Mark Scheme (Results)

Summer 2024

Pearson Edexcel International GCSE
In Mathematics A (4MA1) Paper 2HR

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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

- **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, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.

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

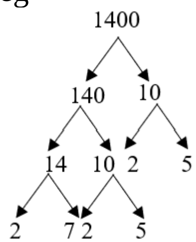
- **Ignoring subsequent work**

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.

<table>
<tr><td colspan="5">International GCSE Maths</td></tr>
<tr><td colspan="5">Apart from Questions 1, 6a, 10, 18, 20, 22 and 25 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method
Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.</td></tr>
<tr><th>Q</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td>1</td><td>eg
$2 \times 2 \times 350$
or $2 \times 7 \times 100$
or $2 \times 5 \times 140$
or $5 \times 7 \times 40$
or $5 \times 5 \times 56$
or $(14 \times 100 =)\ 2 \times 7 \times 100$
or ($28 \times 50 = 4 \times 7 \times 50 =)\ 2 \times 2 \times 7 \times 50 =$
or
<table><tr><td>2</td><td>1400</td></tr><tr><td>2</td><td>700</td></tr><tr><td></td><td>350</td></tr></table></td><td></td><td>3</td><td>M1 for 2 correct stages in prime factorisation with 0 incorrect stages
or
at least 3 stages in prime factorisation with no more than 1 incorrect stage.

Each stage gives 2 factors – may be in a factor tree or a table or listed eg 2, 2, 350 (see LHS for examples of the amount of work needed for the award of this mark).

Example of 3 stages with 1 incorrect stage:
$1400 = 10 \times 14 = 2 \times 5 \times 2 \times 7$</td></tr>
<tr><td></td><td>eg
2, 2, 2, 5, 5, 7
<table><tr><td>eg
<table><tr><td>2</td><td>1400</td></tr><tr><td>2</td><td>700</td></tr><tr><td>5</td><td>350</td></tr><tr><td>2</td><td>70</td></tr><tr><td>5</td><td>35</td></tr><tr><td></td><td>7</td></tr></table></td><td>eg
</td></tr></table></td><td></td><td></td><td>M1 dep on M1 for $2 \times 2 \times 2 \times 5 \times 5 \times 7$ or $2^3, 5^2, 7$ or $2^3 + 5^2 + 7$

(Ignore 1's)

(may be seen in a fully correct factor tree or ladder)</td></tr>
<tr><td></td><td></td><td>$2^3 \times 5^2 \times 7$</td><td></td><td>A1 dep on M2 (do not allow 1 in the final answer)
Can be in any order (allow $2^3 . 5^2 . 7$) but must be in index form as asked for.</td></tr>
<tr><td></td><td>Working required</td><td></td><td></td><td>Total 3 marks</td></tr>
</table>

2 (a)	Allow translated translating translate Allow misspelling of the word eg translat	Translation	2	B1	for translation (with none of reflection, rotation, enlargement, mirrored, turned, move or flipped stated) NB Move with translation is acceptable
		$\begin{pmatrix} 3 \\ -5 \end{pmatrix}$		B1	for (vector =) $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$
(b)		Shape drawn at (−6, −1) (−4, −1) (−4, −2) (−5, −2)	2	B2	condone missing label If not B2 then B1 for a correct trapezium drawn with correct orientation in wrong position **or** 3 points plotted correctly)
					Total 4 marks

3		(x =) 11 (and) (y =) 14	2	B2 (B1	for x = 11 and y = 14 for x = 11 or y = 14) SC B1 for x = 14 and y = 11
					Total 2 marks

