Mark Scheme (Results)

November 2024

Pearson Edexcel International GCSE In Mathematics A (4MA1) Paper 1H

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

November 2024
Question Paper Log Number P75934A
Publications Code 4MA1_1H_2411_MS

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
    - 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.

  Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.

  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

  If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line 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 in another.

International GCSE Maths				
Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.				
Q	**Working**	**Answer**	**Mark**	**Notes**
1 (a)		$10 < p \square 15$	1	B1 allow $10 \square p \square 15$ or $10 < p < 15$ or $10 \square p < 15$ or 10 – 15
(b)	12.5 × 18 + 17.5 × 16 + 22.5 × 14 + 27.5 × 8 + 32.5 × 4 (= 1170) or 225 + 280 + 315 + 220 + 130 (= 1170) [lower bound products are: 180, 240, 280, 200, 120] [upper bound products are: 270, 320, 350, 240, 140] Sum of lower bound products = 1020 Sum of upper bound products = 1320 Sum of products using 11, 16, 21, 26 and 31 = 1080 Sum of products using 12, 17, 22, 27 and 32 = 1140 Sum of products using 13, 18, 23, 28 and 33 = 1200 Sum of products using 14, 19, 24, 29 and 34 = 1260		4	M2 for at least **4** correct products added (need not be evaluated) **or** If not M2 then award: M1 for consistent use of value within interval (including end points) for at least **4** products which must be added or correct midpoints used for at least **4** products and not added
	"1170" ÷ 60			M1 dep on at least M1 Allow division by their Σf provided addition or total under column seen
	Correct answer scores full marks (unless from obvious incorrect working)	19.5		A1 oe
				Total 5 marks

2		Fully correct angle bisector with all relevant arcs	2	B2 for a fully correct angle bisector with all arcs shown (the line and the arcs can intersect on or within the overlay guidelines) (B1 for all arcs and no angle bisector drawn or for a correct angle bisector within or on guidelines but no arcs or insufficient arcs) NB Overlay is available
				Total 2 marks

3	(a)		p^{15}	1	B1 cao
	(b)	$8n^2+6n+n^2-4n$		2	M1 for expanding with at least 3 correct terms (must see for example, $8n^2$ and not just $2n \times 4n$)(can assume that no sign in front of a number is a + if terms written in a list or table)
			$9n^2+2n$		A1 oe $2n+9n^2$ or $n(9n+2)$ or $n(2+9n)$
	(c)	eg $2x+5=12-3x$ or $\frac{2}{3}x+\frac{5}{3}=4-x$ oe		3	M1 for removal of fraction **and** multiplying out RHS correctly by 3 **or** separating fraction (LHS) in an equation
		eg $2x+3x=12-5$ or $5x=7$ or $5-12=-3x-2x$ or $-7=-5x$ or $\frac{2}{3}x+x=4-\frac{5}{3}$ oe or $\frac{5}{3}x=\frac{7}{3}$ oe			M1 ft (dep on 4 terms) correctly rearranging their 4 term equation for terms in x on one side of equation and number terms on the other
		Working required	$\frac{7}{5}$		A1 oe eg 1.4 or $1\frac{2}{5}$ dep on M2
					Total 6 marks

4	(a)		2 3 5 7	1	B1 All numbers must be present with no repeats and no other numbers. Numbers can be in any order Allow commas, colons, etc, between the numbers
	(b)		3 7	1	B1 Both numbers must be present with no repeats and no other numbers. Numbers can be in any order Allow commas, colons, etc, between the numbers
	(c)		2 4 5 6 8	1	B1 All numbers must be present with no repeats and no other numbers. Numbers can be in any order Allow commas, colons, etc, between the numbers
					Total 3 marks

5	$\pi \times 70^2 \times 18$ oe or $\pi \times 0.7^2 \times 0.18$ oe		4	M1 for use of $\pi r^2 h$
	88200π or 277 088(.472)) or 0.0882π or $\frac{441}{5000}\pi$ or 0.277(088472)			A1 Allow 276 948 – 277 200 or Allow 0.276 948 – 0.277 200
	"277 088(.472)" ÷ 1000 (= 277.088…) or $88200\pi \div 1000$ (= 88.2π or $\frac{441}{5}\pi$) "0.277(088472)" × 1000 (= 277.088…) or $88200\pi \div 1000$ (= 88.2π or $\frac{441}{5}\pi$)			M1 Allow a value for their volume which contains ***π***, **70** and **18** to be divided by 1000 Allow a value for their volume which contains ***π***, 0**.7** and **0.18** to be multiplied by 1000
	Correct answer scores full marks (unless from obvious incorrect working)	277		A1 awrt 277
				Total 4 marks

