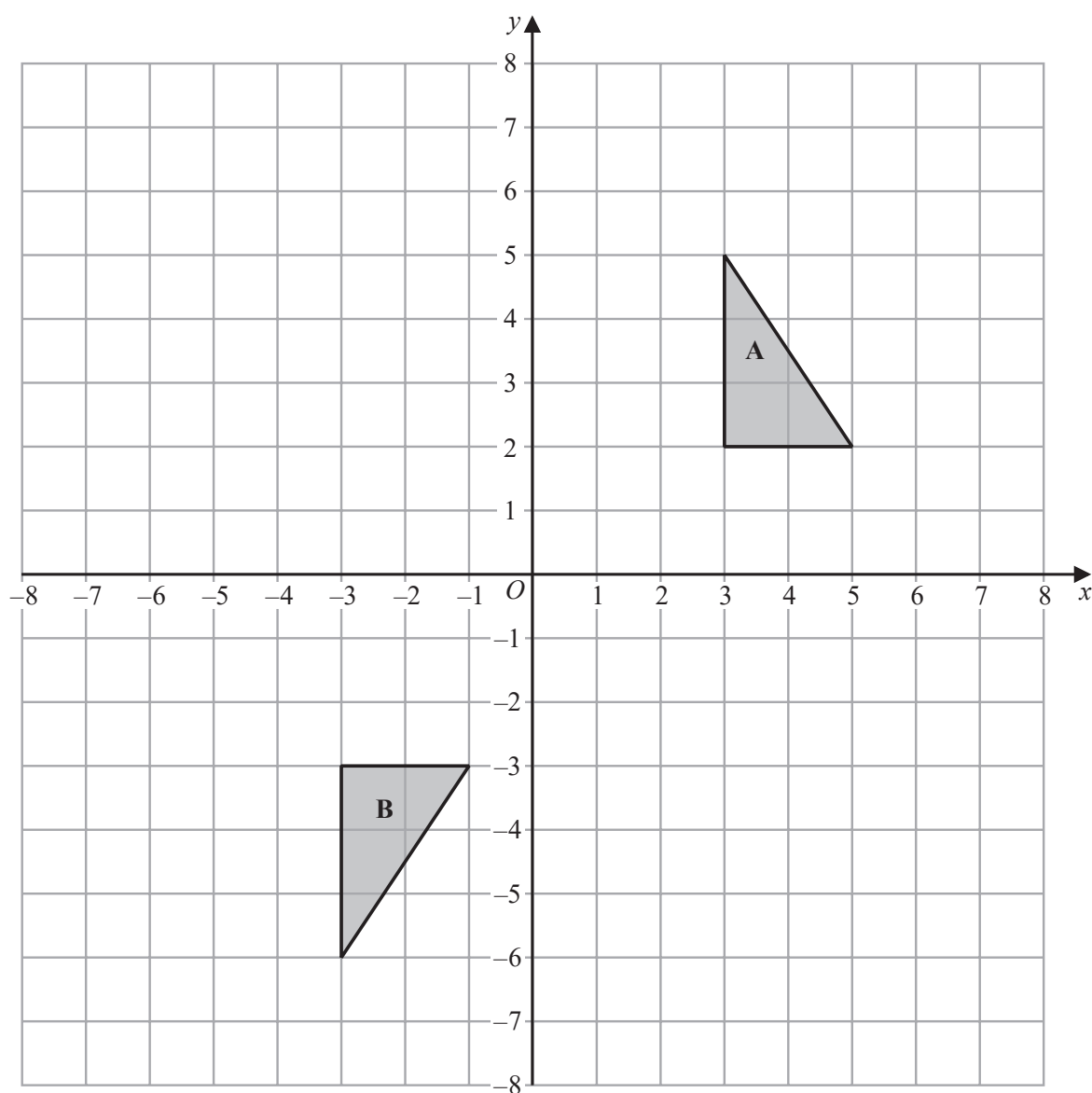
- 9 Martin truncates the number N to 1 digit.
The result is 7

Write down the error interval for N .

(Total for Question 9 is 2 marks)



5



Shape **A** can be transformed to shape **B** by a reflection in the x -axis followed by a translation $\begin{pmatrix} c \\ d \end{pmatrix}$

Find the value of c and the value of d .

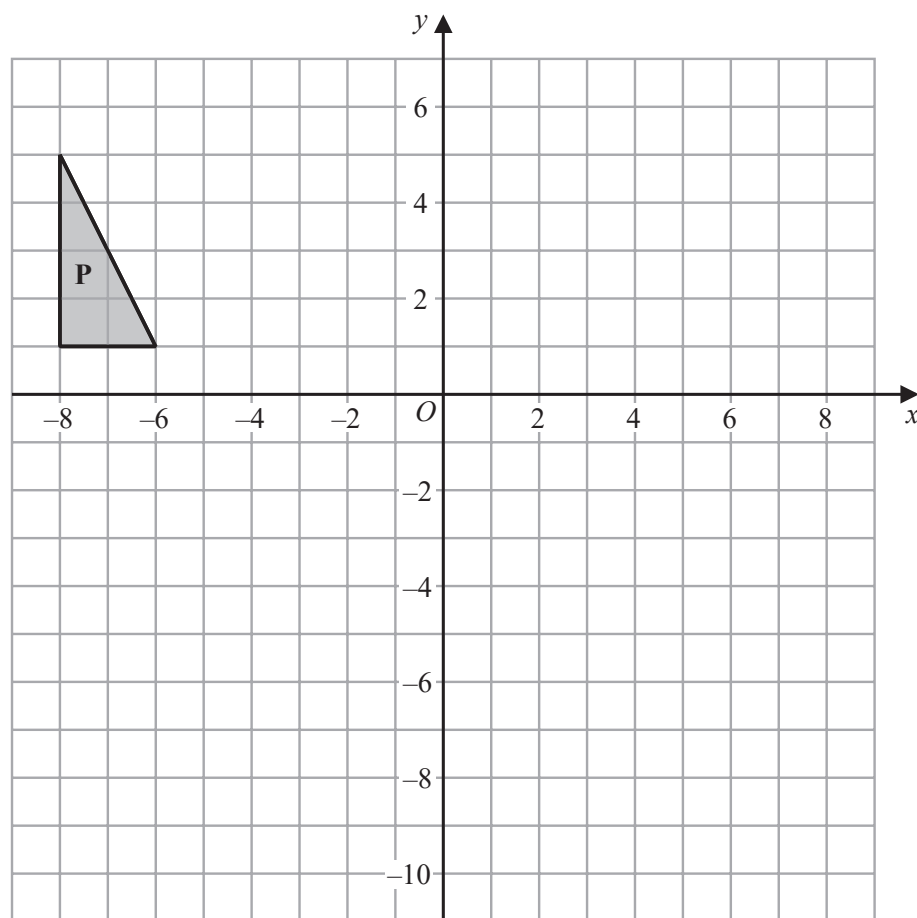
$c = \dots\dots\dots$

$d = \dots\dots\dots$

(Total for Question 5 is 3 marks)



18



- (a) Enlarge triangle **P** by scale factor $-1\frac{1}{2}$ with centre of enlargement $(-2, -1)$
Label your image **Q**.

(2)

Triangle **P** is transformed by a combined transformation of a rotation of 90° anticlockwise about the origin followed by a translation to give triangle **R**.

Exactly one vertex of triangle **P** is invariant under the combined transformation.

- (b) Find one possible column vector for the translation.

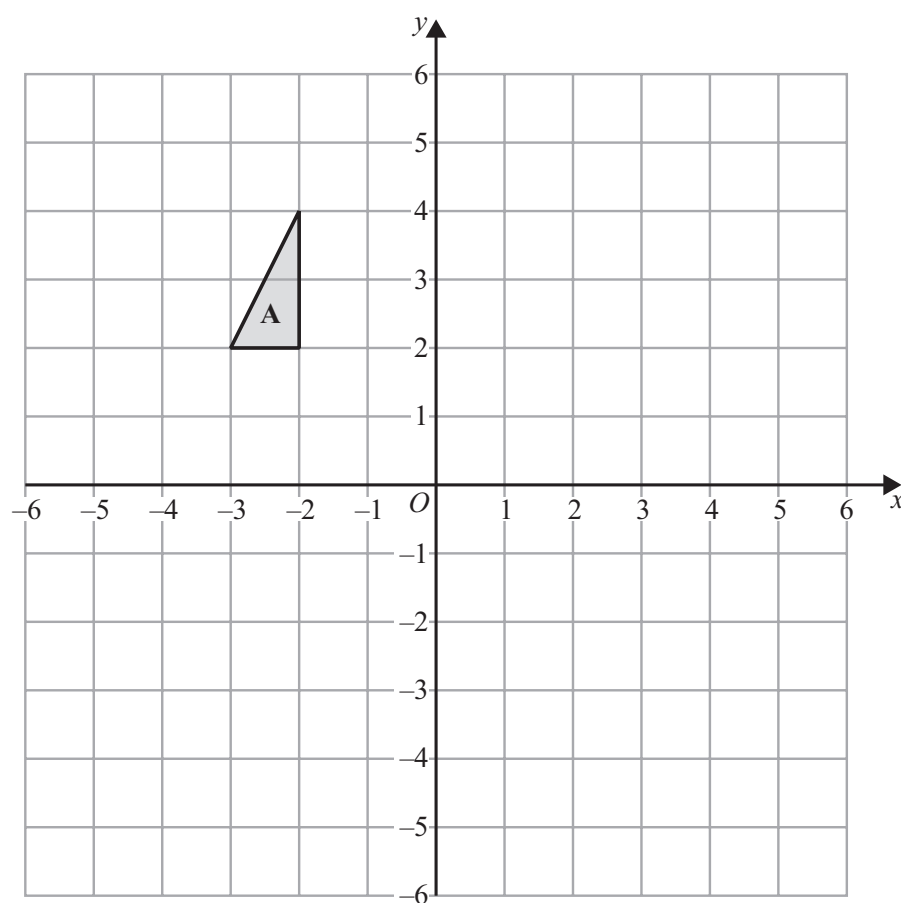
$$\begin{pmatrix} \\ \\ \end{pmatrix}$$

(1)

(Total for Question 18 is 3 marks)



11



Triangle **A** is translated by the vector $\begin{pmatrix} 6 \\ -4 \end{pmatrix}$ to give triangle **B**.

Triangle **B** is rotated 90° clockwise about the point $(1, 2)$ to give triangle **C**.

Describe fully the single transformation that maps triangle **A** onto triangle **C**.

.....

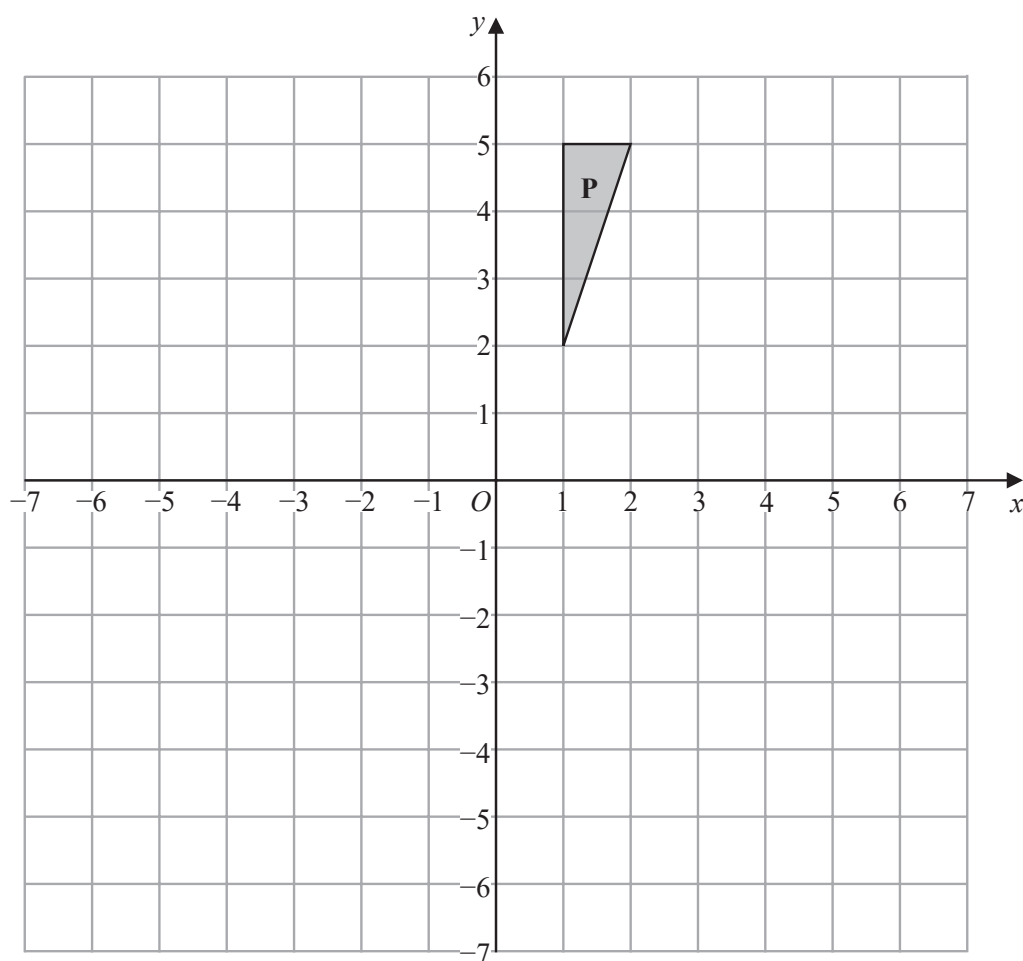
.....

.....

(Total for Question 11 is 3 marks)



11 The diagram shows a triangle **P** on a grid.



Triangle **P** is rotated 180° about $(0, 0)$ to give triangle **Q**.

Triangle **Q** is translated by $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ to give triangle **R**.

(a) Describe fully the single transformation that maps triangle **P** onto triangle **R**.

.....

.....

(3)

Under the transformation that maps triangle **P** onto triangle **R**, the point **A** is invariant.

(b) Write down the coordinates of point **A**.