4	(a)(i)		1, 2, 3, 5, 6, 7	1	B1	in any order with no repeats
	(a)(ii)		4, 5, 7, 8, 9, 10	1	B1	in any order with no repeats
	(b)	eg 1. 2 (**or** 3 **or** 2 and 3) is in both sets oe 2. *A* and *B* have 2 (**or** 3 **or** 2 and 3) oe 3. 2 (**or** 3 **or** 2 and 3) is common oe 4. 2 (**or** 3 **or** 2 and 3) is in the intersection oe 5. $A \cap B = \{2, 3\}$ oe or $A \cap B = \{2\}$ oe or $A \cap B = \{3\}$ oe 6. They share 2 (**or** 3 **or** 2 and 3)oe 7. As 2 and/or 3 are factors of 6 and also prime numbers oe Allow sector for set This is not an exhaustive list	2 (**or** 3 **or** 2 and 3) is a member of *A* and *B*	1	B1	for identifying the element 2 **or** 3 **or** 2 and 3 with a correct explanation to show they know the meaning of intersection and empty set If students mention a number that is common, it must be correct
	(c)		1, 5, 6, 7	2	B2 (B1	for 1, 5, 6, 7 for three correct values with no more than one incorrect or for four correct values with no more than one incorrect)
						Total 5 marks

5	$\sqrt{81}$ (= 9) **or** 9 **or** 9 × 9 (= 81)		4	M1	for method to find the length of the side of the square (may be seen on the diagram)
	4 × "9" (= 36) oe			M1	for the perimeter of the square (the first M mark can be implied by 36)
	eg $\pi \times$"9"$(= 28.2(743...)$ or $9\pi)$			M1	for a correct expression for the circumference for using $2\pi r$ or πD (the first M mark can be implied by 28.2(743…) rounded or truncated to 1 dp or by 9π)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	64.3		A1	accept 64.26 – 64.3
					Total 4 marks

6 (a)	eg $2f = 12f - 51$ **or** $\frac{f}{3} = \frac{4}{2}f - \frac{17}{2}$ **or** $\frac{f}{3} = 2f - \frac{17}{2}$ **or** $0.3f = 2f - 8.5$ **or** $f = 6f - \frac{51}{2}$ **or** $f = 6f - 25.5$ **or** $17 = 4f - \frac{2}{3}f$ **or** $17 = 4f - 0.6f$ **or** $17 = 4f - 0.7f$ **or** $\frac{2}{3}f - 4f = -17$ **or** $0.6f - 4f = -17$ **or** $0.7f - 4f = -17$		3	M1	for a correct first step – multiplying both sides by 3 correctly and expanding to find $2f = 12f - 51$ or $2f = -51 + 12f$ or writing the RHS as 2 terms each over 2 (Allow decimals to 1dp or better – rounded or truncated)
	eg $-10f = -51$ **or** $10f = 51$ **or** $\frac{5f}{3} = \frac{17}{2}$ **or** $5f = \frac{51}{2}$ or $17 = \frac{10f}{3}$ **or** $3.3f = 17$ **or** $-\frac{10f}{3} = -17$ **or** $-3.3f = -17$			M1	for a correct 2 term equation in the form *af* = *b* ft the following equations only $2f = 12f - 17$ oe $2f = 4f - 51$ oe $6f = 12f - 51$ oe (Allow decimals to 1dp or better – rounded or truncated)
	Working required	$\frac{51}{10}$		A1	(dep on at least M1) oe

6 (b)		1	1	B1	
(c)		$3a^3h^4$	2	B2	for $3a^3h^4$ oe B1 for a product in the form ka^ph^q where 2 from k, p or q are correct (allow multiplication signs) eg $5a^3h^4$ or $\frac{12a^3h^4}{4}$ (Allow $3a^3$ or a^3h^4 or $3h^4$ as long as not added to any other term)
(d)		$4x^3y(5x^2+3y^3)$	2	B2	for $4x^3y(5x^2+3y^3)$ B1 for any correct factorisation with at least a 2 term factor outside the bracket eg $2x^3y(10x^2+6y^3)$ **or** $x^3y(20x^2+12y^3)$ **or** $2x(10x^4y+6x^2y^4)$ **or** $4y(5x^5+3x^3y^3)$ **or** $4x^3(5x^2y+3y^4)$ etc **or** the correct highest common factor **and** a 2 term expression with at most one incorrect term eg $4x^3y(5x^2+\ldots)$ or $4x^3y(\ldots+3y^3)$
					Total 8 marks

