Mark Scheme (Results)

November 2024

Pearson Edexcel International GCSE In Mathematics (4MB1) Paper 02

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)

- **Abbreviations**
  - cao – correct answer only
  - ft – follow through
  - isw – ignore subsequent working
  - SC - special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent
  - awrt – answer which rounds to
  - eeoo – each error or omission
  - cas – Correct answer scores full marks (unless from obvious incorrect working)
  - wr working required

- **No working**

  If no working is shown then correct answers normally score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

  If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.

  If a candidate misreads a number from the question. Eg. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review.

  If there is a choice of methods shown, then award the lowest mark, unless the subsequent working makes clear the method that has been used.

  If there is no answer on the answer line then check the working for an obvious answer.

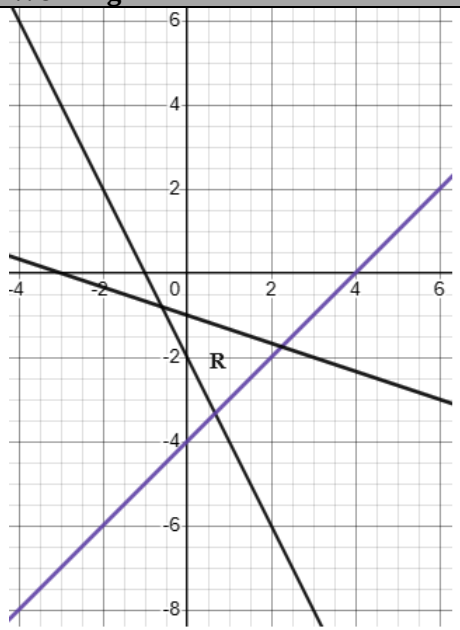
- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.
Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

- **Parts of questions**
  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

Question	Working	Answer	Mark	Notes
1	$21x+35y=52.5$ oe or $18x+30y=45$ $21x+18y=11.7$ $35x+30y=19.5$ oe or $x=\frac{7.5-5y}{3}$ oe or $y=\frac{7.5-3x}{5}$ oe or $x=\frac{3.9-6y}{7}$ oe or $y=\frac{3.9-7x}{6}$ oe		4	M1 multiplying both equations so the coefficients of x are the same or the coefficients of y are the same OR rearranging to get x in terms of y or y in terms of x (this could come from a linear combination of the equations given) Allow one incorrect term for the award of this mark May be implied by a correct equation in terms of one variable or a substitution of x or y with at most one incorrect term
	$17y=40.8$ oe or $17x=-25.5$ oe or $7\left(\frac{7.5-5y}{3}\right)+6y=3.9$ oe or $7x+6\left(\frac{7.5-3x}{5}\right)=3.9$ oe or $3\left(\frac{3.9-6y}{7}\right)+5y=7.5$ oe or $3x+5\left(\frac{3.9-7x}{6}\right)=7.5$ oe			M1ft one incorrect term, for indicating a correct operation to eliminate one variable. If the correct operation is not indicated then the correct operation must be applied throughout. Can be implied by a correct ft equation in terms of one variable OR substitute to give an equation in terms of just x or an equation in terms of just y.
		$x=-1.5$ **or** $y=2.4$		A1 oe award three marks if one method mark has been awarded
		$x=-1.5$ **and** $y=2.4$		A1 oe award full marks if one method mark has been awarded
	wr			***Total 4 marks***

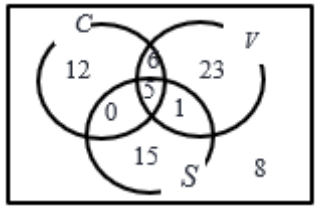
<table>
<tr><th colspan="2">Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td>2</td><td>(a)</td><td rowspan="5"> 
</td><td>Correct line drawn</td><td>2</td><td>M1 for a straight line with a gradient of 1
or line with a positive gradient through one correct point as listed below
or two points correct, which may be plotted or in a table or listed as listed below

<table><tr><td>x</td><td>–4</td><td>–3</td><td>–2</td><td>–1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>–8</td><td>–7</td><td>–6</td><td>–5</td><td>–4</td><td>–3</td><td>–2</td><td>–1</td><td>0</td><td>1</td><td>2</td></tr></table></td></tr>
<tr><td></td><td></td><td></td><td></td><td>A1 correct line between −4 and 6
(tolerance = must go through 2 points in the table)</td></tr>
<tr><td></td><td>(b)</td><td>Correct line drawn</td><td>2</td><td>M1 for a straight line with a gradient of $-\frac{1}{3}$
or line with a negative gradient through one correct point as listed below
or two points correct, which may be plotted or in a table or listed as listed below

<table><tr><td>x</td><td>–3</td><td>0</td><td>3</td><td>6</td></tr><tr><td>y</td><td>0</td><td>–1</td><td>–2</td><td>–3</td></tr></table></td></tr>
<tr><td></td><td></td><td></td><td></td><td>A1 correct line between −4 and 6
(tolerance = must go through 2 points in the table)</td></tr>
<tr><td></td><td>(c)</td><td>Correct region shaded</td><td>1</td><td>B1 dep on correct lines drawn, not necessarily from –4 to 6 but sufficient in length to enclose the correct region

Correct enclosed region identified
Correct region indicated by one of the following
• correct region shaded
• correct region labelled as R
• all of outside region shaded.</td></tr>
<tr><td></td><td>(d)</td><td></td><td>−2 and −3</td><td>1</td><td>B1 dep on B1 being awarded in part (c)
for −2 and −3 only or for (1, −2) and (1, −3) only</td></tr>
</table>

		cas			***Total 6 marks***

Question		Working	Answer	Mark	Notes
Ignore the use of or the omission of brackets throughout					
3	(a) (i)		{ 3, 5, 7, 9 }	1	B1 cao
	(ii)		{ 5, 7 }	1	B1 cao
	(iii)		{ 2, 3, 4, 6, 8, 9, 10 }	1	B1 cao
	(b)		Diagram	3	B3 for all 8 regions correct (B2 for 5 or 6 or 7 regions correct (B1 for 2 or 3 or 4 regions correct)) NB: Blank section not accepted as zero We must see the numerical value not only a calculation (eg 11 – 5 = 6 is acceptable but not just 11 – 5)
	(c) (i)		23	1	B1 for 23 or ft their diagram where values are present (ie not blank) in the required regions "12 + 6 + 5 + 0"
	(ii)		6	1	B1 for 6 or ft their diagram where a value is present (ie not blank) in the required region
	(d)		$\frac{11}{35}$	2	B2 oe eg 0.31(42…) rounded or truncated to 2sf (B1ft their diagram where values are present in the required regions for $\frac{11}{a}$ where $a > 11$ **and** a = "6 + 5 + 23 + 1" **or** $\frac{b}{35}$ where $b < 35$ **and** b = "6 + 5" **or** 11 : 35 B1 only for $\frac{6+5}{6+5+1+23}$ **or** $\frac{11}{70} \div \frac{35}{70}$ oe)