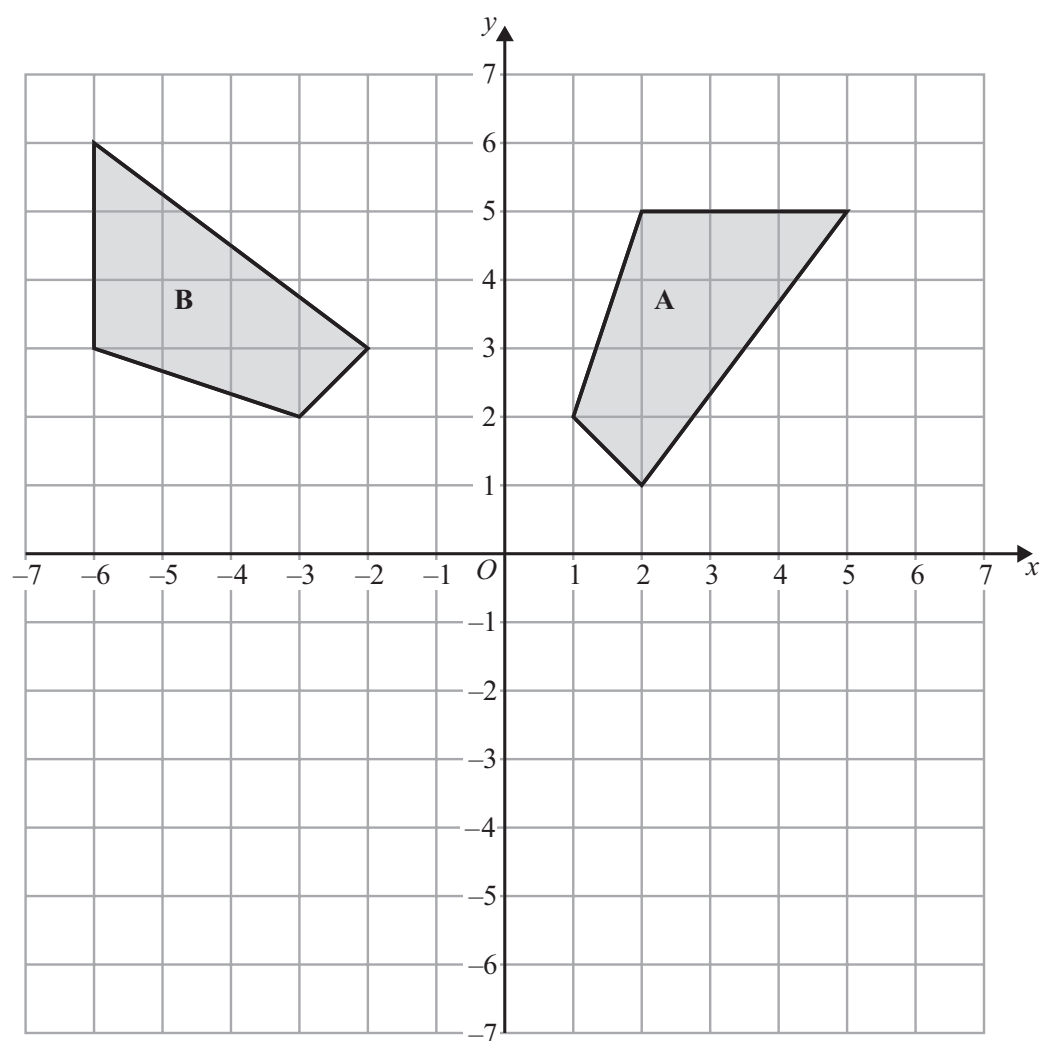
(....., ...)

(1)

(Total for Question 11 is 4 marks)



9



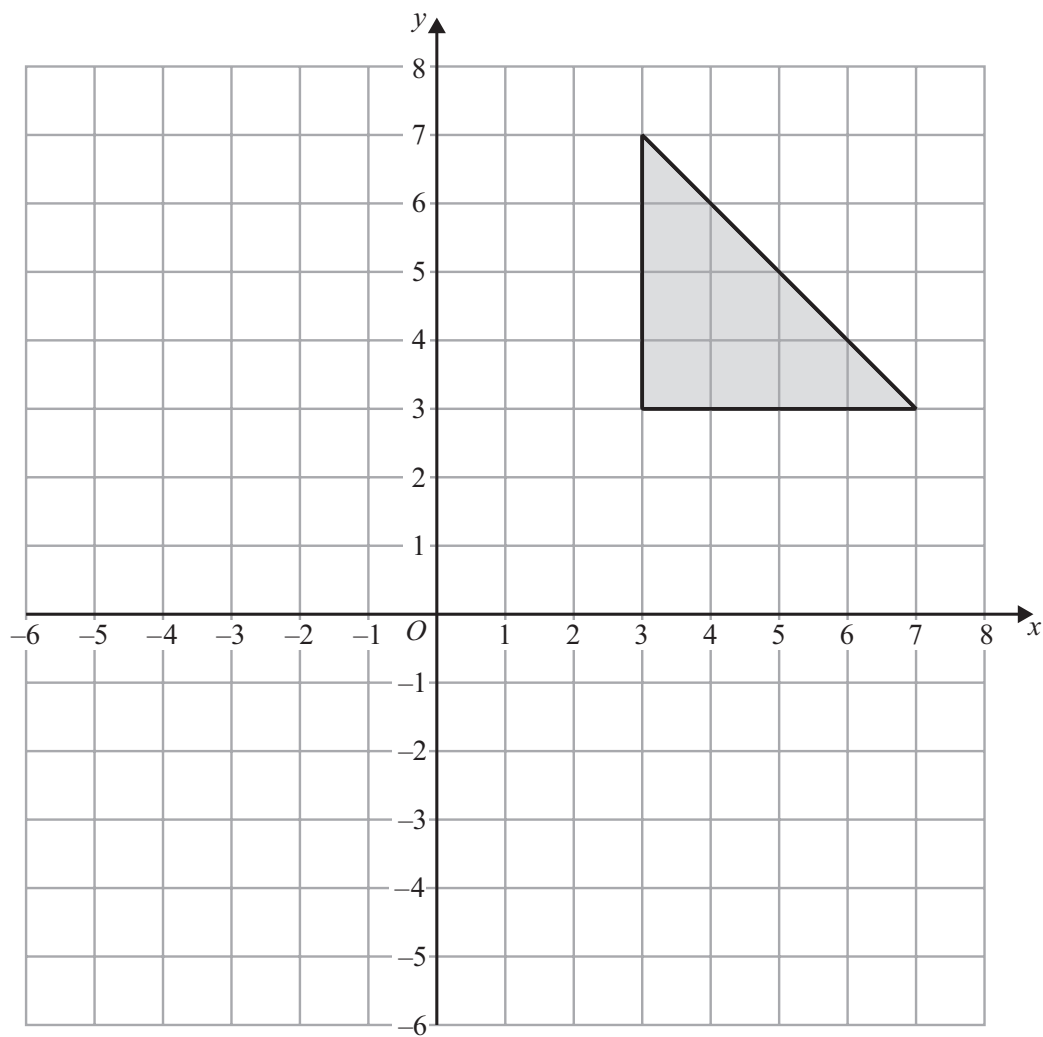
(a) Describe fully the single transformation that maps shape A onto shape B.

.....

.....

.....

(2)



(b) Enlarge the triangle by scale factor $\frac{1}{2}$ centre $(-1, -3)$

(2)

(Total for Question 9 is 4 marks)

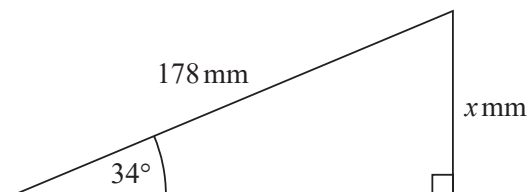
SUB-TOPIC G3b

VECTORS

Sub-topic G3b · 19 questions · 78 marks · lowest tariff first



5



Work out the value of x .
Give your answer correct to 1 decimal place.

(Total for Question 5 is 2 marks)

6 $\mathbf{a} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$

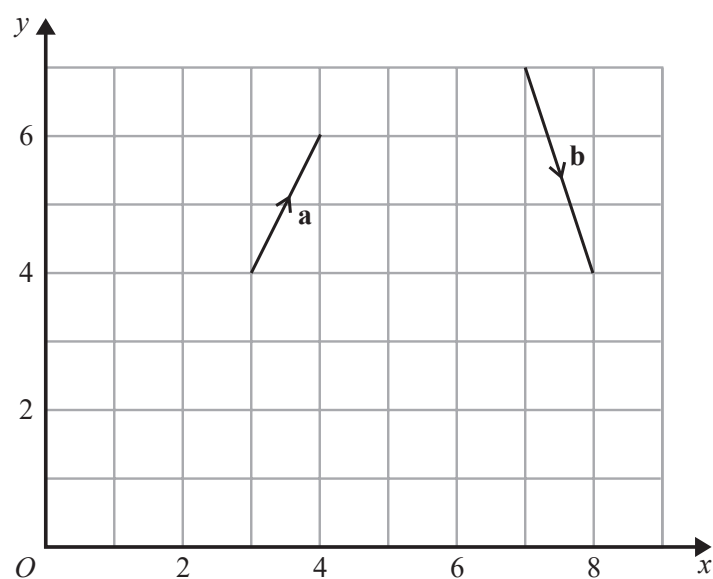
Find $2\mathbf{a} - 3\mathbf{b}$ as a column vector.

$$\begin{pmatrix} \\ \\ \end{pmatrix}$$

(Total for Question 6 is 2 marks)



10 The vector **a** and the vector **b** are shown on the grid.



(a) On the grid, draw and label vector $-2\mathbf{a}$

(1)

(b) Work out $\mathbf{a} + 2\mathbf{b}$ as a column vector.

$\begin{pmatrix} \\ \text{---} \\ \end{pmatrix}$
(2)

(Total for Question 10 is 3 marks)



13 **a** and **b** are vectors such that

$$\mathbf{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} \quad \text{and} \quad 3\mathbf{a} - 2\mathbf{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$$

Find **b** as a column vector.

$$\begin{pmatrix} \dots \\ \dots \end{pmatrix}$$

(Total for Question 13 is 3 marks)



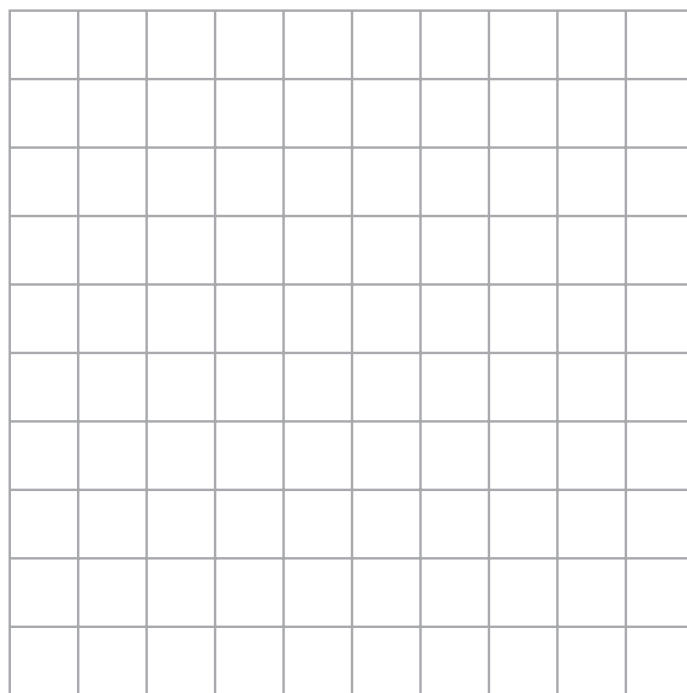
- 22 Given that the vector $a\begin{pmatrix} 2 \\ 6 \end{pmatrix} + b\begin{pmatrix} 8 \\ 2 \end{pmatrix}$ is parallel to the vector $\begin{pmatrix} 13 \\ 6 \end{pmatrix}$
find an expression for b in terms of a .

(Total for Question 22 is 3 marks)



8 $\mathbf{a} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$

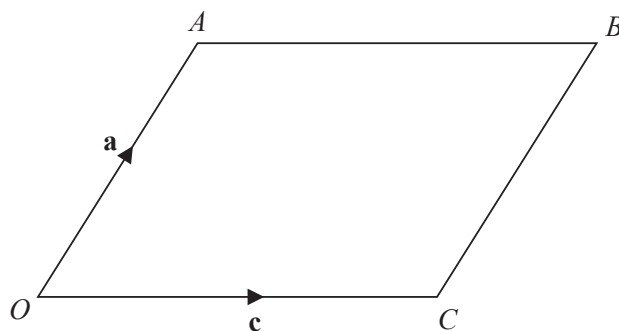
On the grid below, draw and label the vector $2\mathbf{a} + \mathbf{b}$



(Total for Question 8 is 3 marks)



19



$OABC$ is a parallelogram.

$$\vec{OA} = \mathbf{a} \text{ and } \vec{OC} = \mathbf{c}$$

X is the midpoint of the line AC .

OCD is a straight line so that $OC : CD = k : 1$

$$\text{Given that } \vec{XD} = 3\mathbf{c} - \frac{1}{2}\mathbf{a}$$

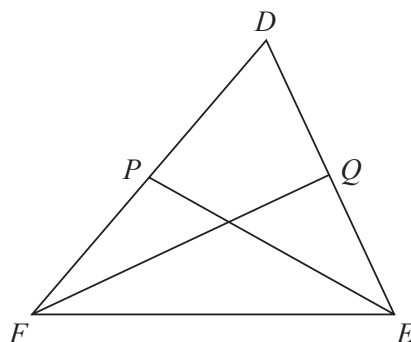
find the value of k .

$$k = \dots\dots\dots$$

(Total for Question 19 is 4 marks)



21 DEF is a triangle.



P is the midpoint of FD .

Q is the midpoint of DE .

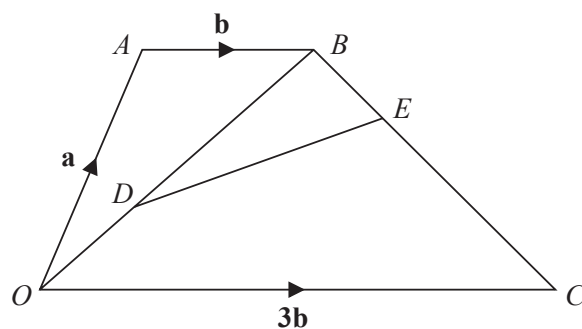
$$\overrightarrow{FD} = \mathbf{a} \quad \text{and} \quad \overrightarrow{FE} = \mathbf{b}$$

Use a vector method to prove that PQ is parallel to FE .