7	eg 3^3 or $\left(3^{-2}\right)\times3^{-5}$ or $\frac{3^3}{\left(3^{10}\right)}$ or $\frac{\left(3^5\right)}{3^{12}}$ or $\frac{\left(3^{-2}\right)}{3^5}$ or $3^{-12}\left(\times3^5\right)$oe or $-2+5-10$ oe or $-12+5$ oe or $3-10$ oe		2	M1	for a correct application of an index rule as a first step or a correct calculation for n
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	-7		A1	Allow 3^{-7}
					Total 2 marks

8	$1 - 0.17$ or 0.83 or $\frac{83}{100}$ **or** 100(%) – 17(%) or 83(%) **or** $\frac{6225}{83}$ (= 75) oe		3	M1
	6225 ÷ "0.83" **or** 6225 ÷ "83" × 100 **or** 6225 × 100 ÷ "83" oe **or** 75 × 100			M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	7500		A1
				Total 3 marks

9	(a)		604 000	1	B1	
	(b)		7×10^{-5}	1	B1	
	(c)	380 000 or 3.8×10^5 or 38×10^4 oe		2	M1	
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	2×10^5		A1	Accept 2.0×10^5 or 2.00×10^5 etc Accept a dot or a comma for a multiplication sign eg $2 , 10^5$ $2 . 10^5$ SC B1 for 200 000 or 20×10^4 or 0.2×10^6 oe or 2×10^n where $n \neq 5$ when given as a final answer (not for incorrect simplification of the denominator)
						Total 4 marks

10	23 × 4.7 (= 108.1) oe			5	B1	(indep) May be embedded in 23 × (4.7 + 2.5) (= 165.6)
	$\sin 30 = \frac{(x)}{5}$ or $\frac{(x)}{\sin 30} = \frac{5}{\sin 90}$ oe where x = height of trapezium	$5\cos 30\left(= \frac{5\sqrt{3}}{2} = 4.33...\right)$ **and** $\left(x^2 =\right) 5^2 - "5\cos 30"^2 \left(= 6.25\right)$			M1	
	$\left(x =\right) 5\sin 30 (= 2.5)$ oe or $\left(x =\right) \frac{5}{\sin 90} \times \sin 30 \left(= 2.5\right)$ oe	$\left(x =\right) \sqrt{5^2 - "5\cos 30"^2} \left(= 2.5\right)$			M1	
	$\frac{1}{2} \times (11 + 23) \times "2.5" (= 42.5)$ oe or $\left(\frac{1}{2} \times "2.5" \times \left(23 - 11\right)\right) + \left(11 \times "2.5"\right) \left(= 42.5\right)$ oe or $\left(\frac{1}{2} \times "2.5" \times \left(23 - 11 - "4.3"\right)\right) + \left(11 \times "2.5"\right) + \left(\frac{1}{2} \times "2.5" \times "4.3"\right) \left(= 42.5\right)$ oe or $\left(11 \times "2.5"\right) + \left(\frac{1}{2} \times 5 \times \left(23 - 11\right) \times \sin 30\right) \left(= 42.5\right)$ oe or $\left(23 \times "2.5"\right) - \left(\frac{1}{2} \times "2.5" \times \left(23 - 11 - "4.3"\right)\right) - \left(\frac{1}{2} \times "2.5" \times "4.3"\right) \left(= 42.5\right)$ oe or $\left(23 \times \left("2.5" + 4.7\right)\right) - \left(\frac{1}{2} \times "2.5" \times \left(23 - 11 - "4.3"\right)\right) - \left(\frac{1}{2} \times "2.5" \times "4.3"\right)$ oe				M1	for a correct method to find the area of the trapezium or the whole shape
	Working required		150.6		A1	dep on M1 awrt 150.6 Allow 151 Accept $\frac{753}{5}$
						Total 5 marks