6	B1 for $2^2 \times 5^2$ oe or $2 \times 2 \times 5 \times 5$ oe or $2^2 \times 7$ oe or $2 \times 2 \times 7$ oe or $5^2 \times 7$ oe or $5 \times 5 \times 7$ oe or $2^2 \times 5 \times 7$ oe or $2 \times 2 \times 5 \times 7$ oe or $2 \times 5^2 \times 7$ oe or $2 \times 5 \times 5 \times 7$ oe or $2^2 \times 5^2 \times 7 \times 11$ or $2 \times 2 \times 5 \times 5 \times 7 \times 11$ oe or 700 or $2^p \times 5^q \times 7^r$ where two of p or q or r are correct	$2^2 \times 5^2 \times 7$	2	B2 Allow $2 \times 2 \times 5 \times 5 \times 7$ Answers must be a product of prime factors Can be in any order (allow $2^2 . 5^2 . 7$) Do not allow 1 in the final answer $2 \times 2 \times 5 \times 5 \times 7$ in working space and 700 on answer line award B2 $2^2 \times 5^2 \times 7$ in working space and 700 on answer line award B2 (B1 for $2^p \times 5^q \times 7^r$ where two of p or q or r are correct **or** one mistake in their product (see working on the left for examples) **or** for 700)
				Total 2 marks

7	475 × 0.16 (= 76) oe **or** 475 × (1 – 0.16) (= 399) oe		4	M1 (working for shop A)
	1 – 0.15 (= 0.85) **or** x – 0.15x = 408 **or** 100(%) – 15(%) (= 85(%)) **or** $\frac{408}{85}$ (= 4.8) oe			M1 (working for shop B)
	408 ÷ "0.85" (= 480) **or** 408 ÷ "85" × 100 (= 480) **or** 408 × 100 ÷ "85" (= 480) oe **or** "4.8" × 100 (= 480) **or** $\frac{408}{85}\times 15\left(=72\right)$			M1 (working for shop B)
	Working required	**A** **and** 72 and 76 seen		A1 dep on M2 for **A** with correct working (72 and 76 seen)
				Total 4 marks

8	(a)(i)	$(x\pm8)(x\pm3)$ or $x(x-3)+8(x-3)$ or $x(x+8)-3(x+8)$		2	M1 for $(x\pm8)(x\pm3)$ or $(x+a)(x+b)$ where $ab = -24$ or $a + b = 5$ and, a and b are integers
		Correct answer scores full marks (unless from obvious incorrect working)	$(x+8)(x-3)$		A1 for $(x+8)(x-3)$ Allow any letter for x Must be in the form $(x+a)(x+b)$ where a and b are integers
	(ii)		–8 and 3	1	B1 must ft from their answer in (a)(i) ft from their incorrect factors in the form $(x + a)(x + b)$ Award B0 for –8 and 3 if no marks scored in (a)(i)
	(b)	$3y-7y>-10-5$ or $5+10>7y-3y$		3	M1 allow use of = or condone incorrect inequality sign
		$-4y>-15$ or $15>4y$ or $y=\frac{15}{4}$ oe or			M1 allow use of = or condone incorrect inequality sign
		Working required	$y<\frac{15}{4}$		A1 dep on M1 oe eg $y < 3.75$ or $\frac{15}{4} > y$ or $3.75 > y$ Must have correct sign on answer line NB Sight of correct answer in working space and just $(y=)\frac{15}{4}$ oe on answer line gains M2 only
					Total 6 marks

9	(a)		0.000 084	1	B1 cao
	(b)	52×10^{145} or 5.2×10^{n} or $p \times 10^{146}$ where $1 \leq p < 10$		2	M1
		Correct answer scores full marks (unless from obvious incorrect working)	5.2×10^{146}		A1
					Total 3 marks