(Total for Question 21 is 4 marks)



18 $OABC$ is a trapezium.



$$\begin{aligned}\vec{OA} &= \mathbf{a} \\ \vec{AB} &= \mathbf{b} \\ \vec{OC} &= 3\mathbf{b}\end{aligned}$$

D is the point on OB such that $OD:DB = 2:3$

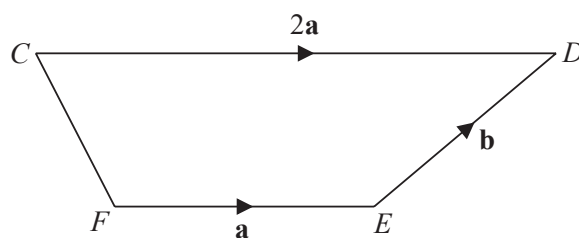
E is the point on BC such that $BE:EC = 1:4$

Work out the vector $\vec{DE}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

(Total for Question 18 is 4 marks)



24 $CDEF$ is a quadrilateral.



$$\vec{FE} = \mathbf{a} \quad \vec{ED} = \mathbf{b} \quad \vec{CD} = 2\mathbf{a}$$

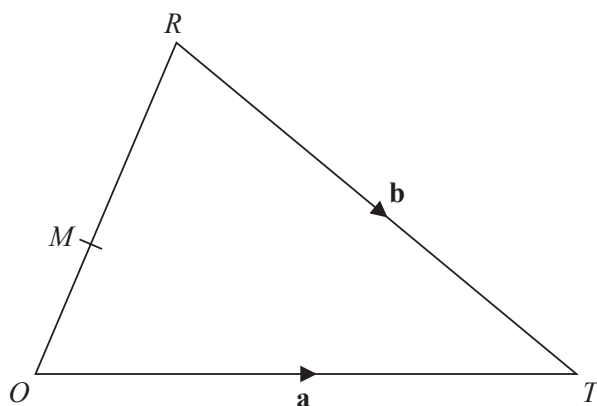
The point P is such that CEP is a straight line and that $CE = EP$

Use a vector method to prove that CF is parallel to DP .

(Total for Question 24 is 4 marks)



20 ORT is a triangle.



$$\vec{OT} = \mathbf{a} \quad \vec{RT} = \mathbf{b}$$

M is the point on OR such that $OM:MR = 2:3$

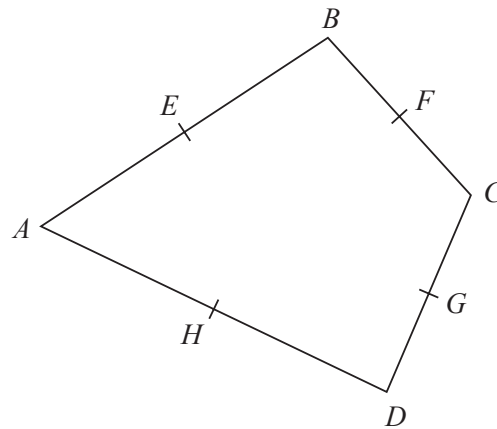
Express $\vec{MT}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Give your answer in its simplest form.

(Total for Question 20 is 4 marks)



18



$ABCD$ is a quadrilateral.

E , F , G and H are the midpoints of AB , BC , CD and DA .

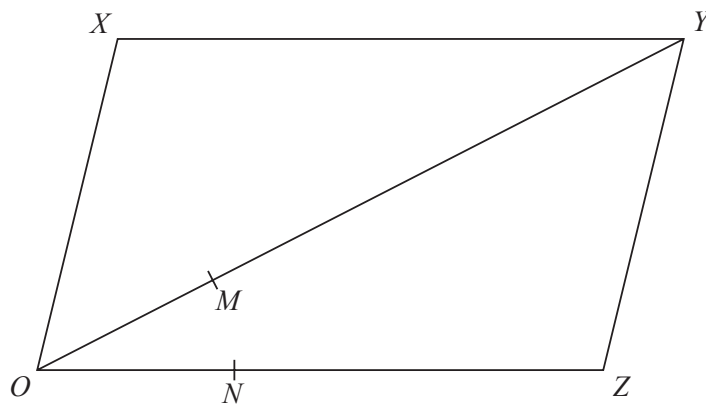
$$\vec{AH} = \mathbf{a} \quad \vec{AE} = \mathbf{b} \quad \vec{DG} = \mathbf{c}$$

Prove, using vectors, that $EFGH$ is a parallelogram.

(Total for Question 18 is 4 marks)



15 $OXYZ$ is a parallelogram.



$\vec{OY} = \mathbf{a}$ and $\vec{OZ} = \mathbf{b}$

M is the point on OY such that $OM:MY = 1:3$

N is the point on OZ such that $ON:NZ = 1:2$

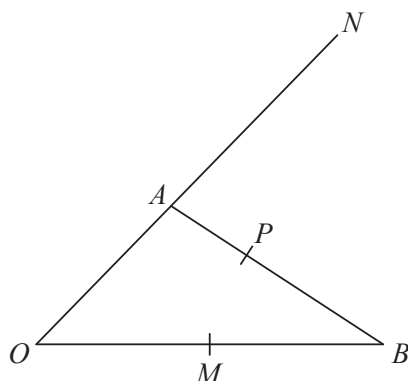
Work out the ratio $XN:MN$

You must show all your working.

(Total for Question 15 is 4 marks)



21



OAN , OMB and APB are straight lines.

$AN = 2OA$.

M is the midpoint of OB .

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = \mathbf{b}$$

$$\vec{AP} = k\vec{AB} \text{ where } k \text{ is a scalar quantity.}$$

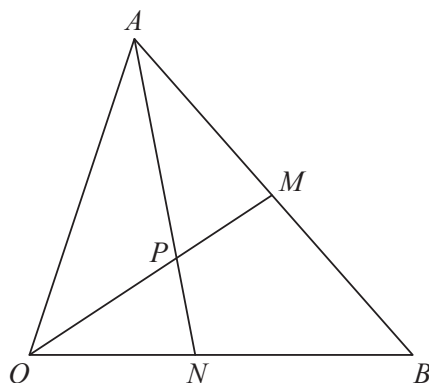
Given that MPN is a straight line, find the value of k .

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



21



OAB is a triangle.

OPM and APN are straight lines.

M is the midpoint of AB .

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = \mathbf{b}$$

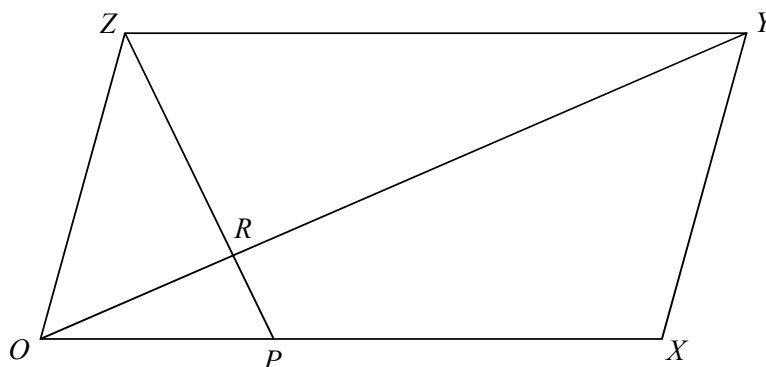
$$OP:PM = 3:2$$

Work out the ratio $ON:NB$

(Total for Question 21 is 5 marks)



24 $OXYZ$ is a parallelogram.



$$\vec{OX} = \mathbf{a}$$

$$\vec{OY} = \mathbf{b}$$

P is the point on OX such that $OP:PX = 1:2$

R is the point on OY such that $OR:RY = 1:3$

Work out, in its simplest form, the ratio $ZP:ZR$

You must show all your working.

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



15 A , B and C are three points such that

$$\overrightarrow{AB} = 3\mathbf{a} + 4\mathbf{b}$$

$$\overrightarrow{AC} = 15\mathbf{a} + 20\mathbf{b}$$

(a) Prove that A , B and C lie on a straight line.

(2)

D , E and F are three points on a straight line such that

$$\overrightarrow{DE} = 3\mathbf{e} + 6\mathbf{f}$$

$$\overrightarrow{EF} = -10.5\mathbf{e} - 21\mathbf{f}$$

(b) Find the ratio

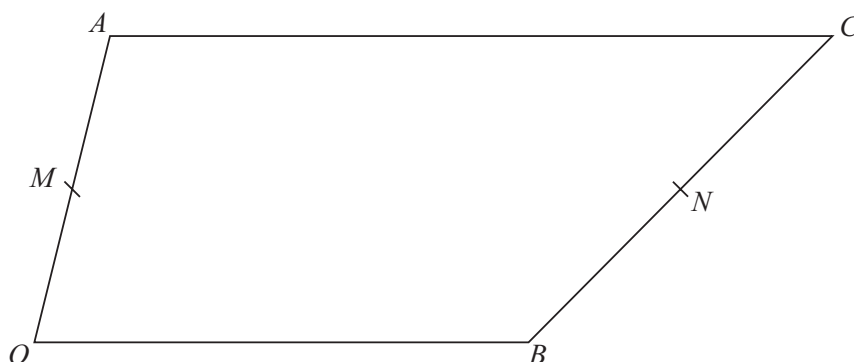
length of DF : length of DE

(3)

(Total for Question 15 is 5 marks)



19 The diagram shows quadrilateral $OACB$.



M is the midpoint of OA .

N is the point on BC such that $BN:NC = 4:5$

$\vec{OA} = \mathbf{a}$ $\vec{OB} = \mathbf{b}$ $\vec{AC} = k\mathbf{b}$ where k is a positive integer.

- (a) Express $\vec{MN}$ in terms of k , $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

(4)

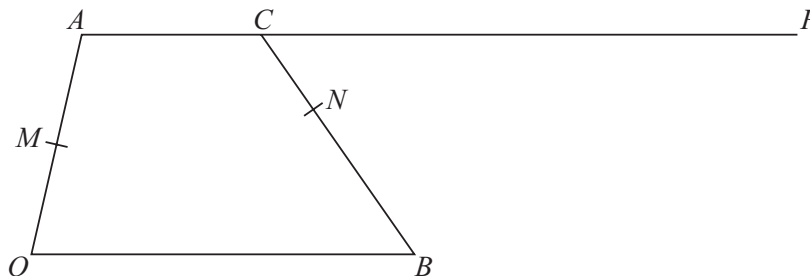
- (b) Is MN parallel to OB ?
Give a reason for your answer.

(1)

(Total for Question 19 is 5 marks)



- 23 $OACB$ is a quadrilateral.
 ACP is a straight line.



M is the midpoint of OA .

N is the point on BC such that $BN:NC = 5:3$

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = 3\mathbf{b} \quad \vec{AC} = 2\mathbf{b}$$

$$\vec{CP} = k \times \vec{AC} \quad \text{where } k \text{ is a scalar.}$$

Given that MNP is a straight line, find the value of k .
 You must show all your working.

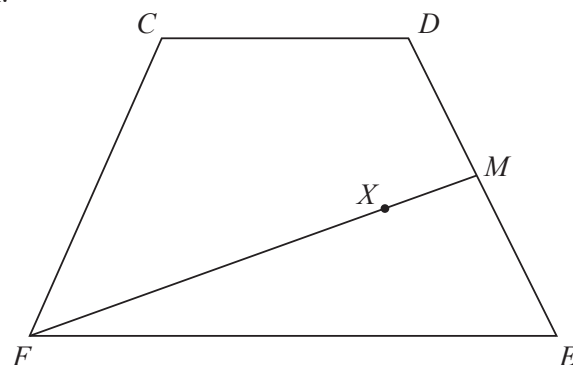
$k = \dots\dots\dots$

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



20 $CDEF$ is a quadrilateral.



$$\vec{CD} = \mathbf{a}, \vec{DE} = \mathbf{b} \text{ and } \vec{FC} = \mathbf{a} - \mathbf{b}.$$

- (a) Express $\vec{FE}$ in terms of $\mathbf{a}$ and/or $\mathbf{b}$.
Give your answer in its simplest form.

.....
(2)

M is the midpoint of DE .

X is the point on FM such that $FX:XM = n:1$

CXE is a straight line.

- (b) Work out the value of n .