		cas			***Total 10 marks***

Question		Working	Answer	Mark	Notes
Throughout allow 3.1, 3.14, etc or $\frac{22}{7}$ for π					
4	(a)	$\frac{80}{360}\times\pi\times2\times6.6$ oe		2	M1 for a correct method to find the arc length
			9.22		A1 awrt 9.1 or 9.2 or $\frac{44}{15}\pi$
	(b)	$\frac{80}{360}\times\pi\times6.6^2\left[=\frac{242}{25}\pi=30.4(1...)\right]$ **or** $\frac{5}{12}\times\frac{80}{360}\times\pi\times6.6^2$		2	M1 for a correct method to find the area of *OCD* **or** for a correct method to find the shaded area
			12.7		A1 awrt 12.5 or 12.6 or 12.7 or $\frac{121}{30}\pi$

	(c)	$\left[OBE =\right]"12.7..."+\frac{80}{360}\times\pi\times1.1^2$ $[="\frac{121}{30}\pi"+\frac{121}{450}\pi=\frac{968}{225}\pi$ $="12.7..."+"0.844..."=13.5...]$ **or** $OB^2-1.1^2=6.6^2\times\frac{5}{12}$		3	M1 for method to find area *OBE* [(b) + *OAF*] Follow through their answer to part (b) If following through their answer from part (b) working for this method mark must be shown Condone a slip on $\frac{80}{360}\times\pi\times1.1^2$ eg omission of the squared provided the formula $\frac{\theta}{360}\times\pi r^2$ has been quoted **or** forms a correct equation for OB^2, where *OB* can be any letter(s) Allow $k\times OB^2-k\times1.1^2=k\times6.6^2\times\frac{5}{12}$ Where *k* can be any constant including 80 or $\frac{80}{2}$ oe or $\frac{80}{360}$ oe or 80π or $0.5\times80\pi$ oe eg $k=\frac{80}{2}$ => $\frac{80}{2}\times OB^2-48.4=726$ or $k=\frac{80}{9}$ then $\frac{80}{9}\times OB^2-\frac{484}{45}=\frac{484}{3}$
		$\left[OB^2=\right]"13.5..."\times\frac{360}{80\pi}[=19.36]$ oe eg $\left[OB^2=\right]"13.5..."\div\left(\frac{1}{2}\times\frac{4}{9}\pi\right)[=19.36]$ or $\left[OB^2=\right]1.1^2\times\frac{"13.5..."}{"0.844..."}[=19.36]$ or $\left[OB^2=\right]\frac{5}{12}\times6.6^2+1.1^2[=19.36]$ or $[OB=]\sqrt{\frac{968\pi/225}{242\pi/25}}\times6.6$ [= 4.4]			M1 for method to find OB^2 or *OB* "13.5…" is the candidate's area of *OBE* or (b) + *OAF* and "0.844…" is the candidate's area of *OAF* If either area is incorrect it must be clearly labelled and working for this method mark must be shown Allow $\left[OB^2=\right]\frac{k\times6.6^2\times\frac{5}{12}+k\times1.1^2}{k}$ Where *k* can be any constant including 80 or $\frac{80}{2}$ oe or $\frac{80}{360}$ oe or 80π or $0.5\times80\pi$ oe eg where $k=\frac{80}{2}$ then $\left[OB^2=\right]=\frac{726+48.4}{40}[=19.36]$ eg where $k=\frac{80}{9}$ then $\left[OB^2=\right]=\frac{161.\dot{3}+10.7\dot{5}}{8.\dot{8}}[=19.36]$

					NB: AB = 4.4 from no correct working is 0 marks
		$\sqrt{19.36}-1.1$	3.3		A1 awrt 3.3
		cas			***Total 7 marks***

Question		Working	Answer	Mark	Notes
5	(a)	$\mathrm{P}(RR)=\frac{8}{13}\times\frac{7}{12}\left(=\frac{56}{156}\right)$ oe $\mathrm{P}(BB)=\frac{5}{13}\times\frac{4}{12}\left(=\frac{20}{156}\right)$ oe $P(RB)=P(BR)=\frac{8}{13}\times\frac{5}{12}\left(=\frac{40}{156}\right)$ oe		3	M1 for one correct product Allow $\frac{8}{n}\times\frac{7}{n-1}$ $n>8$ **or** $\frac{5}{n}\times\frac{4}{n-1}$ $n>5$ **or** $\frac{8}{n}\times\frac{5}{n-1}$ $n>8$ OR Allow $\frac{8}{n}\times\frac{8}{n}$ $n>8$ **or** $\frac{5}{n}\times\frac{5}{n}$ $n>5$ **or** $\frac{8}{n}\times\frac{5}{n}$ $n>8$ Do not accept one of these within another product
		$\frac{8}{13}\times\frac{7}{12}+\frac{5}{13}\times\frac{4}{12}\left(=\frac{56}{156}+\frac{20}{156}\right)$ oe $1-2\times\frac{8}{13}\times\frac{5}{12}\left(=1-2\times\frac{40}{156}\right)$ oe			M1 for a complete method Implies previous method mark Allow $\frac{8}{n}\times\frac{7}{n-1}+\frac{5}{n}\times\frac{4}{n-1}$ **or** $1-2\times\frac{8}{n}\times\frac{5}{n-1}$
			$\frac{76}{156}$		A1 oe eg $\frac{19}{39}$ or 0.48(7…) rounded or truncated to 2sf
	(b)	$\frac{w}{w+11}$ or $\frac{w-1}{w+10}$ or $\frac{11}{w+11}$ or $\frac{10}{w+10}$		5	M1 for one correct probability expression
		$\frac{w}{w+11}\times\frac{w-1}{w+10}=\frac{10}{21}$ or $\frac{11}{w+11}\times\frac{10}{w+10}+2\times\frac{w}{w+11}\times\frac{11}{w+10}=1-\frac{10}{21}$			M1 for forming a correct equation Implies previous method mark Condone $\frac{w}{w+11}\times\frac{w}{w+11}=\frac{10}{21}$
		$11w^2-231w-1100(=0)$ $w^2-21w-100(=0)$			M1 (dep on previous method mark) for a correct 3 term quadratic (oe so look for signs reversed, does not need to equal zero eg allow $w^2-21w=100$)
		$(w=)\frac{--21\pm\sqrt{(-21)^2-4\times1\times(-100)}}{2\times1}$ $(w-25)(w+4)$			M1 for a correct method to solve their three term quadratic Implied by 25 (and –4) Working must be shown if their quadratic is incorrect to gain this method mark.