10	eg $51^2 = (DE)^2 + 24^2$ oe **or** $2601 = (DE)^2 + 576$ oe **or** $(DE^2 =) 51^2 - 24^2$ (= 2025) oe **or** $(DE^2 =) 2601 - 576$ (= 2025) oe **or** $\cos(DFE) = \frac{24}{51}$ **or** $\sin(DEF) = \frac{24}{51}$		5	M1 for applying Pythagoras theorem correctly
	$(DE =)\sqrt{51^2 - 24^2}$ (= $\sqrt{2025}$ = 45) **or** $(DE =)\sqrt{2601 - 576}$ (= $\sqrt{2025}$ = 45) **or** $(DFE =)\cos^{-1}\left(\frac{24}{51}\right)(= 61.9...)$ **or** $(DEF =)\sin^{-1}\left(\frac{24}{51}\right)(= 28.0...)$			M1 for square rooting
	$\frac{\textit{their } DE}{7.5}(= 6)$ oe **or** $\frac{7.5}{\textit{their } DE}\left(= \frac{1}{6}\right)$ **or** $\frac{x}{24} = \frac{7.5}{\textit{their } DE}$ oe **or** tan"*their* 61.9..." $= \frac{7.5}{(x)}$ **or** tan"*their* 28.0..." $= \frac{(x)}{7.5}$ **or** $\frac{(x)}{\sin(\textit{their } 28.0)} = \frac{7.5}{\sin(\textit{their } 61.9)}$ NB Their *ED* or their 61.9 or their 28.0 must be clearly identified Their 61.9.. or their 28.0.. cannot be used as lengths of the triangle Their 45 cannot be used as an angle of the triangle			M1 for a correct method to find the scale factor Allow correct use of sine rule/cosine rule/Pythagoras theorem Allow 0.17 or better for $\frac{1}{6}$ **Special case** Allow $(DE =)\sqrt{51^2 + 24^2}$ $(= \sqrt{3177} = 3\sqrt{353} = 56.3...)$ for "45" for this mark
	24 ÷ "6" oe **or** $24 \times "\frac{1}{6}"$ **or** 24 × "1.67" **or** $(x =)\frac{7.5}{\textit{their } ED} \times 24$ **or** $(x =)\frac{7.5}{\tan"\textit{their } 61.9..."}$ oe **or** $(x =) 7.5 \times \tan"\textit{their } 28.0..."$ oe **or** $(x =)\frac{7.5}{\sin(\textit{their } 61.9)} \times \sin(\textit{their } 28.0)$ oe **or** $51 \times "\frac{1}{6}"(= 8.5)$ **and** $(x =)\sqrt{8.5^2 - 7.5^2}\left(= \sqrt{16}\right)$			M1 dep on previous M1 for a correct method to find *x* or for finding *BC* **and** using Pythagoras theorem to find *x* Allow $24 \times "\frac{7.5}{56(.3...)}"$ **or** $24 \div "\frac{56(.3...)}{7.5}"$ for scale factor for this mark
	Working required	4		A1 dep on M2 The value of 4 must come from correct figures
				Total 5 marks

<table>
<tr><td>11 (a)</td><td><table>
<tr><td>x</td><td>0.5</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>5</td><td>4</td><td>5</td><td>6.7</td><td>8.5</td><td>10.4</td><td>12.3</td></tr>
</table></td><td>Four correct values</td><td>2</td><td>B2 oe

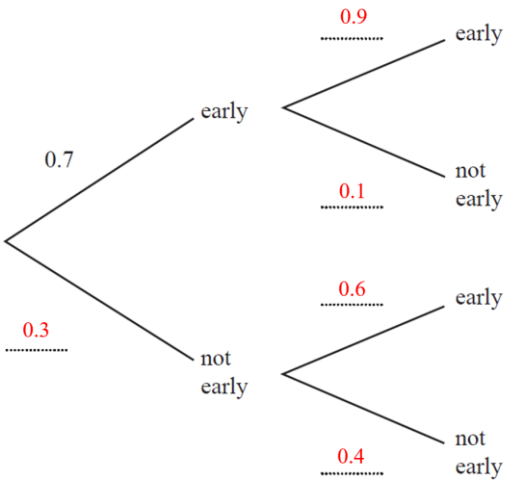
(B1 for 2 or 3 correct values of y)