$n =$
(4)

(Total for Question 20 is 6 marks)

TOTAL FOR PAPER IS 80 MARKS



MARK SCHEMES

official mark schemes, in the same order as the questions



Paper: 1MA1/1H				
Question	Working	Answer	Mark	Notes
18		Correct enlargement	B2 (B1)	Correct enlargement $(-1,-1.5)$, $(-1,-3.5)$ $(-2,-1.5)$ correct size, correct orientation in incorrect position or 2 out of 3 vertices correctly placed
19		$y = 2x + 36$	P1 P1 P1 A1	starts process, eg by rearranging to find gradient, eg $y = 6 - \frac{x}{2}$ or $\frac{-1}{2}$ or positions of B and E complete process to find position of A or uses $\frac{-1}{m}$ to find the gradient of M complete process to find equation of M $y = 2x + 36$ oe
20		$1+\sqrt{2}$	B1 P1 P1 A1	for a value for a known trigonometric ratio stated for process to form 2 equations in a and b or one correct value stated for complete process to solve to reach $a = 2$ and $b = 1$ for $1+\sqrt{2}$ oe



Paper: 1MA1/2H				
Question	Working	Answer	Mark	Notes
3 (a)		31.4	P1	for working with circumference formula, eg $\pi \times 80$ (=251. ...) oe
			A1	for answer in the range 31.4 to 31.5 accept 10π
			C1	Mean distance stays the same with reason, eg total distance remains unchanged or same number of points
4		$\frac{1}{11}$	P1	for starting the process, eg by writing down a correct ratio or using a given number of cubes for one relationship, eg 2B 1Y or B:Y = 2:1 or 4G 1B or G:B = 4:1 or 8G, 1Y or G:Y = 8:1 oe or yellow = 2, blue = 4, or states 2:1:8 oe in any order (can be algebraic)
			P1	for complete process to find possible number of each colour or equivalent ratio, eg 8G 2B 1Y or G:B:Y = 8:2:1 oe or yellow = 2, blue = 4, green = 16 oe (can be algebraic)
			A1	$\frac{1}{11}$ oe
5 (a)		(-2, 1) (-4, 1) (-2, 2) (-5, 2)	B1	Shape labelled A
			B1	Shape labelled B
(b)		(1, -4) (3, -4) (1, -5) (4, -5)		



Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
6	(22, 20)	P1	for process to find width or height of diagram eg $38 - 6 (= 32)$ or $36 - 7 (= 29)$	Figures may be shown on the diagram If $(6 + 38) \div 2$ leads to an answer other than 22, award P2 only Award for P3 for (22, y) or (x, 20) or $x = 22$ or $y = 20$
		P1	for process to find length of side of square eg $"32" \div 4 (= 8)$ or process to find half width of diagram eg $"32" \div 2 (= 16)$	
		P1	for process to find x coordinate eg $6 + 2 \times "8" (= 22)$ or $6 + "16" (= 22)$ or $(6 + 38) \div 2 (= 22)$	
		P1	for process to find y coordinate eg $36 - 2 \times "8" (= 20)$ or $36 - "16" (= 20)$ or $7 + "8" + "29" - 3 \times "8" (= 20)$	
		A1	cao SC: award 4 marks for (20, 22)	
7	rotation 180° about $(-1, -2)$ or enlargement sf -1 centre $(-1, -2)$	B2	rotation 180° about $(-1, -2)$ or enlargement sf -1 centre $(-1, -2)$	Condone missing brackets but do not accept centre written as a vector Do not accept 'half turn' for 'rotation 180° ' Ignore references to clockwise and anticlockwise Triangles at $(-3, 1)$, $(-5, 1)$, $(-4, 3)$ and $(-3, -5)$, $(-5, -5)$, $(-4, -7)$
		(B1	rotation 180° or rotation about $(-1, -2)$ OR enlargement sf -1 or enlargement centre $(-1, -2)$ Award no marks for the description if more than one transformation is given SC B1 for fully correct diagram if B0 scored	



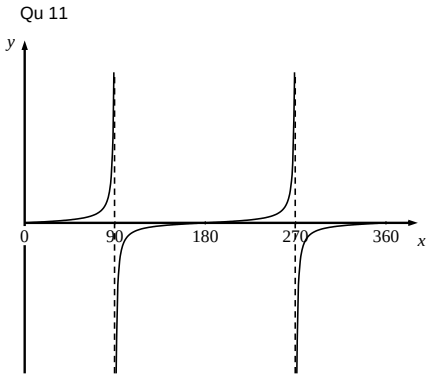
Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
6	No (supported)	P1	For a process to calculate the initial or new pressure, eg $(70 + 10) \div (20 + 10)$ (=2.6 to 2.7) or $80 \div 30$ (=2.6 to 2.7) or $70 \div 20$ (=3.5)	Accept any value in the range 2.6 to 2.7 if unsupported by working
		P1	For a complete process to make a comparison eg. $0.8 \times "3.5"$ (=2.8) OR $\frac{"3.5" - "2.6"}{"3.5"} \times 100$ (=22 to 26) OR $"3.5" \times 0.2$ (=0.7) and $80 \div 30$ (=2.6 to 2.7) OR $\frac{"2.6"}{"3.5"} (\times 100)$ (=0.74 to 0.78 or 74 to 78)	
		A1	for a correct conclusion supported by accurate figures eg 2.8 and 2.6(6...) OR decrease is 24% (or 22% to 26%) OR 0.7 and 2.6 to 2.7 and 3.5 OR 0.7 and 0.9 OR 0.76 (or 0.74 to 0.78) OR 76% (or 74% to 78%)	
7	Enlargement	B2	for correct enlargement at (1,2) (2,3) (2,4) (1,4)	
		(B1	for correct size and orientation in the wrong position OR 3 of 4 vertices correct and joined OR 4 correct vertices not joined)	



Paper: IMA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
11	20	P1 P1 A1	for start of process, eg $\frac{125}{100}$ oe or $\frac{100}{125}$ oe or $\frac{25}{125}$ for a suitable process to develop a percentage, either 80% or 20% eg. $\frac{100}{125} = \frac{x}{100}$ or $\frac{125-100}{125} = \frac{x}{100}$ or $\frac{p}{1.25m} = \frac{xp}{m}$ or $\frac{0.25p}{1.25m} = \frac{xp}{m}$ cao	Values of amount of cereal and cost may be used, eg. 100g of cereal costing £10 An acceptable start of a process would then be: 125g of cereal costing £10 using Jack's idea
12	21	C1 C1 C1	for angle $OAB = 90 - 56 (= 34)$ for process to find angle $CAD (= 69)$ or angle $BCA (= 56)$ or angle $COA (= 138)$, eg use of alternate segment theorem or angle at centre is twice the angle at the circumference cao	Throughout, angles may be written on the diagram; accept as evidence if correct. Ignore absence of degree sign Reasons need not be given.
13	enlargement scale factor $-\frac{1}{3}$ centre (2, 2)	C2 (C1)	for all of: enlargement, (scale factor $= -\frac{1}{3}$ oe, (centre $=$) (2, 2)) for two of: enlargement, (scale factor $= -\frac{1}{3}$ oe, (centre $=$) (2, 2)) Note: award no marks if more than one transformation is given	



Paper: 1MA1/3H			
Question	Answer	Mark	Mark scheme
19	$x = -\frac{23}{7}, y = \frac{15}{7}$ $x = 3, y = -1$	M1 M1 A1 M1 A1	for substitution of a rearrangement eg for $2(1-2y)^2 - y^2 = 17$ or $2x^2 - \left(\frac{1-x}{2}\right)^2 = 17$ or expansion of $(1-2y)^2 = 1 - 4y + 4y^2$ or $\left(\frac{1-x}{2}\right)^2 = \frac{1-2x+x^2}{4}$ for expansion of bracket and substitution eg $2(1-4y+4y^2) - y^2 (= 17)$ or $8x^2 - (1-2x+x^2) (= 68)$ for forming quadratic ready for solving eg $7y^2 - 8y - 15 (= 0)$ or $7x^2 + 2x - 69 (= 0)$ ft a 3 term quadratic, factorising eg $(7y-15)(y+1) (= 0)$ or $(7x+23)(x-3) (= 0)$ or correct use of formula eg $\frac{8 \pm \sqrt{64+420}}{14}$ or $\frac{-2 \pm \sqrt{4+1932}}{14}$ or completing the square $x = -\frac{23}{7}$ oe, $y = \frac{15}{7}$ oe and $x = 3, y = -1$
			Can be implied by both x values correct or both y values correct. Answers must be correctly paired. (Maybe in the body of the working) Accept for x between -3.29 and -3.28 and for y between 2.14 and 2.15 Answers only award 0 marks
20	(-3.5, 1)	M1 A1	for a complete method to show the transformations cao
			Image at (-4,1), (-3,1) and (-3.5, -2)



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
24	Description	C2 (C1)	for (rotation) 90° clockwise about (−1, 0) or (rotation) 90° anticlockwise about (−1, 6) or (rotation) 180° about (−1, 2) or (rotation) 180° about (−1, 4) for (−1, 0) or (−1, 6) or (−1, 2) or (−1, 4))	Award 0 marks if there is reference to other transformations eg coordinates given as vectors (which is a translation)
25	9.75	P1 P1 B1 P1 A1	process to find the gradient of L $\left(= -\frac{3}{2} \right)$ process to find the gradient of the perpendicular line M eg use of $-\frac{1}{m}$ or states gradient as $\frac{2}{3}$ or $y = \frac{2}{3}x + c$ (indep) gives y coordinate of B = 8.5 oe (dep P2) process to find x coordinate of C (= 3) or y coordinate of C (= 4) eg the first stage of solving equations or using elimination by substitution, to find a coordinate of C . 9.75 oe	Could be indicated other ways, eg 8.5 on the y axis of a diagram fit their linear equation for M with L ; allow some error in manipulation of these linear equations as long as the overall process is correct. Award 0 marks for a correct answer with no supportive working.



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
8	45	P1	for $180 - 117 (=63)$ or states, or uses, exterior angle $+ x = 117$	Angles may be shown on the diagram.
		P1	for process to find the exterior or the interior angle of the pentagon, eg $360 \div 5 (=72)$ or $180 - (360 \div 5) (=108)$ or $((5-2) \times 180) \div 5$ $(=108)$	Any angle labelled correctly as 63 and not contradicted scores this mark
		P1	for a complete process to find x , eg $180 - "72" - "63"$ or $"108" - "63"$ or $117 - "72"$	Exterior = 108 or interior = 72 does not score the mark
		A1	cao	An answer of 45 with no supporting working scores 0
9	Enlargement	B2	vertices at (2.5, 1) (2.5, 6) (5, 6)	
		(B1	for triangle of the correct size and orientation in the wrong position or a correct enlargement of a different scale factor centre (0, 1) or correct orientation with 2 of 3 vertices correct)	
10	(a)	M1	for multiplying both sides by 7 as a first step eg $9 + x = 7(11 - x)$ or dividing each term on the left hand side by 7 eg $\frac{9}{7} + \frac{x}{7} = 11 - x$	$\times 7$ written near the equation is not enough for this mark
		M1	(dep M1) for method to isolate the x terms on one side	
		A1	oe	
	(b)	B1	$4(y + 3)$ or $4y + 12$	

Paper: 1MA1/2H					
Question	Answer	Mark	Mark scheme		Additional guidance
13	15.4	M1 M1 A1	for $\frac{AB}{\sin 34} = \frac{23.8}{\sin "120"}$ or $\frac{\sin 34}{AB} = \frac{\sin "120"}{23.8}$ for $(AB) = \frac{23.8}{\sin "120"} \times \sin 34$ for answer in range 15.36 to 15.4		“120” comes from $180 - 26 - 34$ If an answer in the range 15.36 to 15.4 is given in the working space then incorrectly rounded, award full marks
14	116	P1 P1 A1 B1	for setting up an equation, eg $(x + 4)^2 = x^2 + 70$ for process to reduce equation down to a linear equation ready to solve eg $8x = 54$ oe for 6.75 oe ft (dep P2) for finding the area of B or for answer in range 115 to 116	for setting up an equation, eg $x^2 - (x - 4)^2 = 70$ for process to reduce equation down to a linear equation ready to solve eg $8x = 86$ oe for 10.75 oe	Equation must be in a single variable. If a candidate uses a trial and improvement method, it is either full marks or no marks. Candidates must get as far as $ax = b$
15	Enlargement sf –1.5 centre (1, 1)	B2 (B1)	for enlargement scale factor –1.5 and centre (1, 1) for enlargement scale factor –1.5 or enlargement centre (1, 1)		Award no marks if more than one transformation is given



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
1 (a)	x^{15}	B1	cao	Where $a \geq 1$ and $b \geq 1$
		M1	for method to expand one bracket, or collect like terms eg $4 \times x + 4 \times 3 (= 4x + 12)$ or $7 \times 4 - 7 \times 2x (= 28 - 14x)$ or $4 \times x - 7 \times 2x (= 4x - 14x)$ and $4 \times 3 + 7 \times 4 (= 12 + 28)$	
		A1	oe	
		M1	for $3(5x^3 + x^2y)$ or $x(15x^2 + 3xy)$ or $3x(5x^2 + xy)$ or $x^2(15x + 3y)$ or $3x^2(ax + by)$	
		A1	cao	
2	translation $\begin{pmatrix} -5 \\ 6 \end{pmatrix}$	B1	for translation	Award no marks if more than one transformation is given
		B1	for vector $\begin{pmatrix} -5 \\ 6 \end{pmatrix}$	Do not accept as a coordinate $(-5, 6)$
3	89.5 and 90.5	B1	for 89.5 in the correct position	Accept 90.49 or 90.499(...)
		B1	for 90.5 in the correct position	



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
11	Shown	M1	for $6 \times 14.5 (= 87)$ or $13 \times 7 (= 91)$ or $13 \div 6 (= 2.16(666\dots))$	May work in hours or other units of time
		M1	for “87” $\div 7 (= 12.428\dots)$ or “87” $\div 13 (= 6.692\dots)$ or $6 \times 14.5 (= 87)$ and $13 \times 7 (= 91)$ or $14.5 \div “2.16” (= 6.692\dots)$	Accept figure rounded or truncated to 1dp
		C1	(dep M2) for 12.(428...) (workers) or 6.69(2...) (days) or 87 and 91	Figures must be correct and supported by working. Accept value in range 6.69 to 6.72 for number of days
12	comparison shown	M1	for starting to manipulate equation, eg $5y = 10x + 15$ or $5y = 10x - 4$ or $y - 2x + \frac{4}{5} = 0$ or $y - 2x = 3$	Ignore constant terms for both marks
		A1	for statement and equation(s) which can be used to show that the gradients of the two lines are the same, eg $5y = 10x + 15$ and $5y = 10x - 4$ and both have the same x coefficient OR $y = 2x - \frac{4}{5}$ and both have a gradient of 2	
13	enlargement	B2	for correct enlargement at (4, 8) (6, 4) (10, 4) (12, 8)	
		(B1	for correct size and orientation in the wrong position OR 3 of 4 vertices correct)	



Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
10 (a)	$\frac{1}{16}$	M1	for method to find probability of getting a score of 5, eg $\frac{10}{6+8+9+7+10} (= \frac{10}{40})$ oe	Accept any equivalent fraction, decimal form 0.06(25) or 0.063, percentage form 6(.25)% or 6.3% Ignore subsequent incorrect attempts to write the correct answer in a different form.
		A1	for $\frac{1}{16}$ oe	
	15	M1	for method to find the proportion of 1s, eg $\frac{6}{40}$ oe	
		A1	cao	
11	Enlargement scale factor $\frac{1}{3}$ centre (0, 2)	B2 (B1)	for enlargement scale factor $\frac{1}{3}$ centre (0, 2) for any 2 aspects)	No marks if more than one transformation is given
12	$x = 3, y = -2$	M1 A1 M1 A1	for a correct method to eliminate either variable or rearrangement of one equation leading to substitution (condone one arithmetic error) for either correct value of x or correct value of y (dep M1) for a correct substitution of found value into one of the equations or a correct method leading to the second value (condone one arithmetic error) $x = 3, y = -2$	Trial and improvement methods score 0 marks unless both x and y are correct



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
18	Description	C1 C1	for translation for $\begin{pmatrix} 8 \\ 0 \end{pmatrix}$	Award no marks if more than one transformation May be described as, for example “by 8 units in the direction of the x axis”
19	16	P1 P1 A1	for $\text{Prob}(\text{R or G}) = 1 - 0.4 (= 0.6)$ or for (number of red or green counters) = $50 - 0.4 \times 50 (= 30)$ or for use of ratio, eg $[\text{probability}] \times \frac{8}{15} (= 0.32)$ or $[\text{number of counters}] \times \frac{8}{15}$ for a complete process to find number of green counters, eg $(1 - 0.4) \times \frac{8}{15} \times 50$ or for $\frac{16}{50}$ cao	 [probability] may be 0.4 or 0.6 [number of counters] may be 20 or 50
20	Proof	C1 C1 C1	for angle $EAC = \text{angle } EDB$ (Base angles of an <u>isosceles triangle</u> are equal) or for explanation that $AB + BC = BC + CD$ using ratio so $AC = DB$ oe or $AE = DE$ (given) for at least 2 correct pairings with reasons for a complete proof including all reasons given and SAS	Reasons must be linked to their method.