11	(a)	**USE OVERLAY** (NB: a 'bar chart' type graph scores zero marks) (ignore any part of the graph before (5, 6))		2	B2	for a fully correct cf graph – points at ends of intervals and joined with curve or line segments. (B1 for 5 correct points plotted and joined or B1 for 6 correct points plotted but not joined or B1 for 5 or 6 points plotted consistently within each interval (not at upper end) at their correct heights **and** joined eg plotted at 2.5, 7.5, 12.5, 17.5, 22.5, 27.5
	(b)	Readings are [8 – 9.5] and [21 – 23] (but for this M1 these do not have to be correct if correct working is shown – eg lines or marks indicating a **correct use** of CF 15 and CF 45 with an indication on the time axis at the correct points (or they can just show the correct readings))		2	M1ft	for a correct method to **allow** readings to be taken on the time axis from cf 45 (or 45.75) and from cf 15 (or 15.25) oe ft from their cf graph
		If a graph is drawn, answer is in the given range then award the marks	11.5 – 13.5		A1ft	Accept a single value in the range **or** ft from their cf graph
	(c)	35 or lines or marks indicating use of CF 35 or an indication on the time axis at the correct point (or they can just show the correct reading)		2	M1ft	for using or stating 35 (ft from incorrect graph if method shown)
		If a graph is drawn, answer is in the given range then award the marks	16.5 – 18.5		A1ft	ft from their cf graph
	(d)		$\frac{11}{60}$	1	B1	Accept 0.18(333….) or 18.(333…)%
						Total 7 marks

12 (a)	$(AD=)10\times1.5$ (= 15) oe		2	M1	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	5		A1	
(b)	$(2x+5)+(3x-5)=1.5\times(2x+5)$ oe or $5x=1.5\times(2x+5)$ oe or $5x = 3x + 7.5$ oe or $\frac{3x-5}{2x+5}=\frac{1}{2}$ oe		2	M1	for a correct equation for x
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	3.75		A1	oe eg $\frac{15}{4}$ or $3\frac{3}{4}$
					Total 4 marks

13	$\frac{60}{360}\times 2\times\pi\times r$ oe or $\frac{1}{6}\times 2\times\pi\times r$ oe		3	M1	for finding the length of the arc
	$"\frac{60}{360}\times 2\times\pi\times r"+2r$ oe or $"\frac{1}{6}\times 2\times\pi\times r"+2r$ oe			M1	dep on M1 for a complete expression from correct working for a method for the perimeter
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$P=r\left(\frac{1}{3}\pi+2\right)$		A1	oe eg $P=r\left(0.33...\pi+2\right)$ or $P=\left(\frac{1}{3}\pi+2\right)r$ or $P=\left(2+\frac{120}{360}\pi\right)r$ or $P=\left(\frac{120}{360}\pi+2\right)r$
					Total 3 marks

14	0.24 ÷ 0.8 (= 0.3) oe		3	M1	
	"0.3" × (1 – 0.8) oe or "0.3" × 0.2 oe or 1 – ("0.3" × 0.8 + 0.7 × 0.8 + 0.7 × 0.2) oe or 1 – 0.94 oe			M1	for a complete method
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	0.06		A1	oe eg $\frac{3}{50}$ or $\frac{6}{100}$ or 6%
					Total 3 marks

15	360 ÷ 5 (= 72) oe or (5 – 2)×180 ÷ 5 (= 108) oe or 540 ÷ 5 (= 108) oe		3	M1	for a method to find an exterior or interior angle for a regular pentagon Do not award this mark if 108 is assigned as an exterior angle or 72 is assigned as an interior angle Ignore angles on the diagram other than exterior/interior angles of the pentagon even if incorrectly labelled
	$\frac{1}{2}\times 6.5\times 3\times \sin[\textit{angle DCE}]$ oe or $(h=)6.5\times\sin[\textit{angle DCE}](=6.18\ldots)$ **and** $\frac{1}{2}\times 3\times "6.18..."$ oe			M1	ft their angle *DCE* when substituting in $\frac{1}{2}\times 6.5\times 3\times \sin[\textit{angle DCE}]$ [*angle DCE*] means their angle *DCE* provided it is less than 90°
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	9.27		A1	accept 9.26 – 9.28 SC B2 for $\frac{1}{2}\times 6.5\times 3\times \sin"108" = 9.27\ldots$
					Total 3 marks