May be awarded if plotted correctly on the graph</td></tr>
<tr><td>(b)</td><td></td><td>Correct graph</td><td>2</td><td>M1 ft their table dep on B1for at least 6 points plotted correctly (within or on the circles on the overlay)</td></tr>
<tr><td></td><td>Correct answer scores full marks (unless from obvious incorrect working)</td><td></td><td></td><td>A1 for correct curve between $x = 0.5$ and $x = 6$

Note: If a fully correct graph is shown, but an incomplete table is shown in (a), then award the marks for (a)

Ignore curve drawn for $x < 0.5$ and $x > 6$</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Total 4 marks</td></tr>
</table>

12	eg $\tan 47 = \frac{(BD)}{4250}$ **or** $\tan 24 = \frac{4250}{(BC)}$ **or** $\tan(47+"19") = \frac{(BC)}{4250}$ **or** $\frac{(BD)}{\sin 47} = \frac{4250}{\sin 43}$ **or** $(AD=)\frac{4250}{\cos 47}(=6231.686...)$ **or** $(AD=)\frac{4250}{\sin 43}(=6231.686...)$ **or** $(AC=)\frac{4250}{\sin 24}(=10\,449.021...)$ **or** $(AC=)\frac{4250}{\cos 66}(=10\,449.021...)$		4	M1
	eg $(BD=)4250\tan 47(=4557.567...)$ **or** $(BC=)\frac{4250}{\tan 24}(=9545.656...)$ **or** $(BD=)\frac{4250}{\sin 43}\times\sin 47(=4557.567...)$ **or** $\frac{(DC)}{\sin"19"} = \frac{"10449....."}{\sin"137"}$ **or** $\frac{(DC)}{\sin"19"} = \frac{"6231.686"}{\sin 24}$ **or** $(BC=)4250\times\tan(47+"19")(=9545.656...)$ **or** $(DC^2=)"6231"^2+"10\,449"^2-2\times"6231"\times"10\,449"\times\cos 19$			M1
	eg "9545.656" – "4557.567" (= 4988.089) **or** $(DC=)\frac{"6231.686"}{\sin 24}\times\sin 19$ **or** $(DC=)\frac{"10449....."}{\sin"137"}\times\sin"19"$ **or** $(DC=)\sqrt{"6231"^2+"10\,449"^2-2\times"6231"\times"10\,449"\times\cos 19}$			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)	4988		A1 allow in the range 4932 – 4990

13	(a)		Correct probabilities	2	B2 for all 3 correct pairs of probabilities on the correct branches If not B2 then award B1 for one correct pair of probabilities on a correct branch Allow equivalent fractions 0.7 and 0.3 counts as a pair
	(b)	0.7 × "0.9" oe		2	M1ft (probabilities < 1) for a complete method involving one product
		Correct answer scores full marks (unless from obvious incorrect working)	0.63		A1 ft oe eg $\frac{63}{100}$ or 63%
					Total 4 marks

14	$B = \frac{k}{d^2}$ oe	$Bk = \frac{1}{d^2}$ oe		3	M1 (NB Not for $B = \frac{1}{d^2}$) Constant of proportionality must be a symbol such as *k* Allow *D* or *b*	M2 for $0.25 = \frac{k}{12^2}$ oe or $0.25 \times k = \frac{1}{12^2}$ oe or
	$0.25 = \frac{k}{12^2}$ oe or $0.25 = \frac{k}{144}$ oe or $k = 36$	$0.25 \times k = \frac{1}{12^2}$ oe or $0.25 \times k = \frac{1}{144}$ oe or $k = \frac{1}{36}$			M1 for substitution of *B* and *d* into a **correct** formula	
	Correct answer scores full marks (unless from obvious incorrect working)		$B = \frac{36}{d^2}$		A1 e.g $B = 36 \times \frac{1}{d^2}$ or $B = 36 \times d^{-2}$ Award 3 marks if answer is $B = \frac{k}{d^2}$ on the answer line and $k = 36$ clearly given in the body of working of the script M2A0 for $Bd^2 = 36$ or $d = \frac{6}{\sqrt{B}}$ or $d^2 = \frac{36}{B}$	
						Total 3 marks