			25		A1 (dep on all of the previous marks being awarded) for 25 only
		(a) cas (b) wr			***Total 8 marks***

Question		Working	Answer	Mark	Notes
Throughout allow 3.1, 3.14, etc or $\frac{22}{7}$ for π					
6	(a)	$\frac{1660}{25}\times 8\left(=531.2\right)$		4	M1 for working with ratio to find the volume of the hemisphere. Condone $\frac{1660}{(25+8)}\times 8\left(=402.\dot{4}\dot{2}\right)$
		$\frac{2}{3}\pi r^3 = "531.2"$ oe			M1 for forming an equation in *r* Condone "531.2" being 1660 or $\frac{1660}{(25+8)}\times 8\left(=402.\dot{4}\dot{2}\right)$ or a value that has used 1660 in a seen calculation Condone $\frac{2}{3}\pi r^3$ being $\frac{4}{3}\pi r^3$
					M1 for forming an equation in *r* Implies both of the previous method marks 531.2 must be correct or from a correct calculation and equation must be using the formula for the volume of a hemisphere
			6.33		A1 awrt 6.3 or 6.4
	(b)	$\frac{1}{3}\pi\times "6.33"^2\times h$		3	M1 ft candidates answer to part (a) for an expression for the volume of the cone (which may be within an equation) eg $\frac{1}{3}\pi\times "6.33"^2\times h+\frac{2}{3}\pi\times "6.33"^3=1660$ or $\frac{1}{3}\pi\times "6.33"^2\times h=1660-"531.2"$
		$\frac{1}{3}\pi\times "6.33"^2\times h=1660-"531.2"$ oe eg $\frac{1}{3}\pi\times "6.33"^2\times h=1128.8$			M1 dep on the previous method mark being awarded For forming an equation in *h* Follow through their answer to part (a) If following through their answer from part (a) working for this method mark must be shown 531.2 must be correct or from a correct calculation
			26.9		A1 awrt 26 or 27
		cas			***Total 7 marks***

Question		Working	Answer	Mark	Notes
7	(a)	$\overrightarrow{OB} = \mathbf{a} + 3\mathbf{b} + \frac{1}{2}\mathbf{a}\left(= \frac{3}{2}\mathbf{a} + 3\mathbf{b}\right)$ or $\overrightarrow{BO} = -3\mathbf{b} - \frac{1}{2}\mathbf{a} - \mathbf{a}\left(= -\frac{3}{2}\mathbf{a} - 3\mathbf{b}\right)$		3	M1 for a correct method to find $\overrightarrow{OB}$ or $\overrightarrow{BO}$
		$\overrightarrow{AD} = -\mathbf{a} + \frac{3}{5}\left(\frac{3}{2}\mathbf{a} + 3\mathbf{b}\right)$ or $\overrightarrow{AD} = 3\mathbf{b} + \frac{1}{2}\mathbf{a} + \frac{2}{5}\left(-\frac{3}{2}\mathbf{a} - 3\mathbf{b}\right)$			M1 for a correct method to find $\overrightarrow{AD}$
			$-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}$		A1 for a correct answer oe
	(b) (i)	$\overrightarrow{CB} = -2\mathbf{b} + \mathbf{a} + 3\mathbf{b} + \frac{1}{2}\mathbf{a} = \frac{3}{2}\mathbf{a} + \mathbf{b}$		4	M1 for a correct expression for $\overrightarrow{CB}$ or $\overrightarrow{BC}$
		$\overrightarrow{AE} = m\left("-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}"\right)$ oe **or** $\overrightarrow{AE} = -\mathbf{a} + 2\mathbf{b} + k\left("\frac{3}{2}\mathbf{a} + \mathbf{b}"\right)$ oe $\overrightarrow{DE} = \lambda\left("-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}"\right)$ oe **or** $\overrightarrow{DE} = -\left("-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}"\right) - \mathbf{a} + 2\mathbf{b} + k\left("\frac{3}{2}\mathbf{a} + \mathbf{b}"\right)$ oe $\overrightarrow{CE} = k\left("\frac{3}{2}\mathbf{a} + \mathbf{b}"\right)$ oe **or** $\overrightarrow{CE} = -2\mathbf{b} + \mathbf{a} + \mu\left("-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}"\right)$ oe $\overrightarrow{BE} = -\alpha\left("\frac{3}{2}\mathbf{a} + \mathbf{b}"\right)$ oe **or** $\overrightarrow{BE} = -3\mathbf{b} - \frac{1}{2}\mathbf{a} + \beta\left("-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}"\right)$ oe			M1 for **one** correct expression for $\overrightarrow{AE}$ or $\overrightarrow{DE}$ or $\overrightarrow{CE}$ or $\overrightarrow{BE}$ or $\overrightarrow{EA}$ or $\overrightarrow{ED}$ or $\overrightarrow{EC}$ or $\overrightarrow{EB}$ ft part (a) and their $\overrightarrow{CB}$ or $\overrightarrow{BC}$ provided working for this method mark is shown
		eg $\overrightarrow{AE} = m\left("-\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}"\right)$ oe **and** $\overrightarrow{AE} = -\mathbf{a} + 2\mathbf{b} + k\left("\frac{3}{2}\mathbf{a} + \mathbf{b}"\right)$ oe **OR** eg $\overrightarrow{AD} = -\frac{1}{10}\mathbf{a} + \frac{9}{5}\mathbf{b}$ and $\overrightarrow{AE} = -\mathbf{a} + 2\mathbf{b} + k\left("\frac{3}{2}\mathbf{a} + \mathbf{b}"\right)$ and $\frac{-0.1}{-1+1.5k} = \frac{1.8}{2+k}$			M1 for **two** correct expressions for the same vector **OR** for **two** correct expressions for parallel vectors eg 2 of $\overrightarrow{AD}$, $\overrightarrow{DE}$, $\overrightarrow{AE}$ **AND** using ratios to form an equation in one variable that can lead to a solution ft part (a) and their $\overrightarrow{CB}$ or $\overrightarrow{BC}$ provided working for this method mark is shown
			$\frac{4}{7}$		A1 for $\frac{4}{7}$