16 (i)		**E**	1	B1	
(ii)		**A**	1	B1	
					Total 2 marks

17	$\left(\text{fg}(k)=\right)\dfrac{3k+1}{2(3k+1)-4}$ oe or $\dfrac{3k+1}{2(3k+1)-4}=2$ oe or $\left(\text{fg}(k)=\right)\dfrac{3k+1}{6k-2}$ oe or $\dfrac{3k+1}{6k-2}=2$ oe or $x=2\left(2x-4\right)$ or $x=4x-8$ or $x=\dfrac{8}{3}$ oe		3	M1	for a correct expression for fg(k) or fg(x) or for f(x) = 2 Allow x instead of k for all marks
	$3k+1=2(6k-2)$ oe or $3k+1=2\left(2(3k+1)-4\right)$ oe or $3k+1=12k-4$ oe or $3k+1=\dfrac{8}{3}$ oe			M1	dep on M1 for **correctly** removing the denominator to form a correct equation or for g(k) = $\dfrac{8}{3}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\dfrac{5}{9}$		A1	oe eg 0.55(555…) rounded or truncated or $0.\dot{5}$ (must show recurring)
					Total 3 marks

18	eg $1000x = 306.306\ldots$ $\underline{\quad x = \quad 0.306\ldots}$ OR eg $1000\,000x = 306\,306.(\ldots)$ $\underline{\quad 1000x = \quad 306.306\ldots}$		2	M1	M1 for two correct **algebraic equations** involving recurring decimals that when subtracted give a whole number or terminating decimal (306 or 306 000 etc) with intention to subtract. eg $1000x = 306.306...$ and $x = 0.306....$ **or** $1000\,000x = 306306.(\ldots)$ and $1000x = 306.306$ (if recurring dots not shown in both numbers then showing at least **one** of the numbers to at least 6sf)
	eg $1000x - x = 306.306.... - 0.306306.... = 306$ **and** $\frac{306}{999} = \frac{34}{111}$ or $999x = 306$ **and** $\frac{306}{999} = \frac{34}{111}$ OR eg $1000\,000x - 1000x = 306306.(\ldots) - 306.306 = 306\,000$ **and** $\frac{306\,000}{999\,000} = \frac{34}{111}$ or $999\,000x = 306\,000$ **and** $\frac{306\,000}{999\,000} = \frac{34}{111}$	shown		A1	for completion to $\frac{34}{111}$ dep on M1
	Working required				**Total 2 marks**

19	18.5 **or** 19.5 **or** 1.45 **or** 1.55		3	B1	for one correct bound Allow $19.4\dot{9}$ for 19.5 Allow $1.54\dot{9}$ for 1.55
	(distance =) 19.5 × 1.55			M1	for $UB_s \times UB_t$ where $19 < UB_s \leqslant 19.5$ **and** $1.5 < UB_t \leqslant 1.55$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	30.2		A1	accept 30.225 or 30.23 answer must come from correct figures (19.5, 1.55)
					Total 3 marks

20	eg $(3x+4)(2x-5)$ **or** $(x=)\dfrac{--7\pm\sqrt{(-7)^2-4\times6\times(-20)}}{2\times6}$ oe **or** $6\left[\left(x-\dfrac{7}{12}\right)^2-\left(\dfrac{7}{12}\right)^2\right]-20$ oe		4	M1	first step to finding the critical values - if factorising (in the form ($ax+b$) where a and b are integers), allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as $\dfrac{7\pm\sqrt{49+480}}{12}$ oe **or** $6\left(x-\dfrac{7}{12}\right)^2-\dfrac{529}{24}$ oe or $\left(x-\dfrac{7}{12}\right)^2-\dfrac{529}{144}$ oe
	$(x=)\ -\dfrac{4}{3}$ and $\dfrac{5}{2}$ oe			A1	dep on M1 for two **correct** critical values Accept –1.3…… May use <, ≤, > or ≥ instead of =
				M1ft	(dep on M1 and two critical values found) for $x < a$ and $x > b$ where a is their lower critical value and b is their upper critical value **or** $x > \dfrac{5}{2}$ oe **or** $x < -\dfrac{4}{3}$ oe **or** $-\dfrac{4}{3} > x > \dfrac{5}{2}$ oe
	Working required	$x < -\dfrac{4}{3}$ $x > \dfrac{5}{2}$		A1	oe dep on previous M1 Accept –1.3…… or $\left(-\infty,-\dfrac{4}{3}\right),\left(\dfrac{5}{2},(+)\infty\right)$ or $\left(-\infty,-\dfrac{4}{3}\right)\cup\left(\dfrac{5}{2},(+)\infty\right)$ Do not ISW
					Total 4 marks