15	$3x(2x-1)=6x^2-3x$ or $3x(5x+4)=15x^2+12x$ or $(2x-1)(5x+4)=10x^2+8x-5x-4$ $(10x^2+3x-4)$		3	M1	An expansion with only one error. Do not award this mark for $6x^2 - 3x + 15x^2 + 12x$	M2 for 3 (out of a maximum of 4) of $30x^3+24x^2-15x^2-12x$
	$(6x^2-3x)(5x+4)=30x^3+24x^2-15x^2-12x$ $(15x^2+12x)(2x-1)=30x^3-15x^2+24x^2-12x$ $3x(10x^2+8x-5x-4)=30x^3+24x^2-15x^2-12x$ $3x(10x^2+3x-4)=30x^3+9x^2-12x$			M1	ft dep on M1 allow one further error	(M1 for 2 correct out of a maximum of 4)
	Correct answer scores full marks (unless from obvious incorrect working)	$30x^3+9x^2-12x$		A1	cao (terms may be in any order but must be simplified) dep on M1 accept $a = 30$, $b = 9$, $c = -12$ ISW correct factorisation eg $3(10x^3+3x^2-4x)$ Do not ISW incorrect simplification	
						Total 3 marks

16	$120 = \frac{1}{2} \times a \times b \times \sin 50$ oe or $\frac{120 \times 2}{\sin 50}$ oe or $120 = \frac{1}{2} \times 2x \sin 25 \times x \cos 25$ oe or $\frac{120 \times 2}{2 \times \sin 25 \times \cos 25}$ oe or 313(.2977494)		4	M1 for a **correct** equation for $a \times b$ or r^2 (allow any letters for a or b) or for a **correct** expression for $a \times b$ or r^2 or for 313(.2977494)
	$(radius =) \sqrt{\frac{120 \times 2}{\sin 50}}$ (= 17.7(0021891)) oe or $(radius =) \sqrt{\frac{120 \times 2}{2 \times \sin 25 \times \cos 25}}$ (= 17.7(0021891)) oe or $(radius =) \sqrt{313(.2977494)}$ (= 17.7(0021891))			M1 for a **correct** rearrangement to find the radius or for square rooting 313(.2977494) or for 17.7(0021891))
	(area of $OAPB =) \pi \times "17.7"^2 \times \frac{50}{360}$ oe			M1
	Correct answer scores full marks (unless from obvious incorrect working)	137		A1 awrt 137
				Total 4 marks

17	(a)		$5\sqrt{27}$	1	B1 Allow $n = 5$ Do not accept 5 by itself
	(b)	$\frac{5-\sqrt{2}}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ or $\frac{5-\sqrt{2}}{\sqrt{2}-1}\times\frac{-\sqrt{2}-1}{-\sqrt{2}-1}$		3	M1 for rationalising the denominator by multiplying numerator and denominator by $\sqrt{2}+1$ or $-\sqrt{2}-1$
		eg $\frac{5\sqrt{2}+5-2-\sqrt{2}}{2-1}$ oe or $\frac{5\sqrt{2}+5-2-\sqrt{2}}{\sqrt{4}+\sqrt{2}-\sqrt{2}-1}$ oe or $5\sqrt{2}+5-2-\sqrt{2}$			M1 (numerator must be expanded to 4 terms, denominator may be 4 terms which need to be all correct) Accept 1 in the denominator without working
		Working required	$3+4\sqrt{2}$		A1 or for stating $a = 3$ and $b = 4$ dep on M2
					Total 4 marks

18	eg two from 1.5 × 10 (= 15) or 0.8 × 15 (= 12) or 4 × 5 (= 20) or 2.5 × 30 (= 75) or 4.6 × 5 (= 23) or eg two from 15 or 12 or 20 or 75 or 23 **or** eg two from 150 or 120 or 200 or 750 or 230 or eg two from 6 or 4.8 or 8 or 30 or 9.2		4	M1 for at least two correct frequencies **or** for counting squares or blocks
	eg 1.5 × 10 + 0.8 × 15 + 4 × 5 + 2.5 × 30 + 4.6 × 5 (= 145) or 15 + 12 + 20 + 75 + 23 (= 145) **or** 150 + 120 + 200 + 750 + 230 (= 1450) 6 + 4.8 + 8 + 30 + 9.2 (= 58) **or** $\frac{1}{3}\times"12"+"20"+"75"(=99)$ 4 + 20 + 75 (= 99)			M1 for a method to find the number of students in each time interval with an intention to add Allow one error **or** for a method to find the total number of squares or blocks oe with an intention to add Allow one error **or** for a correct method to find the frequency between 20 and 60 minutes eg 4 + 20 + 75 M2 for a value of 99 for 20 – 60 minute interval
	eg $\frac{0.8\times5+"20"+"75"}{"15"+"12"+"20"+"75"+"23"}$ or $\frac{\frac{1}{3}\times"12"+"20"+"75"}{"145"}$ **or** $\frac{\frac{1}{3}\times"120"+"200"+"750"}{"1450"}$ or $\frac{\frac{1}{3}\times"4.8"+"8"+"30"}{"58"}\left(=\frac{39.6}{58}\right)$			M1 for a complete method Allow the one error in the previous M mark to follow through
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{99}{145}$		A1 oe but must be a fraction
				Total 4 marks