(b)(ii)			7 : 3	2	B2 oe must be integers
		$\overrightarrow{AE} = -\frac{1}{7}\mathbf{a} + \frac{18}{7}\mathbf{b}$ **or** $\overrightarrow{DE} = -\frac{3}{70}\mathbf{a} + \frac{27}{35}\mathbf{b}$ **or** $m = \frac{10}{7}$ oe **or** $\lambda = \frac{3}{7}$ oe			(B1 for a correct simplified expression for $\overrightarrow{AE}$ or $\overrightarrow{DE}$ **or** correct value for m or λ where m is from $\overrightarrow{AE}$ and λ is from $\overrightarrow{DE}$ Allow if found in the working space of b(i))
		cas			***Total 9 marks***

Question		Working	Answer	Mark	Notes
8	(a)	$\frac{560-518}{560}[=0.075]$ or $\frac{560-518}{560}\times 100$ or $\frac{518}{560}[=0.925]$ or $\frac{518}{560}\times 100[=92.5]$		2	M1 for a method to find the percentage change Allow 518 – 560 for 560 – 518
			7.5 (%)		A1 allow –7.5(%)
	(b)	$\frac{126}{508+126+86}\times 360$		2	M1 for a method to find angle
			63		A1 cao
	(c)		$5 < w \leqslant 10$	1	B1 allow eg 5 – 10 or $5 < w < 10$
	(d)	$2.5\times 10(=25)$ $7.5\times 7(=52.5)$ $12.5\times 6(=75)$ $17.5\times 5(=87.5)$ $22.5\times 2(=45)$ $25+52.5+75+87.5+45(=285)$		4	M2 for at least **3** correct products added (need not be evaluated but must be added) **or** If not M2 then award M1 for *xf* calculated and added for at least 3 class intervals where *x* is a number in the range (including end points) OR correct mid-points used for at least 3 products but not added) [lower bound products are: 0, 35, 60, 75, 40] [upper bound products are: 50, 70, 90, 100, 50]
		$\frac{"285"}{30}$			M1 dep on at least M1 previously scored for dividing their sum by 30 Allow division by "30" provided addition or total under column seen The "285" can be a sum of products
			9.5		A1 oe

€	(e)	[US traders =] $29.50\times4\ [=118]$		5	M1 for method to find the cost in US	M2 for [US traders =] $29.50\times4\times0.92[=108.56]$
		[US traders =] $29.50\times0.92\ [=27.14]$			M1 for method to use the exchange rate	
		[French traders =] $1.72\times60+22.80$ $[=103.2+22.8=126]$			M1 for a method to find the total cost in France ie cost per kilo × 60 + delivery cost	M2 for [French traders =] $(1.72\times60)\times0.85=87.72$ $+\quad 22.80\times0.85=19.38$ $=107.10$
		[French traders =] "126" × 0.85 [=107.1]			M1 dep on previous method mark for a method to use the discount on the full amount, "126" must come from a correct calculation.	
			French with working		A1 for France with correct comparable figures **€108(.56) and €107(.10)** Award full marks for a correct answer with correct comparable figures provided it is not from obvious incorrect working	
$	(e)	[US traders =] $29.50\times4\ [=118]$		5	M1 for method to find the cost in US	
		[French traders =] $1.72\times60+22.80$ $[=103.2+22.8=126]$			M1 for a method to find the total cost in France ie cost per kilo × 60 + delivery cost	M2 for [French traders =] $(1.72\times60)\times0.85=87.72$ $+\quad 22.80\times0.85=19.38$ $=107.10$ M3 for [French traders =] 116(.41…)
		[French traders =] "126" × 0.85 [=107.1]			M1 dep on previous method mark for a method to use the discount on the full amount, "126" must come from a correct calculation.	
		[Delivery cost =] $22.80\div0.92\ [=24.78(2...)]$ [1kg of apples =] $1.72\div0.92\ [=1.86(9...)]$ [60kg of apples =] $103.2\div0.92\ [=112.17(3...)]$ [Delivery after discount=] $19.38\div0.92\ [=21.06(5...)]$ [1kg after discount =] $1.462\div0.92\ [=1.58(9...)]$ [60kg after discount =] $87.72\div0.92\ [=95.34(7...)]$			M1 for method to use the exchange rate This mark can be awarded at any stage	
			French with working		A1 for France with correct comparable figures **$118 and $116(.41…)**	

					Award full marks for a correct answer with correct comparable figures provided it is not from obvious incorrect working
		cas			***Total 13 marks***

Question		Working	Answer	Mark	Notes
9	(a)		$f(x) \geqslant -8$	1	B1 Allow f or y Allow $[-8,\infty)$ or $[-8,\infty]$ DO NOT allow $x \geqslant -8$
	(b)	$3\times 2^2 - 8$	4	1	B1 cao
(c) Allow any letter throughout for x or g(x) or h(x) or $g^{-1}(x)$ or $h^{-1}(x)$					
	(c)	$\left[g(x)=\right]2(x+1)^2 \pm ...$ **or** $\left[h(x)=\right]3(x+1)^2 \pm ...$ $\left[g(x)=\right]...(x+1)^2 \pm ...$ **or** $\left[h(x)=\right]...(x+1)^2 \pm ...$		7	M1 Attempting to complete the square for g(x) or h(x) where … can be any constant term(s) but not term(s) in x
		$\left[g(x)=\right]2(x+1)^2 - 5$ **or** $\left[h(x)=\right]3(x+1)^2 - 5$			M1 completing the square for g(x) or h(x)
		$\frac{g(x)+5}{2} = (x+1)^2$ **or** $\frac{h(x)+5}{3} = (x+1)^2$			M1 dep on at least one method mark being awarded. To award this mark the completed squared must be of the form $a(x+1)^2 \pm b$, $a\neq 1$, $b\neq 0$ For rearranging to get $(x+1)^2$ on its own.
		$\left[g^{-1}(x)=\right]\sqrt{\frac{x+5}{2}} - 1$ **or** $\left[h^{-1}(x)=\right]\sqrt{\frac{x+5}{3}} - 1$			A1 correct inverse function.
		$\left[hg^{-1}(x)=\right]\ 3\left("\sqrt{\frac{x+5}{2}} - 1"\right)^2 + 6\left("\sqrt{\frac{x+5}{2}} - 1"\right) - 2$ **or** $\left[hg^{-1}(x)=\right]3\left("\sqrt{\frac{x+5}{2}} - 1"+1\right)^2 - 5$ **or** $\left[gh^{-1}(x)=\right]\ 2\left("\sqrt{\frac{x+5}{3}} - 1"\right)^2 + 4\left("\sqrt{\frac{x+5}{3}} - 1"\right) - 3$			M1 dep on the third method mark being awarded for $hg^{-1}(x)$ or $gh^{-1}(x)$