21	eg $\frac{5-2}{3-(-5)}\left(=\frac{3}{8}=0.375\right)$ oe or (2 = –5m + c and 5 = 3m + c leading to) $(m=)\frac{3}{8}(=0.375)$ or (C =) (6, −3) or (0, 13)		4	M1	for a method to find the gradient of AB **or** for finding the possible coordinates of C
	eg $\left[\frac{3}{8}\right]\times m=-1$ oe or $(m=)"-\frac{8}{3}"$ oe or $\frac{5-(-3)}{3-6}\left(=-\frac{8}{3}=-2.6(666...)\right)$ or $\frac{5-13}{3-0}\left(=-\frac{8}{3}=-2.6(666...)\right)$			M1ft	(indep) for finding the gradient of BC Allow perpendicular gradient to be truncated or rounded to 1 dp $\left[\frac{3}{8}\right]$ means their gradient of AB
	eg $5="-\frac{8}{3}"\times 3+c$ or c = 13 or $y="-\frac{8}{3}"x+13$ or $y-5="-\frac{8}{3}"(x-3)$ oe or $y--3="-\frac{8}{3}"(x-6)$ oe or $y-13="-\frac{8}{3}"(x-0)$ oe or $y-13="-\frac{8}{3}"x$ oe			M1ft	(ft dep on previous M1 for their perpendicular gradient) for substitution to find 'c' or to find an equation for BC If students find the coordinates of D [(–2, –6) or (–8, 10)] then allow for this mark $y--6="-\frac{8}{3}"(x--2)$ oe or $y-10="-\frac{8}{3}"(x--8)$ oe
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$8x+3y-39=0$		A1	oe a, b and c must be integers eg. $16x+6y=78$ or $-8x-3y+39=0$ or $3y=-8x+39$
					Total 4 marks

22	eg $x^2+(3x-1)^2=3x-1+11$	eg $\left(\frac{y+1}{3}\right)^2+y^2=y+11$		5	M1 for substitution of $y=3x-1$ (or $x=\frac{\pm y\pm 1}{3}$) into $x^2+y^2=y+11$ to obtain an equation in *x* only (or *y* only)
	$10x^2-9x-9(=0)$ oe **or** $10x^2-9x=9$ oe **or** $10x^2=9+9x$ oe	$10y^2-7y-98(=0)$ oe **or** $10y^2-7y=98$ oe **or** $10y^2=98+7y$ oe			M1ft dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of ax^2+bx+c (= 0) where at least 2 coefficients (*a* or *b* or *c*) are correct
	$(5x+3)(2x-3)(=0)$ **or** $(x=)\frac{9\pm\sqrt{(-9)^2-4\times 10\times(-9)}}{2\times 10}$ **or** $10\left[\left(x-\frac{9}{20}\right)^2-\left(\frac{9}{20}\right)^2\right]-9(=0)$ **or** $x=-0.6$ and $x=1.5=\frac{3}{2}$	$(5y+14)(2y-7)(=0)$ **or** $(y=)\frac{7\pm\sqrt{(-7)^2-4\times 10\times(-98)}}{2\times 10}$ **or** $10\left[\left(y-\frac{7}{20}\right)^2-\left(\frac{7}{20}\right)^2\right]-98(=0)$ **or** $y=-2.8=-\frac{14}{5}$ and $y=3.5=\frac{7}{2}$			M1ft dep on first M1 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{9\pm\sqrt{81+360}}{20}$ **or** $\frac{7\pm\sqrt{49+3920}}{20}$ **or** if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for *x* **or** correct values for *y* (Allow incorrect labels for *x* or *y* for this mark only)
	$(y=)$ 3 × "–0.6" – 1 (= –2.8) **and** $(y=)$ 3 × "1.5" – 1 (=3.5)	$(x=)\ \frac{"-2.8"+1}{3}(=-0.6)$ **and** $(x=)\frac{"3.5"+1}{3}(=1.5)$			M1ft dep on previous M1 for substituting **their** 2 found values of *x* or *y* into one of the two given equations **or** fully correct values for the other variable
	Working required		$x=-0.6$ $y=-2.8$ $x=1.5$ $y=3.5$		A1 oe dep on M2 for 4 correct values correctly labelled or correctly shown as coordinates
					Total 5 marks