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
15 (a)	$(a - b)(a + b)$	B1	for $(a - b)(a + b)$ oe	
(b)	Relationship shown	M1 C1	for factorising the expression, eg $(2^{20} - 1)(2^{20} + 1)$ or for $(2^{40} \div (2^{20})^2)$ for explanation, eg 2^{20} is even so $2^{20} - 1$ and $2^{20} + 1$ are odd (leading to conclusion)	Note that 1048575 and 1048577 earns 2 marks as an alternative approach
16	Triangle at (6, -2) (4, 4) (8, 4)	M1 A1	for the correct shape in the correct orientation in the wrong position or for two correct points cao	
17 (a)	16.5 to 19.5	M1 M1 A1	for tangent drawn at $t = 2.5$ dep (M1) for a complete method to find the gradient from tangent eg $(48 - 0) \div (4 - 1.4) (= 18.4...)$ for answer in the range 16.5 to 19.5 or ft acceptable tangent	The tangent must be seen to award any marks Award 0 marks for a correct answer (in the range) with no (or incorrect) supportive working
(b)	Description	C1	eg speed or velocity	“speed” may be expressed in a different way, eg distance per unit time (at that point) Award if extra information is given provided not contradictory.



Paper: 1MA1/3H																	
Question	Answer	Mark	Mark scheme	Additional guidance													
11 (a)	Box plot drawn	M1	for method to find UQ (47) or greatest value (62) from the table	May be implied by one of these values being correctly plotted. Box can be any height. Accept ends that are marked (eg line, cross, dot) or defined by the end of the whiskers if clear													
		M1	for showing a box and at least 3 correctly plotted values from 25, 35, 40, 47, 62														
		A1	for a fully correct box plot														
	(b)	Comparison	C1	ft a correct comparison of medians from figures, eg the median speed for Sunday was greater than the median speed for Friday or the speed on Friday is generally lower as the median is lower	Simply quoting values is insufficient, they must be compared. <table><tr><td></td><td>Median</td><td>Range</td><td>IQR</td></tr><tr><td>Friday</td><td>40</td><td>37</td><td>12</td></tr><tr><td>Sunday</td><td>42</td><td>44</td><td>15</td></tr></table> Figures need not be stated but if they are they must be correct. For 2 marks, at least one comparison must be in context (eg refers to speed or mph)		Median	Range	IQR	Friday	40	37	12	Sunday	42	44	15
				Median		Range	IQR										
			Friday	40		37	12										
Sunday	42	44	15														
C1	ft for a correct comparison of spread, eg the (interquartile) range of the speeds for Friday is smaller than the (interquartile) range of the speeds for Sunday, the (interquartile) range on Sunday is larger than the (interquartile) range on Friday Comparisons for this mark can relate to the range or the IQR																
12	Correct enlargement	B2	for correct enlargement $(-2, -4)$, $(-2, -6)$, $(-6, -4)$	Award for clear intention, shading not needed.													
		(B1	for correct size and orientation but incorrect position or 2 out of 3 vertices correctly placed)														



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
11	enlargement scale factor $\frac{2}{3}$ centre $(-4, -2)$	C2 (C1)	for enlargement, scale factor $\frac{2}{3}$ oe , centre $(-4, -2)$ for 2 of the 3 aspects)	Award no marks if more than one transformation is given
12	5.9	P1 P1 P1 P1 A1	for a process to find the volume of the cylinder, eg $\pi \times 3^2 \times 8 (= 226.19...)$ for process to find mass of cylinder, eg " $226.19 \times 7.86 (= 1777.89...)$ " or $[\text{volume}_1] \times 7.86$ for process to find volume of cube, eg " $1777.89 \div 8.5 (= 209.16...)$ " or $[\text{mass}] \div 8.5$ for process to find side length, eg $\sqrt[3]{209.16...}$ or $\sqrt[3]{[\text{volume}_2]}$ for answer in range 5.9 to 5.94	Can be implied by 72π [volume ₁] must be unambiguously the volume of the cylinder but cannot be 3 or 8 [mass] must be unambiguously the mass of the cylinder [volume ₂] must be unambiguously the volume of the cube



Paper: 1MA1/2H				
Question	Working	Answer	Mark	Notes
6		Secure Bank (supported)	P1 P1 C1	for a process to work out the interest after one year e.g. $0.02 \times 25000 (=500)$ or $0.043 \times 25000 (=1075)$ or for 1.02 or 25500 or 1.043 or 26075 for process to find value of the investment after 3 years or the multiplicative factor for 3 years at one of the banks, e.g. $25000 \times 1.02 \times 1.02 \times 1.02$ oe ($= 26530\dots$) or $1.02^3 (= 1.0612\dots)$ or $25000 \times 1.043 \times 1.009 \times 1.009$ oe ($= 26546\dots$) or $1.043 \times 1.009 \times 1.009 (= 1.0618\dots)$ [accept total interest of 1530.. or 1546.. if final values of investment are not found] for Secure Bank from correct figures, eg. 26530.. and 26546.. or 1530... and 1546... or 1.0612... and 1.0618...
7		$4.755 \leq n < 4.765$	B2 [B1]	for $4.755 \leq n < 4.765$ for 4.755 or 4.765 or 4.7649]
8		12	M1 A1	for evidence of taking a reading from the graph from $h = 160$ for answer in the range 11.8 to 12.2
9		No (supported)	M2 [M1 C1 M2 C1]	for the correct position of C or E for a correct position of B or D] for No with correct supporting evidence, eg. showing C and E in the correct positions OR for C is a rotation of 90° anticlockwise about O or E is a rotation of 90° clockwise about O for No with supporting evidence, eg. C is a rotation of 90° anticlockwise about O and E is a rotation of 90° clockwise about O.



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
6	7	P1 P1 A1	process to use gradient eg $y=3x+c$ or $c = -6$ or $\frac{15-9}{d-5}$ or $(15-9) \div 3$ or (6, 12) (dep) full process to rearrange equation formed to isolate d eg rearrangement of $15 = 3d - 6$ or $3 = \frac{15-9}{d-5}$ or for $5 + \frac{15-9}{3}$ cao	Condone use of a letter other than d , for d Must show processes to get as far as $d =$ Award P2 for an answer of (7, 15)
7	(a) 8.623×10^{-5} (b) 7.44×10^6	B1 M1 A1	cao for $\frac{3200+0.051}{0.00043}$ or $\frac{3200.051}{0.00043}$ or performs an operation eg shows 163.2, 7441860.5, 118.6(...) or an answer or $7.44(\dots) \times 10^n$ where $n \neq 6$ or 7441979(...) or an answer of 7.4×10^6 for $7.44(1979\dots) \times 10^6$	7441979.0689... If a correct answer is shown in working and then rounded incorrectly, award full marks. Answer need only be given correctly to 3 sig fig; if following digits are incorrect ignore them.
8	Rotation 90° anticlockwise centre $(-1,1)$	M1 A1 A1	stating rotation or for showing R [(1,1), (1,-3), (3,-3)] for rotation of 90° anticlockwise for centre $(-1, 1)$ given as a coordinate.	Award for a triangle in the correct position without the label R as long as this is the only triangle in lower right quadrant. Accept rotation of 270° clockwise Can be given as a coordinate alone. Do not award A marks if there is evidence of other transformations in the description, or other ambiguity in the answer given.

Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
3	18	M1	for listing factors of 72 and 90, at least 4 correct for each (with no more than 1 incorrect in each list), could be in factor pairs	Factors of 72: 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, 72 Factors of 90: 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90 2, 3 ² is not enough, it must be a product
		A1	OR for the prime factors of 72 (2, 2, 2, 3, 3) or 90 (2, 3, 3, 5)	
			for 18 or 2×3^2 oe SC B1 for answer of 6 or 9 if M0 scored	
4	sketch	M1	for sketch of a cylinder	Hidden edges may or may not be shown
		A1	sketch of cylinder, with dimensions shown	2 (cm) for radius or 4 (cm) for diameter and 5 (cm) for height
5	$c = -6$ $d = -1$	M1	for reflection in x-axis shown on diagram	Vertices (3, -2), (5, -2), (3, -5)
		A1	for $c = -6$ or $d = -1$	One correct value is M1A1 regardless of second value or diagram
		A1	for both $c = -6$ and $d = -1$	
			SCB2 for $c = -1$ and $d = -6$	

If an answer is shown in the range in working and then incorrectly rounded award full marks.



Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
11	Rotation 90° clockwise centre (−4, 1)	M1 A2 (A1)	for triangle B drawn at (4, 0), (4, −2), (3, −2) or for triangle C drawn at (−3, 0), (−3, −1), (−1, −1) or for rotating their B 90° clockwise about (1, 2) for rotation 90° clockwise centre (−4, 1) for any 2 of the 3 aspects)	Award for a triangle in the correct position without the label B or C as long as this is the only triangle in the quadrant. Accept just the vertices marked. Accept 270° (anticlockwise) Do not award A1 for ‘rotation 90° clockwise’ if triangle C is shown not in the correct orientation Do not award A marks if there is evidence of other transformations in the description or other ambiguity in the answer given
12 (i)	H	B1	cao	
(ii)	F	B1	cao	
(iii)	J	B1	cao	



Paper: IMA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
10	(a)	P1	for correct process, eg $10^5 \times 365 \times 81$ or for a correct answer not written in standard form, eg 2956500000 or $2.9(565) \times 10^n$ where $n \neq 9$ or	Values may be rounded. Allow 350, 360, 366, 370, 400 and 80, 100
		A1	for an answer in the range 2.8×10^9 to 4.0×10^9	
	(b)	P1	for correct process, eg $\frac{90}{2 \times 10^{12}}$ or for correct answer not written in standard form, eg 45×10^{-12} or 0.45×10^{-10} or 4.5×10^n where $n \neq -11$	Allow $90 \div 2 \times 10^{12}$
		A1	cao	
11	(a)	M1	for method to find position of Q , eg shape drawn at $(-1, -2)$, $(-1, -5)$ and $(-2, -5)$ or for method to find position of R , eg shape drawn at $(4, -4)$, $(4, -7)$ and $(3, -7)$ or for method to translate their Q correctly	The method mark is awarded if no working is shown but at least 2 of the 3 aspects are correct in the description
		A2	for rotation of 180° about $(2.5, -1)$ or enlargement by scale factor -1 , centre $(2.5, -1)$	
		(A1	for any 2 of the 3 aspects)	
	(b)	B1	for $(2.5, -1)$ ft from rotation or enlargement in (a)	Cannot award A marks for a combination of transformations With no extra incorrect aspects No follow through from a combined transformation in part (a)



Paper: 1MA1/1H					
Question	Answer	Mark	Mark scheme	Additional guidance	
8	(a)	Proof	M1	for identifying angle A as common or for angle $AED = \text{angle } ACB$ or angle $ADE = \text{angle } ABC$ with appropriate reason(s) eg <u>corresponding angles</u> are equal or <u>co-interior angles</u> add up to 180 and <u>angles</u> on a straight <u>line</u> add up to 180	Statement can be implied by identifying a third pair of equal angles (no reason needed)
		C1	for completing the proof by identifying a second pair of equal angles with appropriate reason(s) and a statement that the angles in each triangle are the same		
	(b)	6	P1	for a scale factor of 1.5 or $\frac{2}{3}$ oe or for $\frac{AE}{20} = \frac{18}{30}$ oe	
		P1	for a process to find the length of AE , eg $18 \div 1.5 (= 12)$ oe or $(AE =) \frac{20 \times 18}{30}$ oe or for a complete process to find the length of EC , eg $18 \times (1 - \frac{2}{3})$ oe		
		A1	cao		
9	(a)	Rotation 90° (anticlockwise) about $(-1, 0)$	B2	for rotation 90° (anticlockwise) about $(-1, 0)$	Accept 270° clockwise
		(B1	for any 2 of the 3 aspects)	Award no marks if more than one transformation is given	
	(b)	Enlargement	B2	for correct enlargement with vertices at $(1,0)$, $(3,0)$, $(1,2)$	Award for clear intention, shading not needed
		(B1	for correct size and orientation but incorrect position or 2 out of 3 vertices correctly placed)		



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
5	99.5	M1	for $\sin(34) = \frac{x}{178}$ oe or alternative method to find x	If an answer in the range 99.5 to 99.7 is given in the working space then incorrectly rounded, award full marks
		A1	for answer in range 99.5 to 99.7	
6	$\begin{pmatrix} -9 \\ 14 \end{pmatrix}$	M1	for $2\begin{pmatrix} 3 \\ 4 \end{pmatrix} - 3\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ or $\begin{pmatrix} 6 \\ 8 \end{pmatrix}$ and $\begin{pmatrix} 15 \\ -6 \end{pmatrix}$ or $\begin{pmatrix} -9 \\ y \end{pmatrix}$ or $\begin{pmatrix} x \\ 14 \end{pmatrix}$	May be seen in two separate calculations eg $2 \times 3 + -3 \times 5$ and $2 \times 4 + -3 \times -2$ Condone incorrect notation if method is clear for this mark only
		A1	cao	
7	35.3	P1	for starting the process to find length of third side of triangle, eg $9^2 - 6^2 (= 45)$ or $6^2 + x^2 = 9^2$	[radius] is any value If an answer in the range 35.2 to 35.4 is given in the working space then incorrectly rounded, award full marks No working, answer only, no marks
		P1	for $\sqrt{9^2 - 6^2}$ or $\sqrt{81 - 36}$ or $\sqrt{45}$ or $3\sqrt{5}$ ($= 6.7..$) or $r^2 = 45$	
		P1	for stating or using $\pi \times [\text{radius}]^2 \div 4$	
		A1	for answer in range 35.2 to 35.4	

Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
10 (a)	Diagram	B1	for correct vector drawn including arrow	May be drawn anywhere on the grid. Condone missing label Accept consistent incorrect notation for M1
	(b) $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$	M1	for $\mathbf{a} + 2\mathbf{b}$ drawn with resultant vector or for writing $\mathbf{a}$ and $\mathbf{b}$ as column vectors and attempt to add $\mathbf{a} + 2\mathbf{b}$, eg $\begin{pmatrix} 1 \\ 2 \end{pmatrix} + 2 \times \begin{pmatrix} 1 \\ -3 \end{pmatrix}$ or $\begin{pmatrix} 1+2 \\ c \end{pmatrix}$ or $\begin{pmatrix} d \\ 2+-6 \end{pmatrix}$ or $\begin{pmatrix} -4 \\ 3 \end{pmatrix}$	
		A1	cao	
11 (a)	$\frac{2}{25}$	B1	accept 0.08	All powers and products must be evaluated
	(b) $\frac{1}{8}$	M1	$fg(x) = \frac{2}{(4x^3)^2}$ oe or $g(1) = 4$ or $\frac{2}{(4 \times 1^3)^2}$ oe	
		A1	oe	
12	BDAC	B2	all correct	
		(B1	for at least 2 correct)	



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
13	$\begin{pmatrix} -1 \\ 4 \end{pmatrix}$	M1 M1 A1	for $3\begin{pmatrix} 2 \\ -3 \end{pmatrix} - 2\mathbf{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$ oe or for $\begin{pmatrix} 6 \\ -9 \end{pmatrix}$ for $2\mathbf{b} = \begin{pmatrix} 3 \times 2 - 8 \\ 3 \times -3 - -17 \end{pmatrix} (= \begin{pmatrix} -2 \\ 8 \end{pmatrix})$ oe or $-2\mathbf{b} = \begin{pmatrix} 8 - 3 \times 2 \\ -17 - 3 \times -3 \end{pmatrix} (= \begin{pmatrix} 2 \\ -8 \end{pmatrix})$ oe or for one element correct, -1 or 4 cao (if M0 scored, SC B1 for $\begin{pmatrix} 1 \\ -4 \end{pmatrix}$)	Must see “ $2\mathbf{b} = \dots$ ” or “ $-2\mathbf{b} = \dots$ ” to award 2 marks One correct element scores 2 marks
14	(a) $4(p-3)(p+3)$ (b) $6m^3 + 11m^2 - 57m - 20$	M1 A1 M1 M1 A1	for $4(p^2 - 9)$ or partial factorisation which includes the product of 2 linear factors eg. $(4p - 12)(p + 3)$ or $(p - 3)(4p + 12)$ or $(2p - 6)(2p + 6)$ or $2(2p - 6)(p + 3)$ or $2(2p + 6)(p - 3)$ or $2(p - 3)2(p + 3)$ for $4(p - 3)(p + 3)$ for a method to find the product of two linear expressions, 3 correct terms out of 4 terms, eg. $6m^2 + 2m - 15m - 5 = 6m^2 - 13m - 5$ or $2m^2 + 8m - 5m - 20 = 2m^2 + 3m - 20$ or $3m^2 + 12m + m + 4 = 3m^2 + 13m + 4$ for a complete method to obtain all terms, at least half of which are correct (ft their first product), eg. $6m^3 + 2m^2 - 15m^2 + 24m^2 + 8m - 60m - 5m - 20$ for $6m^3 + 11m^2 - 57m - 20$	Note that, for example, $3m - 20$ is regarded as three terms in the expansion of $(m + 4)(2m - 5)$ First product must be a 3 or 4 term quadratic but need not be simplified or may be incorrect. Accept $a = 6$, $b = 11$, $c = -57$, $d = -20$

Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
22	$b = 3a$	P1	for $a\binom{2}{6} + b\binom{8}{2} = k\binom{13}{6}$ oe or for setting up a linear equation in a or b eg $2a + 8b = 13k$ or $6a + 2b = 6k$, $k \neq 0, 1$ or for $2a + 8b = 13$ and $6a + 2b = 6$ or for $\frac{2a+8b}{6a+2b} = \frac{13}{6}$ oe	Accept any non zero value substituted for k
		P1	for process to solve the simultaneous equations to get $b = \frac{3k}{2}$ and $a = \frac{k}{2}$ or $b = \frac{3}{2}$ and $a = \frac{1}{2}$ or both $2a + 8b = 13k$ and $6a + 2b = 6k$ with process to eliminate k	
		A1	for $b = 3a$ oe	

Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
8	Vector $\begin{pmatrix} 5 \\ 8 \end{pmatrix}$ drawn	M1	for $2 \times 3 + -1 (= 5)$ or $2 \times 2 + 4 (= 8)$ seen as a calculation or for $\begin{pmatrix} 2 \times 3 \\ 2 \times 2 \end{pmatrix} + \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ or for $\begin{pmatrix} 5 \\ b \end{pmatrix}$ or $\begin{pmatrix} a \\ 8 \end{pmatrix}$ or for $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$ drawn or $\begin{pmatrix} 6 \\ 4 \end{pmatrix}$ drawn or $\begin{pmatrix} -1 \\ 4 \end{pmatrix}$ drawn	May be in the correct position in a column vector or coordinate.
		M1	for $\begin{pmatrix} 5 \\ 8 \end{pmatrix}$ or for $\begin{pmatrix} 5 \\ 8 \end{pmatrix}$ drawn with no arrow or incorrect arrow or for $\begin{pmatrix} 5 \\ b \end{pmatrix}$ drawn with arrow or $\begin{pmatrix} a \\ 8 \end{pmatrix}$ drawn with arrow, where $b \neq 8$ and $a \neq 5$	Condone missing arrows
		A1	cao	For this mark the drawn vector must include an arrow showing direction. Need not be labelled but do not award if there is any ambiguity



Paper: 1MA1/1H				
Question	Working	Answer	Mark	Notes
19		$\frac{2}{5}$	P1 for first step to solve the problem e.g. $\overrightarrow{AC} = -\mathbf{a} + \mathbf{c}$ or $\overrightarrow{OX} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c}$ or demonstrates the location of D and X on the diagram P1 for a correct vector statement using $\overrightarrow{CD}$ eg $\overrightarrow{CD} = \overrightarrow{CX} + \overrightarrow{XD}$ or $\overrightarrow{CD} = \overrightarrow{OD} - \overrightarrow{OC}$ or $\overrightarrow{OD} = \frac{7}{2}\mathbf{c}$ or $\overrightarrow{CD} = 2.5\mathbf{c}$ oe P1 for a correct equation or ratio using k eg equating $\overrightarrow{XD} = 3\mathbf{c} - \frac{1}{2}\mathbf{a} = \frac{1}{2}(-\mathbf{a} + \mathbf{c}) + \frac{1}{k}\mathbf{c}$ or $\frac{\overrightarrow{OD}}{\overrightarrow{OC}} = \frac{k+1}{k}$ or $k = \frac{1}{2.5}$ or using a ratio approach eg $(\overrightarrow{OC} : \overrightarrow{CD}) = k : 1 = 1 : 2.5$ A1 cao	
20		$x = -\frac{24}{5}$ $y = -\frac{7}{5}$ $x = -3,$ $y = 4$	M1 for substitution of a rearrangement of $y - 3x = 13$ e.g. $(3x + 13)^2 + x^2 = 25$ M1 (dep M1) for expansion of bracket after substitution (at least 3 terms correct out of the 4 terms) e.g. $9x^2 + 39x + 39x + 169$ M1 for forming quadratic ready for solving e.g. $10x^2 + 78x + 144 (= 0)$ M1 for factorising e.g. $(5x + 24)(x + 3) (= 0)$ oe A1 $x = -\frac{24}{5}, y = -\frac{7}{5}$ and $x = -3, y = 4$ SC: B1 (if M0) for all 4 values mis-associated or one correct pair of values or values given as coordinates.	

Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
21	Proof	M1 M1 B1 C1	for $\overrightarrow{DQ} = \frac{1}{2}(\mathbf{b} - \mathbf{a})$ oe or $\overrightarrow{EQ} = \frac{1}{2}(\mathbf{a} - \mathbf{b})$ oe for $\overrightarrow{PQ} = \frac{1}{2}\mathbf{a} + \overrightarrow{DQ}$ or $\frac{1}{2}\mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a})$ oe or $\overrightarrow{PQ} = -\frac{1}{2}\mathbf{a} + \mathbf{b} + \overrightarrow{EQ}$ or $-\frac{1}{2}\mathbf{a} + \mathbf{b} + \frac{1}{2}(\mathbf{a} - \mathbf{b})$ oe for $\overrightarrow{PQ} = \frac{1}{2}\mathbf{b}$ for complete proof with statement, eg $FE = 2PQ$ or FE is a multiple of PQ or $\mathbf{b} = 2(\frac{1}{2}\mathbf{b})$	Vectors could be written on the diagram
22	0.5	P1 P1 P1 P1 A1	derive an algebraic expression for the area of A eg $\frac{1}{8}\pi[(5x-1)^2 - (3x-1)^2]$ expand and simplify for either area A or area B eg $\frac{1}{8}\pi(16x^2 - 4x)$ or $\pi(x^2 - 2x + 1)$ (dep P2) equate and rearrange into a quadratic eqn of the form $ax^2 + bx + c = 0$ eg $2x^2 + 3x - 2 = 0$ (dep P3) factorise eg $(2x-1)(x+2) = 0$ or use of formula eg $\frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times -2}}{2 \times 2}$ oe	Accept only the single value of 0.5 oe but award 0 marks for a correct answer with no supportive working



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
18	$\frac{2}{5}\mathbf{a} + \mathbf{b}$	P1 for relationship involving D eg $\overrightarrow{OD} = \frac{2}{5}\overrightarrow{OB}$ or $\overrightarrow{DB} = \frac{3}{5}\overrightarrow{OB}$ or for relationship involving E eg $\overrightarrow{BE} = \frac{1}{5}\overrightarrow{BC}$ or $\overrightarrow{EC} = \frac{4}{5}\overrightarrow{BC}$ P1 for relationship involving D in terms of $\mathbf{a}$ and $\mathbf{b}$ eg $\overrightarrow{OD} = \frac{2}{5}(\mathbf{a} + \mathbf{b})$ or $\overrightarrow{DB} = \frac{3}{5}(\mathbf{a} + \mathbf{b})$ or for relationship involving E in terms of $\mathbf{a}$ and $\mathbf{b}$ eg $\overrightarrow{BE} = \frac{1}{5}(-\mathbf{b} - \mathbf{a} + 3\mathbf{b})$ oe or $\overrightarrow{EC} = \frac{4}{5}(-\mathbf{b} - \mathbf{a} + 3\mathbf{b})$ oe or $\overrightarrow{BC} = 2\mathbf{b} - \mathbf{a}$ oe or $\overrightarrow{CB} = \mathbf{a} - 2\mathbf{b}$ oe P1 (dep P2) for expression for $\overrightarrow{DE}$ in terms of $\mathbf{a}$ and $\mathbf{b}$ eg $\overrightarrow{DE} = \frac{3}{5}(\mathbf{a} + \mathbf{b}) + \frac{1}{5}(-\mathbf{b} - \mathbf{a} + 3\mathbf{b})$ A1 for $\frac{2}{5}\mathbf{a} + (1)\mathbf{b}$ or $\frac{1}{5}(2\mathbf{a} + 5\mathbf{b})$		
19	0.95	P1 for initial use of the formula eg $3610 = kP_n$ or $P_{n+1} = 4000k$ or for $P_{n+2} = k^2P_n$ or for $3610 = k^2 \times 4000$ P1 for a complete method to find k eg $\sqrt{\frac{3610}{4000}}$ or ± 0.95 A1 oe	Accept n or any integer replacement for n This may be seen in steps	



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
24	Proof	C1	for $\overrightarrow{CE} = 2\mathbf{a} - \mathbf{b}$ oe	Vectors may be seen on diagram. Award marks provided not ambiguous. For the award of the first 3 marks, expressions for vectors $\overrightarrow{CE}$, $\overrightarrow{EP}$, $\overrightarrow{CP}$, $\overrightarrow{CF}$ and $\overrightarrow{DP}$ may not be simplified
		C1	for $\overrightarrow{EP} = 2\mathbf{a} - \mathbf{b}$ oe or for $\overrightarrow{CP} = 4\mathbf{a} - 2\mathbf{b}$ oe	
		C1	for $\overrightarrow{CF} = \mathbf{a} - \mathbf{b}$ oe or for $\overrightarrow{DP} = 2\mathbf{a} - 2\mathbf{b}$ oe	
		C1	for $\overrightarrow{CF} = \mathbf{a} - \mathbf{b}$ and $\overrightarrow{DP} = 2\mathbf{a} - 2\mathbf{b}$ (or $2(\mathbf{a} - \mathbf{b})$) leading to conclusion	
25	14.1	P1	for a process to find the volume of the top eg $92.8 \div 2.9 (= 32)$	Values can be truncated or rounded For this mark, [total volume] does not have to come from a correct process but is the value that the student believes is the total volume of the pyramid.
		P1	for finding total mass of P eg $92.8 + 972.8 (= 1065.6)$	
		P1	for finding total volume of P eg $\frac{1065.6}{4.7} (= 226.7234)$	
		P1	(dep P2) for $\frac{32}{[\text{total volume}]} \times 100$	
		A1	for answer in the range 14.1 to 14.2	

Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
20	$\frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$	P1 P1 P1 A1	for process to find $\vec{OR} = \mathbf{a} - \mathbf{b}$ or $\vec{RO} = \mathbf{b} - \mathbf{a}$ for process to find $\vec{MR} = \frac{3}{5}(\mathbf{a} - \mathbf{b})$ or $\vec{MO} = \frac{2}{5}(\mathbf{b} - \mathbf{a})$ or $\vec{RM} = \frac{3}{5}(\mathbf{b} - \mathbf{a})$ or $\vec{OM} = \frac{2}{5}(\mathbf{a} - \mathbf{b})$ for complete process to find $\vec{MT}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, eg $\frac{3}{5}(\mathbf{a} - \mathbf{b}) + \mathbf{b}$ oe or $\frac{2}{5}(\mathbf{b} - \mathbf{a}) + \mathbf{a}$ oe for $\frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$ or $\frac{1}{5}(3\mathbf{a} + 2\mathbf{b})$ or $\frac{3\mathbf{a} + 2\mathbf{b}}{5}$	Accept decimals instead of fractions
21 (a)	Sketch graph	B1	cao	Allow freehand sketch provided intention is clear. (-3, -4), (-2, -3), (-1, -3), (0, -4)
(b)	Sketch graph	B1	cao	Allow freehand sketch provided intention is clear. (0, 0), (1, 1), (2, 1), (3, 0)



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
18	Proof	B1	for $\overrightarrow{EH} = -\mathbf{b} + \mathbf{a}$ or $\overrightarrow{HE} = -\mathbf{a} + \mathbf{b}$ or $\overrightarrow{HG} = \mathbf{a} + \mathbf{c}$ or $\overrightarrow{GH} = -\mathbf{c} - \mathbf{a}$	
		B1	for $\overrightarrow{BC} = -2\mathbf{b} + 2\mathbf{a} + 2\mathbf{c}$ or $\overrightarrow{CB} = 2\mathbf{b} - 2\mathbf{a} - 2\mathbf{c}$	
		B1	for $\overrightarrow{EF} = \mathbf{b} + \frac{1}{2}(-2\mathbf{b} + 2\mathbf{a} + 2\mathbf{c}) (= \mathbf{a} + \mathbf{c})$ or $\overrightarrow{FE} = \frac{1}{2}(2\mathbf{b} - 2\mathbf{a} - 2\mathbf{c}) - \mathbf{b} (= -\mathbf{a} - \mathbf{c})$ or $\overrightarrow{FG} = \frac{1}{2}(-2\mathbf{b} + 2\mathbf{a} + 2\mathbf{c}) - \mathbf{c} (= -\mathbf{b} + \mathbf{a})$ or $\overrightarrow{GF} = \mathbf{c} + \frac{1}{2}(2\mathbf{b} - 2\mathbf{a} - 2\mathbf{c}) (= -\mathbf{a} + \mathbf{b})$	
		A1	for completing proof, $\overrightarrow{EH} = \overrightarrow{FG}$ or $\overrightarrow{HG} = \overrightarrow{EF}$ (so $EFGH$ is a parallelogram)	
19 (a)	17	M1	For $(gf(x)) = 2(2x + 3)^2 - 1$ or $(gf(x)) = 8x^2 + 24x + 17$ or $2(2 \times (-3) + 3)^2 - 1$	Substitution may be seen in 2 steps
		A1	cao	
(b)	$\frac{x+1}{2}$	M1	for a suitable first step, eg adds 1 to both sides, eg $y + 1 = 2x$ or $x + 1 = 2y$ or $g(x) + 1 = 2x$ or $x = \frac{y+1}{2}$	
		A1	oe	



Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
14	6	M1 M1 A1	for either $\sin 30 = 0.5$ oe $\sin 45 = \frac{1}{\sqrt{2}}$ or $\frac{\sqrt{2}}{2}$ for $\frac{AB}{\sin 45} = \frac{3\sqrt{2}}{\sin 30}$ oe cao	
15	4 : 1	P1 P1 P1 A1	for $\overrightarrow{OM} = \frac{1}{4}\mathbf{a}$ or $\overrightarrow{MO} = -\frac{1}{4}\mathbf{a}$ or $\overrightarrow{ON} = \frac{1}{3}\mathbf{b}$ or $\overrightarrow{NO} = -\frac{1}{3}\mathbf{b}$ $\overrightarrow{OX} = \mathbf{a} - \mathbf{b}$ or $\overrightarrow{XO} = -\mathbf{a} + \mathbf{b}$ or $\overrightarrow{ZY} = \mathbf{a} - \mathbf{b}$ or $\overrightarrow{YZ} = -\mathbf{a} + \mathbf{b}$ for $\overrightarrow{XN} = \mathbf{b} - \mathbf{a} + \frac{1}{3}\mathbf{b}$ ($= \frac{4}{3}\mathbf{b} - \mathbf{a}$) oe or $\overrightarrow{MN} = \frac{1}{3}\mathbf{b} - \frac{1}{4}\mathbf{a}$ oe or $\overrightarrow{XM} = \mathbf{b} - \mathbf{a} + \frac{1}{4}\mathbf{a}$ ($= \mathbf{b} - \frac{3}{4}\mathbf{a}$) oe for $\overrightarrow{XN} = \mathbf{b} - \mathbf{a} + \frac{1}{3}\mathbf{b}$ oe and $\overrightarrow{MN} = \frac{1}{3}\mathbf{b} - \frac{1}{4}\mathbf{a}$ or $\frac{4}{3}\mathbf{b} - \mathbf{a} - \mathbf{b} + \frac{3}{4}\mathbf{a}$ oe for 4 : 1 oe	Implies 1 st P1 A correct answer with no supportive working gets 0 marks



Paper: 1MA1/3H				
Question	Working	Answer	Mark	Notes
21		$\frac{2}{5}$	P1	for process to find $\overrightarrow{AB}$ ($= \mathbf{b} - \mathbf{a}$) or $\overrightarrow{BA}$ ($= \mathbf{a} - \mathbf{b}$)
			P1	for process to find $\overrightarrow{MN}$ ($= -\frac{1}{2}\mathbf{b} + \mathbf{a} + 2\mathbf{a}$) or $\overrightarrow{PN}$ ($= -k(\mathbf{b} - \mathbf{a}) + 2\mathbf{a}$) or $\overrightarrow{MP}$ ($= -\frac{1}{2}\mathbf{b} + \mathbf{a} + k(\mathbf{b} - \mathbf{a})$ or $\frac{1}{2}\mathbf{b} + (1 - k)(\mathbf{a} - \mathbf{b})$)
			P1	for process to find two of $\overrightarrow{MN}$, $\overrightarrow{PN}$ and $\overrightarrow{MP}$
			P1	for process to find k , using $\overrightarrow{MN}$ as a multiple of $\overrightarrow{PN}$ or using $\overrightarrow{MN}$ as a multiple of $\overrightarrow{MP}$ or using $\overrightarrow{PN}$ as a multiple of $\overrightarrow{MP}$
			A1	for $\frac{2}{5}$ oe



Question 2

London	$1.089 \times 1.46 = \$1.58(9\ldots)$ per litre	$\rightarrow$	$1.589\ldots \times 3.785 = \$6.01(7\ldots)$ per gallon
	$1.089 \times 3.785 = £4.12(1\ldots)$ per gallon	$\rightarrow$	$4.121\ldots \times 1.46 = \$6.01(7\ldots)$ per gallon
New York	$2.83 \div 1.46 = £1.93(8\ldots)$ per gallon	$\rightarrow$	$1.938\ldots \div 3.785 = £0.51(2\ldots)$ per litre
	$2.83 \div 3.785 = \$0.74(7\ldots)$ per litre	$\rightarrow$	$0.747\ldots \div 1.46 = £0.51(2\ldots)$ per litre

The table shows the most commonly used approaches. There are of course other approaches that can be used.

Question 9(a)

n	$(0.85)^n$	$12\,500 \times (0.85)^n$
1		10 625
2	0.7225	9031.25
3	0.614125	7676.5625
4	0.52200625	6525.078125
5	0.4437053125	5546.316406



Paper: IMA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
20	fully correct working leading to $16(1+\sqrt{2})$	C1	for expanding the numerator, eg $18 + 2\sqrt{2}\sqrt{18} + 2$ or $\sqrt{324} + \sqrt{36} + \sqrt{36} + \sqrt{4}$ (= 32) or for simplifying $\sqrt{18}$, eg. $\sqrt{18} = 3\sqrt{2}$ or $\sqrt{18} + \sqrt{2} = 4\sqrt{2}$	Expanded terms need not be simplified
		C1	(indep) for method to rationalise the denominator, eg. $\frac{\text{"numerator"}}{\sqrt{8}-2} \times \frac{\sqrt{8}+2}{\sqrt{8}+2}$	
		C1	for fully correct working leading to $16(1+\sqrt{2})$	Accept $a = 16, b = 1$
21	3 : 4	P1	starts process eg $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ oe	
		P1	for process to find $\overrightarrow{OM} = \mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a})$ oe ($= \frac{1}{2}(\mathbf{a} + \mathbf{b})$)	
		P1	for process to find $\overrightarrow{AP} = -\mathbf{a} + \frac{3}{5}(\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b})$ oe or (indep) for $\overrightarrow{AN} = -\mathbf{a} + k\mathbf{b}$	
		P1	process to find "k" using $\overrightarrow{AN} = -\mathbf{a} + k\mathbf{b}$ as a multiple of $\overrightarrow{AP}$	
		A1	cao	
		P1	ALTERNATIVE for producing OM to C such that AC is parallel to OB	
		P1	for process to show that $MC = OM$, using congruent triangles ACM and BOM	Formal geometric reasoning relating to congruent and similar triangles is not required
		P1	for process to find PC as a multiple of $OM/5$ ($= 7OM/5$)	
		P1	for process to find ON as a multiple of $AC(OB)$ ($= 3OB/7$) using similar triangles ACP and NOP	
		A1	cao	

Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
24	4 : 3	P1	Process to find a missing vector using the given ratios as fractions, eg. $\frac{1}{3}$ of $\overrightarrow{OX}$ ($-\frac{1}{3}\mathbf{a}$) or, $\frac{1}{4}$ of $\overrightarrow{OY}$ ($-\frac{1}{4}\mathbf{b}$)	Might be embedded in their answer for ZP The award of this mark implies the first two process marks.
		P1	for a process to use $\overrightarrow{ZO} = \overrightarrow{YX} = \mathbf{a} - \mathbf{b}$ oe	
		P1	for a process to find either $\overrightarrow{ZP}$ or $\overrightarrow{ZR}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, eg. either $\overrightarrow{ZP} = \mathbf{a} - \mathbf{b} + \frac{1}{3}\mathbf{a}$ or $\overrightarrow{ZR} = \mathbf{a} - \mathbf{b} + \frac{1}{4}\mathbf{b}$	
		P1	for a process to write $\overrightarrow{ZP}$ and $\overrightarrow{ZR}$ as multiples of the same vector, eg. multiplying both by 12 to get the ratio, $\frac{4}{3}(\mathbf{a} - 0.75\mathbf{b})$ and $\mathbf{a} - 0.75\mathbf{b}$ respectively	
		A1	oe	



Paper: 1MA1/1H				
Question	Answer	Mark	Mark scheme	Additional guidance
15 (a)	$\vec{AC} = 5\vec{AB}$ and reason	M1	for $\vec{AC} = 5(3\mathbf{a} + 4\mathbf{b})$ or $\vec{BC} = 4(3\mathbf{a} + 4\mathbf{b})$ or indicates that $15\mathbf{a} + 20\mathbf{b} = 5 \times (3\mathbf{a} + 4\mathbf{b})$	Do not award this mark if any incorrect working seen Could use AB and BC or AC and BC
		C1	for $\vec{AC} = 5\vec{AB}$ or $\vec{AC} = 5(3\mathbf{a} + 4\mathbf{b})$ or $15\mathbf{a} + 20\mathbf{b} = 5(3\mathbf{a} + 4\mathbf{b})$ and a correct reason, eg AC is a multiple of AB / multiples of each other / AB is a factor of AC or they have the same gradient / are parallel / go in the same direction or they have a point in common / both start at A or AC is an enlargement of AB	
		P1	for $(\vec{DF} \Rightarrow) 3\mathbf{e} + 6\mathbf{f} + (-10.5\mathbf{e} - 21\mathbf{f}) \quad (= -7.5\mathbf{e} - 15\mathbf{f})$ or for a multiplicative relationship for $\vec{DE}$ and $\vec{EF}$ eg $\vec{EF} = -3.5 \vec{DE}$ or for $(DE : EF \Rightarrow) 1 : -3.5$ oe	
		P1	for a multiplicative relationship for $\vec{DF}$ and $\vec{DE}$ eg $\vec{DF} = -2.5 \vec{DE}$ or for $(DF : DE \Rightarrow) -5 : 2$ oe eg $-2.5 : 1$ or $-7.5 : 3$ or for answer of $2 : 5$ oe	
(b)	5 : 2	A1	oe eg $2.5 : 1$	



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
19 (a)	$\frac{1}{18}(8\mathbf{b} + 10\mathbf{b} - \mathbf{a})$	P1	for a correct expression for $\overrightarrow{CB}$ or $\overrightarrow{BC}$ eg, $\overrightarrow{CB} = -k\mathbf{b} - \mathbf{a} + \mathbf{b}$ or $\overrightarrow{BC} = -\mathbf{b} + \mathbf{a} + k\mathbf{b}$	All vectors must be clearly identified
		P1	for a correct expression for $\overrightarrow{CN}$ or $\overrightarrow{BN}$ or $\overrightarrow{NC}$ or $\overrightarrow{NB}$ eg, $\overrightarrow{CN} = \frac{5}{9}(-k\mathbf{b} - \mathbf{a} + \mathbf{b})$ or $\overrightarrow{BN} = \frac{4}{9}(-\mathbf{b} + \mathbf{a} + k\mathbf{b})$ or $\overrightarrow{NC} = \frac{5}{9}(-\mathbf{b} + \mathbf{a} + k\mathbf{b})$ or $\overrightarrow{NB} = \frac{4}{9}(-k\mathbf{b} - \mathbf{a} + \mathbf{b})$	This mark implies the previous one
		P1	for a correct unsimplified expression for $\overrightarrow{MN}$ eg $\frac{1}{2}\mathbf{a} + k\mathbf{b} + \frac{5}{9}(-k\mathbf{b} - \mathbf{a} + \mathbf{b})$ oe or $-\frac{1}{2}\mathbf{a} + \mathbf{b} + \frac{4}{9}(-\mathbf{b} + \mathbf{a} + k\mathbf{b})$ oe	
		A1	for $\frac{1}{18}(8k\mathbf{b} + 10\mathbf{b} - \mathbf{a})$ oe eg $\frac{5}{9}\mathbf{b} + \frac{4}{9}k\mathbf{b} - \frac{1}{18}\mathbf{a}$	Must have a maximum of 3 vector terms, $\mathbf{a}$, $\mathbf{b}$, and $k\mathbf{b}$
(b)	No, with explanation	C1	No with supporting reason ft (a) Acceptable reasons: No, since $\frac{1}{18}(8k\mathbf{b} + 10\mathbf{b} - \mathbf{a})$ is not a multiple of $\mathbf{b}$ No, as N is not the midpoint of BC No, they are not multiples of each other No, does not factorise to $\mathbf{b}$ Not a multiple of OB OB doesn't have an $\mathbf{a}$ Not acceptable reasons: Yes... No, they don't share the same multiples OB doesn't go into MN	