		or $\left[\text{gh}^{-1}(x)=\right]2\left(\text{"}\sqrt{\frac{x+5}{3}}-1\text{"}+1\right)^2-5$			
		$3\left(\sqrt{\frac{x+5}{2}}-1\right)^2+6\left(\sqrt{\frac{x+5}{2}}-1\right)-2=6.1$ **or** $3\left(\text{"}\sqrt{\frac{x+5}{2}}-1\text{"}+1\right)^2-5=6.1$ **or** $2\left(\sqrt{\frac{6.1+5}{3}}-1\right)^2+4\left(\sqrt{\frac{6.1+5}{3}}-1\right)-3$ **or** $2\left(\text{"}\sqrt{\frac{6.1+5}{3}}-1\text{"}+1\right)^2-5$			M1 dep on previous method mark being awarded $\text{hg}^{-1}(x)=6.1$ or $\text{gh}^{-1}(6.1)$
			2.4		A1 oe dep on at least one M1 awarded
		(a) cas, (b) cas, (c) wr			***Total 9 marks***

ALTERNATIVE METHOD 2					
	(c)	$2x^2+4x-3-y[=0]$ **or** $3x^2+6x-2-y[=0]$			M1 for a correct first step of arranging all terms on the same side of an equation / expression
		$[g^{-1}(x)=]\dfrac{-4\pm\sqrt{16-4\times2\times(-y-3)}}{4}$ **or**			M1dep for applying the quadratic formula allow one sign error and ± or + or –
		$[h^{-1}(x)=]\dfrac{-6\pm\sqrt{36-4\times3\times(-y-2)}}{6}$			M1dep on first M being awarded for applying the quadratic formula correctly allow ± or + or –
		$[g^{-1}(x)=]\dfrac{-4+\sqrt{16-4\times2\times(-x-3)}}{4}$ **or** $[h^{-1}(x)=]\dfrac{-6+\sqrt{36-4\times3\times(-x-2)}}{6}$			A1 correct inverse function (must only have +) $[g^{-1}(x)=]\dfrac{-4+\sqrt{40+8x}}{4}$ $[h^{-1}(x)=]\dfrac{-6+\sqrt{60+12x}}{6}$
		$\left[hg^{-1}(x)=\right]\ 3\left("\dfrac{-4\pm\sqrt{16-4\times2\times(-x-3)}}{4}"\right)^2+6\left("\dfrac{-4\pm\sqrt{16-4\times2\times(-x-3)}}{4}"\right)-2$ **or** $\left[hg^{-1}(x)=\right]3\left("\dfrac{-4\pm\sqrt{16-4\times2\times(-x-3)}}{4}"+1\right)^2-5$ **or** $\left[gh^{-1}(x)=\right]2\left("\dfrac{-6\pm\sqrt{36-4\times3\times(-x-2)}}{6}"\right)^2+4\left("\dfrac{-6\pm\sqrt{36-4\times3\times(-x-2)}}{6}"\right)-3$ **or** $\left[gh^{-1}(x)=\right]2\left("\dfrac{-6+\sqrt{36-4\times3\times(-x-2)}}{6}"+1\right)^2-5$			M1 dep on third method mark being awarded for $hg^{-1}(x)$ or $gh^{-1}(x)$
		$3\left("\dfrac{-4\pm\sqrt{16-4\times2\times(-x-3)}}{4}"\right)^2+6\left("\dfrac{-4\pm\sqrt{16-4\times2\times(-x-3)}}{4}"\right)-2=6.1$			M1 dep on previous method mark being awarded $hg^{-1}(x)=6.1$ or $gh^{-1}(6.1)$

		or $3\left(\text{"}\frac{-4\pm\sqrt{16-4\times2\times(-x-3)}}{4}\text{"}+1\right)^2-5=6.1$ **or** $2\left(\text{"}\frac{-6\pm\sqrt{36-4\times3\times(-6.1-2)}}{6}\text{"}\right)^2+4\left(\text{"}\frac{-6\pm\sqrt{36-4\times3\times(-6.1-2)}}{6}\text{"}\right)-3$ **or** $2\left(\text{"}\frac{-6\pm\sqrt{36-4\times3\times(-6.1-2)}}{6}\text{"}+1\right)^2-5$			
			2.4		A1 oe

ALTERNATIVE METHOD 3					
	(c)	$3x^2 + 6x - 2 = 6.1$			M1 for h(x) = 6.1
		$3x^2 + 6x - 2 - 6.1[= 0]$			M1 for h(x) = 6.1 **and** arranging all terms on the same side of an equation / expression
		$[x =]\dfrac{-6 \pm \sqrt{36 - 4 \times 3 \times -8.1}}{6}$			M1 dep for applying the quadratic formula allow one sign error and ± or + or –
		$[x =]\dfrac{-6 \pm \sqrt{36 - 4 \times 3 \times -8.1}}{6}$			M1dep on second M being awarded for applying the quadratic formula correctly allow ± or + or –
		$[x =]\dfrac{-6 + \sqrt{36 - 4 \times 3 \times -8.1}}{6} = \dfrac{-10 + \sqrt{370}}{10}$			A1 (must only have +)
		$2\left("\dfrac{-10 \pm \sqrt{370}}{10}"\right)^2 + 4\left("\dfrac{-10 \pm \sqrt{370}}{10}"\right) - 3$ oe			M1 dep on previous method mark being awarded for $g\left(\dfrac{-10 + \sqrt{370}}{10}\right)$
			2.4		A1 oe
					Total 9 marks