23 (i)		(6, 7)	1	B1	
(ii)		(2, −3)	1	B1	
					Total 2 marks

24 (a)	eg $\frac{1}{3}\times\pi\times x^2\times 3x\left(=\pi x^3\right)$ oe **or** $\frac{1}{2}\times\frac{4}{3}\times\pi\times x^3\left(=\frac{4}{6}\pi x^3=\frac{2}{3}\pi x^3\right)$ oe **or** $\frac{4}{3}\times\pi\times(kx)^3$ oe		4	M1	for an expression for the volume of the cone **or** the hemisphere **or** the sphere NB Ignore missing brackets around *kx* for this mark Allow *r* for *x* for all M marks
	eg $\frac{4}{3}\times\pi\times(kx)^3=12.5\times\left(\frac{1}{2}\times\frac{4}{3}\pi x^3+\frac{1}{3}\pi x^2(3x)\right)$ oe **or** $\frac{4}{3}\times\pi\times(kx)^3=12.5\left(\frac{2}{3}\pi x^3+\pi x^3\right)$ oe **or** $\frac{4}{3}\times\pi\times(kx)^3=12.5\times\frac{5}{3}\pi x^3$ oe **or** $\frac{4}{3}\times\pi\times(kx)^3=\frac{125}{6}\pi x^3$ oe			M1	for a **correct** equation for the volumes NB If $(kx)^3$ not expanded at this stage then must see brackets
	eg $\left(k^3=\right)\frac{\frac{125}{6}\pi}{\frac{4}{3}\pi}$ oe **or** $\left(k^3=\right)\frac{125}{8}$ oe **or** $\left(k=\right)\sqrt[3]{\frac{125}{8}}$ oe $k^3x^3=\frac{12.5\times\frac{5}{3}\pi x^3}{\frac{4}{3}\pi}$ oe **or** $kx=\frac{\sqrt[3]{12.5\times\frac{5}{3}\pi x^3}}{\sqrt[3]{\frac{4}{3}\pi}}$ **or** $kx=\sqrt[3]{\frac{125x^3}{8}}$ oe			M1	for a **correct** calculation for *k* or k^3 or for a **correct** equation for *kx* or k^3x^3
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	2.5		A1	oe
(b)		64	1	B1	
					Total 5 marks