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
23	$\frac{15}{4}$	P1	for process to find $\overrightarrow{BC}$ or $\overrightarrow{CB}$, eg $\overrightarrow{BC} = -3\mathbf{b} + \mathbf{a} + 2\mathbf{b}$ oe ($= \mathbf{a} - \mathbf{b}$) or $\overrightarrow{CB} = -2\mathbf{b} - \mathbf{a} + 3\mathbf{b}$ oe ($= -\mathbf{a} + \mathbf{b}$)	Vectors must be unambiguously identified Accept BC for $\overrightarrow{BC}$ etc throughout Allow $\mathbf{a}$ for $\mathbf{a}$ and $\mathbf{b}$ for $\mathbf{b}$ throughout Vectors could be written on the diagram and may be in either direction.
		P1	for process that uses the ratio 5 : 3, eg $\overrightarrow{BN} = \frac{5}{8}(-3\mathbf{b} + \mathbf{a} + 2\mathbf{b})$ ($= \frac{5}{8}\mathbf{a} - \frac{5}{8}\mathbf{b}$) or $\overrightarrow{NB} = -\frac{5}{8}\mathbf{a} + \frac{5}{8}\mathbf{b}$ oe or $\overrightarrow{CN} = \frac{3}{8}(-2\mathbf{b} - \mathbf{a} + 3\mathbf{b})$ ($= -\frac{3}{8}\mathbf{a} + \frac{3}{8}\mathbf{b}$) or $\overrightarrow{NC} = \frac{3}{8}\mathbf{a} - \frac{3}{8}\mathbf{b}$ oe	Throughout, do not condone missing brackets unless recovered Follow through candidates $\overrightarrow{BC}$ or $\overrightarrow{CB}$ provided full method to find subsequent vectors is clearly shown A correct expression for $\overrightarrow{BN}$ or $\overrightarrow{NB}$ or $\overrightarrow{CN}$ or $\overrightarrow{NC}$ implies the previous P mark
		P1	for a process to find an expression, in terms of $\mathbf{a}$ and $\mathbf{b}$, for $\overrightarrow{MN}$ or $\overrightarrow{MP}$ or $\overrightarrow{NP}$ eg $\overrightarrow{MN} = -\frac{1}{2}\mathbf{a} + 3\mathbf{b} + \frac{5}{8}(\mathbf{a} - \mathbf{b})$ oe ($= \frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}$) or $\overrightarrow{MN} = \frac{1}{2}\mathbf{a} + 2\mathbf{b} + \frac{3}{8}(-\mathbf{a} + \mathbf{b})$ oe ($= \frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}$) or $\overrightarrow{MP} = \frac{1}{2}\mathbf{a} + 2\mathbf{b} + k(2\mathbf{b})$ oe or $\overrightarrow{NP} = \frac{3}{8}\mathbf{a} - \frac{3}{8}\mathbf{b} + k(2\mathbf{b})$ oe	Follow through candidates $\overrightarrow{BN}$ or $\overrightarrow{NB}$ or $\overrightarrow{CN}$ or $\overrightarrow{NC}$ provided full method to find subsequent vectors is clearly shown May use $\overrightarrow{NM}$ or $\overrightarrow{PM}$ or $\overrightarrow{PN}$ Allow equivalent vectors throughout eg $\overrightarrow{MP} = \frac{1}{2}\mathbf{a} + 2\mathbf{b} + \mu(\mathbf{b})$ This mark may be awarded without the previous mark being awarded



Paper: 1MA1/3H				
Question	Answer	Mark	Mark scheme	Additional guidance
		P1	for a process to find a correct expression, in terms of a and b for the same vector eg $\overrightarrow{MP}$ or $\overrightarrow{NP}$ or parallel vectors eg $\overrightarrow{MP}$ and $\overrightarrow{MN}$ or $\overrightarrow{NP}$ and $\overrightarrow{MN}$ eg $\overrightarrow{MP} = \frac{1}{2}\mathbf{a} + 2\mathbf{b} + k(2\mathbf{b})$ oe and $\overrightarrow{MP} = \lambda\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ oe or $\overrightarrow{NP} = \frac{3}{8}\mathbf{a} - \frac{3}{8}\mathbf{b} + k(2\mathbf{b})$ oe and $\overrightarrow{NP} = \lambda\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ oe or $\overrightarrow{MP} = \frac{1}{2}\mathbf{a} + 2\mathbf{b} + k(2\mathbf{b})$ oe and $\overrightarrow{MN} = \frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}$ oe or $\overrightarrow{NP} = \frac{3}{8}\mathbf{a} - \frac{3}{8}\mathbf{b} + k(2\mathbf{b})$ oe and $\overrightarrow{MN} = \frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}$ oe OR for a process to find a correct expression in terms of a and b, for $\overrightarrow{AP}$ or $\overrightarrow{CP}$ using $\overrightarrow{MN}$ $\overrightarrow{AP} = -\frac{1}{2}\mathbf{a} + \mu\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ oe or $\overrightarrow{CP} = -\frac{3}{8}\mathbf{a} + \frac{3}{8}\mathbf{b} + \mu\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ oe OR for a process to find a correct expression in terms of a and b for the same vector $\overrightarrow{BP}$ or $\overrightarrow{OP}$ $\overrightarrow{BP} = \mathbf{a} - \mathbf{b} + k(2\mathbf{b})$ oe and $\overrightarrow{BP} = \frac{5}{8}\mathbf{a} - \frac{5}{8}\mathbf{b} + \mu\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ oe $\overrightarrow{OP} = \mathbf{a} + 2\mathbf{b} + k(2\mathbf{b})$ oe and $\overrightarrow{OP} = \frac{1}{2}\mathbf{a} + \mu\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ oe	Vectors do not have to be simplified May use $\overrightarrow{NM}$ or $\overrightarrow{PM}$ or $\overrightarrow{PN}$ Condone use of same variable for equivalent vector journeys Condone lack of labelling if vector journeys are correctly equated May use $\overrightarrow{PA}$ or $\overrightarrow{PC}$ NB: $\overrightarrow{CP} = -\frac{1}{2}\mathbf{a} - 2\mathbf{b} + \mu\left(\frac{1}{8}\mathbf{a} + \frac{19}{8}\mathbf{b}\right)$ May use $\overrightarrow{PB}$ or $\overrightarrow{PO}$
		A1	for $\frac{15}{4}$ oe	Award 0 marks for a correct answer with no supportive working



QUESTION 4 – Additional information NOT Exhaustive**Final comparable values, can be truncated or rounded, they just need to be accurate enough to allow a comparison**

Cost per lb in \$: $2 \times 2.2 (= 4.4)$ $3.75 \times 1.2(0) (= 4.5)$ $"4.5" \div "4.4" (= 1.02\dots)$ and $4.9(0) \div 5 (= 0.98)$ New York and 1.02... and 0.98	Cost per lb in £: $2 \times 2.2 (= 4.4)$ $4.9(0) \div 1.2(0) (= 4.08\dots)$ $3.75 \div "4.4" (= 0.85\dots)$ and $"4.08\dots" \div 5 (= 0.81(6\dots))$ New York and 0.85... and 0.81(6...)
Cost per kg in \$: $5 \div 2.2 (= 2.27\dots)$ $3.75 \times 1.2(0) (= 4.5)$ $"4.5" \div 2 (= 2.25)$ and $4.9(0) \div "2.27\dots" (= 2.15(6))$ New York and 2.25 and 2.15(6)	Cost per kg in £: $5 \div 2.2 (= 2.27\dots)$ $4.9(0) \div 1.2(0) (= 4.08\dots)$ $3.75 \div 2 (= 1.87(5))$ and $"4.08\dots" \div "2.27\dots" (= 1.79(6\dots))$ New York and 1.87(5) and 1.79(6...)
Number of lbs per \$: $2 \times 2.2 (= 4.4)$ $3.75 \times 1.2(0) (= 4.5)$ $"4.4" \div "4.5" (= 0.97(7\dots))$ and $5 \div 4.9(0) (= 1.02\dots)$ New York and 0.97(7...) and 1.02...	Number of lbs per £: $2 \times 2.2 (= 4.4)$ $4.9(0) \div 1.2(0) (= 4.08\dots)$ $"4.4" \div 3.75 (= 1.17\dots)$ and $5 \div "4.08\dots" (= 1.22\dots)$ New York and 1.17... and 1.22...
Number of kg per \$: $5 \div 2.2 (= 2.27\dots)$ $3.75 \times 1.2(0) (= 4.5)$ $2 \div "4.5" (= 0.44\dots)$ and $"2.27\dots" \div 4.9(0) (= 0.46\dots)$ New York and 0.44... and 0.46...	Number of kg per £: $5 \div 2.2 (= 2.27\dots)$ $4.9(0) \div 1.2(0) (= 4.08\dots)$ $2 \div 3.75 (= 0.53\dots)$ and $"2.27\dots" \div "4.08\dots" (= 0.55(6\dots))$ New York and 0.53... and 0.55(6...)
Cost of 5 lb in \$: $2 \times 2.2 (= 4.4)$ $3.75 \times 1.2(0) (= 4.5)$ $"4.5" \div "4.4" \times 5 (= 5.11\dots)$ New York and 5.11...	Cost of 5 lb in £: $2 \times 2.2 (= 4.4)$ $4.9(0) \div 1.2(0) (= 4.08\dots)$ $3.75 \div "4.4" \times 5 (= 4.26\dots)$ New York and 4.08... and 4.26...
Cost of 2 kg in \$: $5 \div 2.2 (= 2.27\dots)$ $3.75 \times 1.2(0) (= 4.5)$ $4.9(0) \div "2.27\dots" \times 2 (= 4.31\dots)$ New York and 4.5 and 4.31...	Cost of 2 kg in £: $5 \div 2.2 (= 2.27\dots)$ $4.9(0) \div 1.2(0) (= 4.08\dots)$ $"4.08\dots" \div "2.27\dots" \times 2 (= 3.59\dots)$ New York and 3.59...



Paper: IMA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
20 (a)	2a	M1	for $\mathbf{a} - \mathbf{b} + \mathbf{a} + \mathbf{b} (=2\mathbf{a})$	Accept ft from (a) providing vectors are clearly stated
		A1	cao	
	4	P1	for a process to find $\overrightarrow{MF} = -0.5\mathbf{b} - \mathbf{a} - (\mathbf{a} - \mathbf{b}) (=0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{CE} = \mathbf{a} + \mathbf{b}$ or $\overrightarrow{FM} = \mathbf{a} - \mathbf{b} + \mathbf{a} + 0.5\mathbf{b} (=2\mathbf{a} - 0.5\mathbf{b})$	
		P1	For finding a suitable vector expression for two of $(\overrightarrow{CE}$ or $\overrightarrow{EC})$, ($\overrightarrow{CX}$ or $\overrightarrow{XC}$) or $(\overrightarrow{EX}$ or $\overrightarrow{XE})$ eg, $\overrightarrow{CX} = \mathbf{a} + 0.5\mathbf{b} + \frac{1}{n+1}(0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{CX} = -\mathbf{a} + \mathbf{b} + \frac{n}{n+1}(2\mathbf{a} - 0.5\mathbf{b})$ $\overrightarrow{XE} = \frac{1}{n+1}(2\mathbf{a} - 0.5\mathbf{b}) + 0.5\mathbf{b}$ or $\overrightarrow{XE} = \frac{n}{n+1}(0.5\mathbf{b} - 2\mathbf{a}) + 2\mathbf{a}$ or $\overrightarrow{XC} = \frac{n}{n+1}(0.5\mathbf{b} - 2\mathbf{a}) + \mathbf{a} - \mathbf{b}$ or $\overrightarrow{XC} = \frac{1}{n+1}(2\mathbf{a} - 0.5\mathbf{b}) - 0.5\mathbf{b} - \mathbf{a}$ or $\overrightarrow{EX} = -0.5\mathbf{b} + \frac{1}{n+1}(0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{EX} = -2\mathbf{a} + \frac{n}{n+1}(2\mathbf{a} - 0.5\mathbf{b})$	
		P1	for complete process to equate the coefficients of $\mathbf{a}$ and $\mathbf{b}$ eg $\frac{n-1}{n+1} = \frac{n+2}{2(n+1)}$	
		A1	cao	
(b)	4	P1	for a process to find $\overrightarrow{MF} = -0.5\mathbf{b} - \mathbf{a} - (\mathbf{a} - \mathbf{b}) (=0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{CE} = \mathbf{a} + \mathbf{b}$ or $\overrightarrow{FM} = \mathbf{a} - \mathbf{b} + \mathbf{a} + 0.5\mathbf{b} (=2\mathbf{a} - 0.5\mathbf{b})$	Accept ft from (a) providing vectors are clearly stated



Paper: 1MA1/2H				
Question	Answer	Mark	Mark scheme	Additional guidance
			ALTERNATIVE	
		P1	for a process to find $\overrightarrow{MF} = -0.5\mathbf{b} - \mathbf{a} - (\mathbf{a} - \mathbf{b}) (=0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{CE} = \mathbf{a} + \mathbf{b}$ or $\overrightarrow{FM} = \mathbf{a} - \mathbf{b} + \mathbf{a} + 0.5\mathbf{b} (=2\mathbf{a} - 0.5\mathbf{b})$	Accept ft from (a) providing vectors are clearly stated
		P1	For finding two suitable vector expressions for $\overrightarrow{FX}$ eg $\overrightarrow{FX} = \frac{n}{n+1}(2\mathbf{a} - 0.5\mathbf{b})$ and $\overrightarrow{FX} = \mathbf{a} - \mathbf{b} + k\mathbf{a} + k\mathbf{b}$	
		P1	for complete process to equate the coefficients of $\mathbf{a}$ and $\mathbf{b}$ eg $\frac{2n}{n+1} - 1 = 1 - \frac{n}{2(n+1)}$	
		A1	cao	