Question		Working	Answer	Mark	Notes
10	(a)		−3, 6, 0, 9	3	B3 for all 4 correct values (B2 for 3 correct (B1 for 2 correct))
	(b)		A smooth curve passing through all the points	3	B3 for a fully correct curve. Do not allow straight line segments (B2 for a smooth curve going through at least 5 correct points or at least 7 correct points plotted but joined by line segments B1 at least 7 correct points plotted but not joined) NB: If you are unable to see the points then allow if curve or line segment passes through or on the circles.
	(c)			2	M1 for a tangent drawn which must touch the curve at $x = -2$
			19		A1 dep on M1 for 15 – 23
	(d)			3	M1 for the line $y = 1$ drawn on the grid provided the curve has at least two solutions at $y = 1$
			$-1.8 < x < 0.4$		A1 dep on M1 for $-1.8 < x < 0.4$ allow ± 0.1 and $\leqslant$ signs A0 if values are given to > 2dp
			$1.3 < x < 2.5$		A1 dep on M1 for $1.3 < x < 2.5$ accept $x > 1.3$ allow ± 0.1 and $\leqslant$ or $\geqslant$ signs A0 if values are given to > 2dp
		(a) *cas*, (b) *cas*, (c) *wr* (d) *wr*			***Total 11 marks***

Question		Working	Answer	Mark	Notes	
In this question ignore any labelling of triangles even if incorrect						
11	(a)		Correct triangle B	2	B2 for triangle in correct position, eg vertices at (4, 1) (5, 1) (5, −2)	
					(B1 for triangle of correct size in correct orientation but wrong position)	
	(b)		Correct triangle C	2	B2 for triangle in correct position, eg vertices at (1, −2) (2, −2) (1, −5)	
					(B1 for a correct reflection in $y = a$ where $y \neq -0.5$)	
	(c)	Points can be in any order Could just be one correct point $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}\begin{pmatrix} -1 & -1 & -2 \\ 1 & 4 & 4 \end{pmatrix}$		3	M1 for intention to multiply the correct way, can be implied by writing the matrices in the correct order or correctly stating or plotting one point.	
		Points can be in any order $\begin{pmatrix} 2 & 2 & 4 \\ -2 & -8 & -8 \end{pmatrix}$			M1 for at least two correct columns or correctly stating or plotting two points.	
			Correct triangle E		A1 for triangle correctly drawn with vertices at (2, −2) (2, −8) (4, −8) Award 3 marks for a correct triangle drawn, irrespective of working in the working space.	
	(d)		enlargement	3	B1 for enlargement	B0 if multiple transformations stated. Multiple transformations are when more than one of reflection (mirrored), rotation (turn), translation (move), enlargement (stretch / squash) is stated eg a vector or SF or equation of a line do not imply multiple transformations
			scale factor 2		B1 for scale factor 2	These two marks can still be awarded if multiple transformations are stated
			centre (0, 10)		B1 centre (0, 10) must be a coordinate and not a vector Do not allow if another coordinate is given as well	

	(e)	A to F = $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ F to A = $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$		5	M1 for stating the correct matrix from A to F or from F to A **or** for stating a correct coordinate of triangle F which may be in a matrix [Coordinates of F = (–1, 1) (–1, 2), (–4, 1)]
		F to G = $\begin{pmatrix} \boxed{6} & 2 \\ 2 & 4 \end{pmatrix}$ oe A to G = $\begin{pmatrix} 2 & \boxed{2k-7} \\ 4 & -2 \end{pmatrix}$ oe A to F = $\begin{pmatrix} 0 & \boxed{5/2k-6} \\ 1 & \boxed{1-2k/4k-12} \end{pmatrix}$ oe G to F = $\begin{pmatrix} \boxed{0.2} & \boxed{-0.1} \\ \boxed{-0.1} & \boxed{0.3} \end{pmatrix}$ oe G to A = $\begin{pmatrix} \boxed{-2/24-8k} & \boxed{7-2k/24-8k} \\ \boxed{-4/24-8k} & \boxed{2/24-8k} \end{pmatrix}$ oe F to A = $\begin{pmatrix} \boxed{0.2k-0.1} & 1 \\ \boxed{0.4k-1.2} & 0 \end{pmatrix}$ oe			M1 correct transformation matrix F to G or G to F or correct transformation matrix in terms of *k* for A to G or G to A or A to F or F to A Where **at least one** of the elements in a $\boxed{\ }$ must be correct This mark and the following mark may be awarded in either order
		eg **N** = $\begin{pmatrix} 2 & -6 \\ 4 & -2 \end{pmatrix}$ oe **or** $\begin{pmatrix} 7-2k & 2 \\ 2 & 4 \end{pmatrix}^{-1} = \frac{1}{24-8k}\begin{pmatrix} 4 & -2 \\ -2 & 7-2k \end{pmatrix}$ oe eg $\begin{pmatrix} 0.2k-0.1 & 1 \\ 0.4k-1.2 & 0 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 1 & 0.1-0.2k \\ 0 & 1.2-0.4k \end{pmatrix}$ or $\begin{pmatrix} 7-2k & 2 \\ 2 & 4 \end{pmatrix}\begin{pmatrix} 0.2 & -0.1 \\ -0.1 & 0.3 \end{pmatrix} = \begin{pmatrix} 1.2-0.4k & 0.2k-0.1 \\ 0 & 1 \end{pmatrix}$			M1 for finding a **fully correct** inverse matrix **or** multiplying two matrices that are inverses of each other where one is in terms of *k* and **at least one** element in terms of *k* is correct This mark and the previous mark may be awarded in either order
					M1 for a correct equation to find *k* implies M4
			0.5		A1 oe Award full marks for a correct answer provided it is not from obvious incorrect working

					Total 15 marks

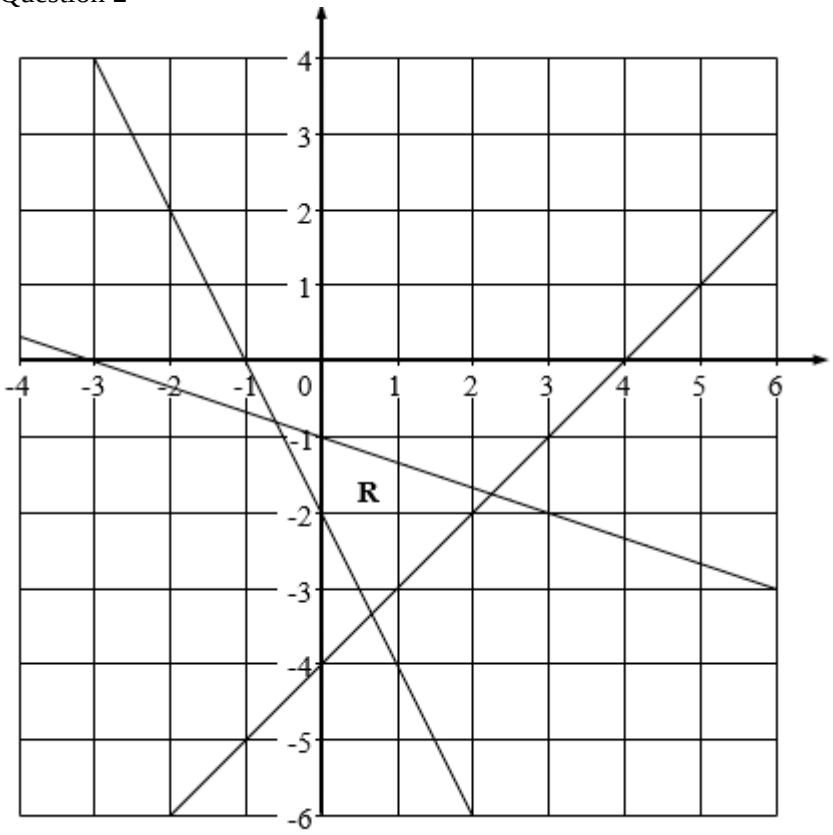
Work down the columns
Points can be any order, only need to use one point rather than all three
Award maximum of M1 for finding the inverse