25 (a) (i)		$\frac{8}{5}\mathbf{a}+3\mathbf{b}$	1	B1oe	must be in simplest form eg $1.6\mathbf{a}+3\mathbf{b}$ or $\frac{8\mathbf{a}+15\mathbf{b}}{5}$
(ii)		$\frac{9}{4}\mathbf{b}-2\mathbf{a}$	1	B1oe	must be in simplest form eg $2.25\mathbf{b}-2\mathbf{a}$ or $\frac{9\mathbf{b}-8\mathbf{a}}{4}$
(b)	eg $\left(\overrightarrow{OM}=\right)2\mathbf{a}+\frac{3}{4}\mathbf{b}$ oe or $\left(\overrightarrow{OY}=\right)k\left(\text{"}\frac{8}{5}\mathbf{a}+3\mathbf{b}\text{"}\right)$ oe or $\left(\overrightarrow{YN}=\right)(1-k)\left(\text{"}\frac{8}{5}\mathbf{a}+3\mathbf{b}\text{"}\right)$ oe or $\left(\overrightarrow{OY}=\right)2\mathbf{a}+\frac{3}{4}\mathbf{b}+\lambda\left(\text{"}\frac{9}{4}\mathbf{b}-2\mathbf{a}\text{"}\right)$ oe or $\left(\overrightarrow{OY}=\right)3\mathbf{b}-\mu\left(\text{"}\frac{9}{4}\mathbf{b}-2\mathbf{a}\text{"}\right)$ oe		4	M1ft	ft their answers in (a) for a correct expression for a vector eg $\overrightarrow{OM}$ or $\overrightarrow{OY}$ or $\overrightarrow{YN}$ Students may use other variations eg $\overrightarrow{MO}$ or $\overrightarrow{YO}$ or $\overrightarrow{NY}$ For all M marks Allow any letter for k eg n, λ Allow any letter for λ eg μ
	eg $\left(\overrightarrow{OY}=\right)k\left(\text{"}\frac{8}{5}\mathbf{a}+3\mathbf{b}\text{"}\right)$ oe **and** $2\mathbf{a}+\frac{3}{4}\mathbf{b}+\lambda\left(\text{"}\frac{9}{4}\mathbf{b}-2\mathbf{a}\text{"}\right)$ oe or $\left(\overrightarrow{OY}=\right)k\left(\text{"}\frac{8}{5}\mathbf{a}+3\mathbf{b}\text{"}\right)$ oe **and** $3\mathbf{b}-\mu\left(\text{"}\frac{9}{4}\mathbf{b}-2\mathbf{a}\text{"}\right)$ oe or $\left(\overrightarrow{OM}=\right)2\mathbf{a}+\frac{3}{4}\mathbf{b}$ oe **and** $k\left(\text{"}\frac{8}{5}\mathbf{a}+3\mathbf{b}\text{"}\right)-\lambda\left(\text{"}-2\mathbf{a}+\frac{9}{4}\mathbf{b}\text{"}\right)$ oe or $\left(\overrightarrow{YN}=\right)(1-k)\left(\text{"}\frac{8}{5}\mathbf{a}+3\mathbf{b}\text{"}\right)$ oe **and** $-\lambda\left(\text{"}-2\mathbf{a}+\frac{9}{4}\mathbf{b}\text{"}\right)+\frac{3}{4}(3\mathbf{b})-\frac{1}{5}(2\mathbf{a})$ oe or $\left(\overrightarrow{OY}=\right)2\mathbf{a}+\frac{3}{4}\mathbf{b}+\lambda\left(\text{"}\frac{9}{4}\mathbf{b}-2\mathbf{a}\text{"}\right)$ **and** $3\mathbf{b}-\mu\left(\text{"}\frac{9}{4}\mathbf{b}-2\mathbf{a}\text{"}\right)$			M1ft	for 2 independent expressions for the same vector (may be embedded in a correct equation)
	eg $3k=\frac{3}{4}+\frac{9}{4}\left(1-\frac{4}{5}k\right)$ oe or $3k=3-\frac{9}{4}\left(\frac{4}{5}k\right)$ oe or $4k=3\left(\frac{5-4k}{5}\right)+1$ oe or λ = 0.5 oe or μ = 0.5 oe			M1	a **correct** equation for k or the correct value of λ or μ (cannot assume that Y is the midpoint of MR)
	Question requires a complete ***vector method*** *to be awarded marks*	$\frac{5}{8}$		A1oe	dep on M2
					Total 6 marks

26	$(3x-5)(x+2)$	$\frac{4(3x^2+x-10)-(3x-5)(4x-1)}{3x^2+x-10}$ oe or $\frac{27x-45}{3x^2+x-10}$		4	M1 for correctly factorising $3x^2+x-10$ to give $(3x-5)(x+2)$ (may be seen later on in working) **OR** combining 2 fractions into a correct single fraction
	$\frac{4x-1}{x+2}$ implies first M1	$\frac{4(3x^2+x-10)-(3x-5)(4x-1)}{(3x-5)(x+2)}$ or $\frac{27x-45}{(3x-5)(x+2)}$			M1 for inverting and cancelling giving a correct fraction **OR** for a correct single fraction where the denominator is factorised
	$\frac{4(x+2)-(4x-1)}{x+2}$ or $\frac{4x+8-4x+1}{x+2}$ or $\frac{4(x+2)}{x+2}-\frac{4x-1}{x+2}$ or $\frac{4x+8}{x+2}-\frac{4x-1}{x+2}$	$\frac{9(3x-5)}{(3x-5)(x+2)}$			M1 for a correct single fraction or two correct fractions with a common denominator **OR** for a correct fully factorised single fraction
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		$\frac{9}{x+2}$		A1
					Total 4 marks

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