For reference $A=\begin{pmatrix}1 & 2 & 1\\ 1 & 1 & 4\end{pmatrix}$

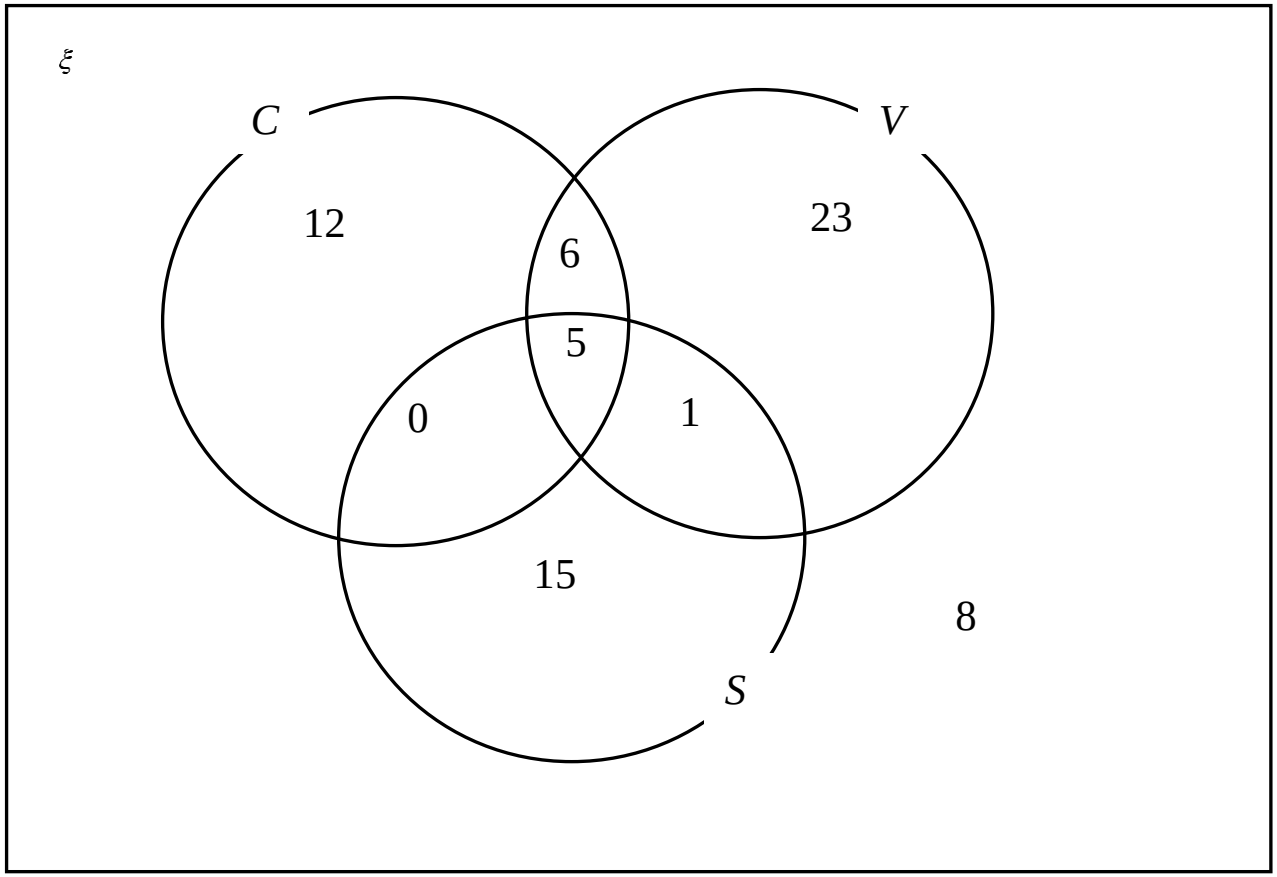
M1 for stating the correct matrix from A to F = $\begin{pmatrix}0 & -1\\ 1 & 0\end{pmatrix}$ or from F to A = $\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix}$ **or** for stating a correct coordinate of triangle F which may be in a matrix F = $\begin{pmatrix}-1 & -1 & -4\\ 1 & 2 & 1\end{pmatrix}$			For finding the inverse of $\mathbf{N}^{-1}$ $\mathbf{N}=\begin{pmatrix}2 & -6\\ 4 & -2\end{pmatrix}$ **or** correct coordinate of G $G=\begin{pmatrix}-4 & -2 & -22\\ 2 & 6 & -4\end{pmatrix}$	M1
For correct coordinate of G in terms of k. $G=\begin{pmatrix}2k-5 & 2k-3 & 8k-26\\ 2 & 6 & -4\end{pmatrix}$		For finding the inverse of $\mathbf{N}^{-1}$ $\mathbf{N}=\begin{pmatrix}2 & -6\\ 4 & -2\end{pmatrix}$ **or** correct coordinate of G $G=\begin{pmatrix}-4 & -2 & -22\\ 2 & 6 & -4\end{pmatrix}$	For $\begin{pmatrix}7-2k & 2\\ 2 & 4\end{pmatrix}^{-1}=\frac{1}{24-8k}\begin{pmatrix}4 & -2\\ -2 & 7-2k\end{pmatrix}$ **or** correct coordinate of F in terms of k. $F=\frac{1}{4k-12}\begin{pmatrix}10 & 10 & 40\\ 2k-11 & 6k-23 & -4k-8\end{pmatrix}$	M1
For correct coordinate of A in terms of k. $A=\begin{pmatrix}-0.2k+1.1 & -0.2k+2.1 & -0.8k+1.4\\ -0.4k+1.2 & -0.4k+1.2 & -1.6k+4.8\end{pmatrix}$	For finding the inverse of $\mathbf{N}^{-1}$ $\mathbf{N}=\begin{pmatrix}2 & -6\\ 4 & -2\end{pmatrix}$ **or** correct coordinate of G $G=\begin{pmatrix}-4 & -2 & -22\\ 2 & 6 & -4\end{pmatrix}$	For $\begin{pmatrix}7-2k & 2\\ 2 & 4\end{pmatrix}^{-1}=\frac{1}{24-8k}\begin{pmatrix}4 & -2\\ -2 & 7-2k\end{pmatrix}$ **or** correct coordinate of F in terms of k. $F=\frac{1}{4k-12}\begin{pmatrix}10 & 10 & 40\\ 2k-11 & 6k-23 & -4k-8\end{pmatrix}$	For correct coordinate of A in terms of k. $A=\begin{pmatrix}-0.2k+1.1 & -0.2k+2.1 & -0.8k+1.4\\ -0.4k+1.2 & -0.4k+1.2 & -1.6k+4.8\end{pmatrix}$	M1

Correct equation for *k* from equating coordinate of A	Correct equation for *k* from equating coordinate of G	Correct equation for *k* from equating coordinate of F	Correct equation for *k* from equating coordinate of A	M1
k = 0.5 (oe)				A1

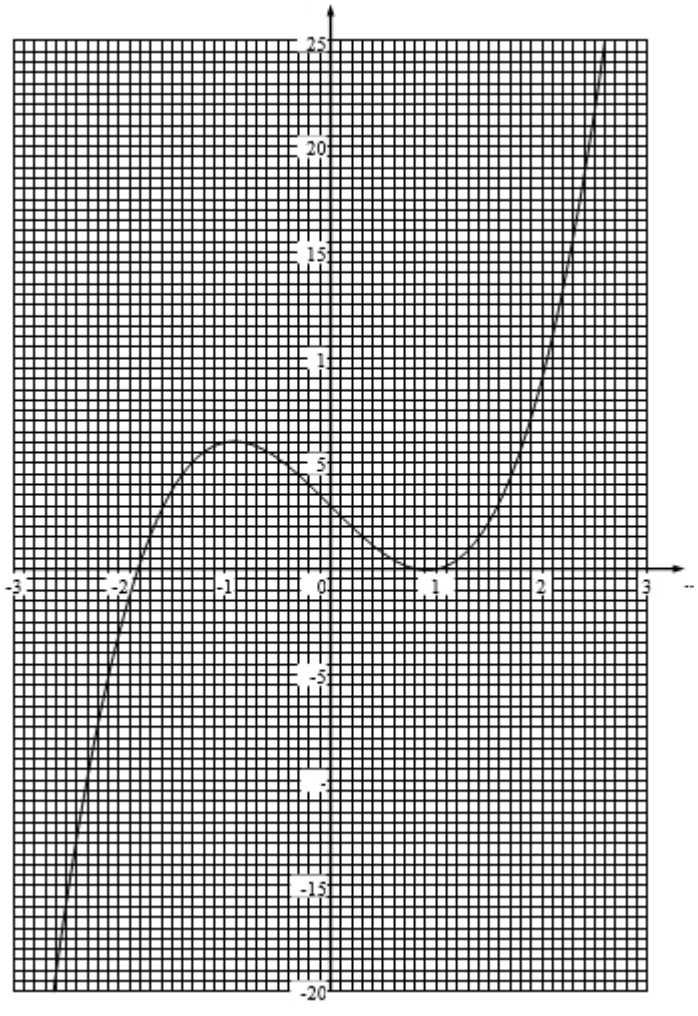
Question 2



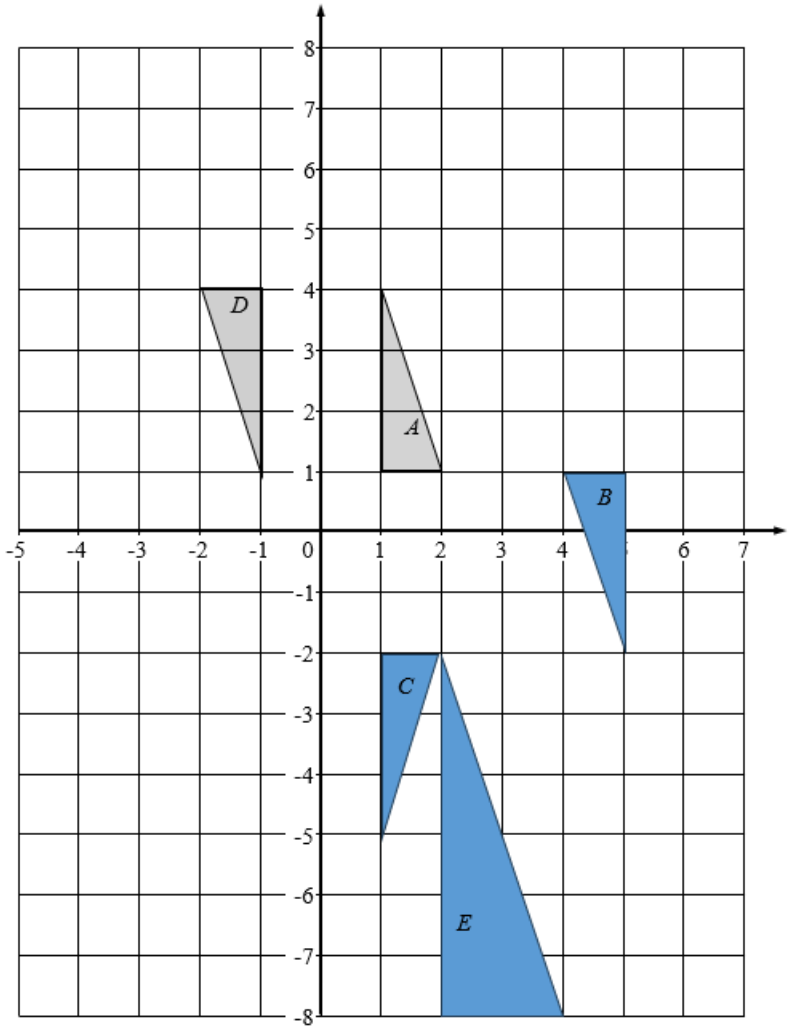
Question 3



Q10



Qu11



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