19	$\frac{30}{2}\left[2a+(30-1)d\right]=4395$ or $30a + 435d = 4395$ or $2a+29d=293$		5	M1 for using $S_n=\frac{n}{2}\left[2a+(n-1)d\right]$
	$a+(10-1)d+a+(20-1)d=284$ or $a+9d+a+19d=284$ or $2a+28d=284$ or $a+14d=142$			M1 for using $U_n=a+(n-1)d$ correctly to form an equation
	eg $2a+29d=293$ – $2a+28d=284$ ($d = 9$)	eg $28a+406d=4102$ – $29a+406d=4118$ ((–) a = (–) 16)		M1 dep on M2 for a correct method to eliminate a or d: coefficients of a or d the same **and** correct operator to eliminate selected variable (condone any one arithmetic error) **or** writing a or d in terms of the other variable and correctly substituting.
	$\frac{45}{2}\left[2(16)+(45-1)9\right]$			M1 dep on previous M1 for using $S_n=\frac{n}{2}\left[2a+(n-1)d\right]$ correctly with $a = 16$ and $d = 9$
	Working required	9630		A1 dep on M2
				Total 5 marks

20	$4\times 2x^3$ or $8x^3$ or ± 64		4	M1 for differentiating one term correctly
	$8x^3 - 64 = 0$ oe			M1 dep on M1 The equation must be in the form $ax^3 - 64 = 0$ oe where $a \neq 0$ or $8x^3 + b = 0$ oe where $b \neq 0$ where *a* and *b* are constants
	$x = \sqrt[3]{\frac{64}{8}} (= 2)$			M1 dep on previous M1 for solving for *x*. The equation must be in the form $ax^3 - 64 = 0$ oe where $a \neq 0$ or $8x^3 + b = 0$ oe where $b \neq 0$ where *a* and *b* are constants
	Working required	$y = -96$		A1 oe eg $y + 96 = 0$ or $y = 0x - 96$ or $-y = 96$ dep on M3 must be an equation in terms of *y* Do not accept –96 or (2, –96)
				Total 4 marks

21	28.35 or 28.45 or 16.5 or 17.5 or 87.5 or 92.5		3	B1 Accept $28.44\dot{9}$ for 28.45 $17.4\dot{9}$ for 17.5
	$(T =)\frac{28.45^2 + 17.5^2}{87.5}$ (= 12.75031429)			M1 for substituting the correct bounds into the formula for T $(T =)\frac{UB_x^{\ 2} + UB_y^{\ 2}}{LB_w}$ where $28.4 < UB_x \leq 28.45$ $17 < UB_x \leq 17.5$ $87.5 \leq LB_w < 90$
	Working required	12.8		A1 awrt 12.8 dep on M1 Answer must come from correct figures (28.45, 17.5 and 87.5)
				Total 3 marks

22	$\frac{1}{2}\times\frac{4}{3}\times\pi\times12^3\left(=1152\pi=3619.(114)\right)$ oe or $\frac{1}{2}\times\frac{4}{3}\times\pi\times9^3\left(=486\pi=1526.(814)\right)$ oe or $\frac{4}{3}\times\pi\times12^3\left(=2304\pi=7238(.229)\right)$ oe or $\frac{4}{3}\times\pi\times9^3\left(=972\pi=3053(.628)\right)$ oe		3	M1 for finding the volume of a sphere or a hemisphere
	$\frac{1}{2}\times\frac{4}{3}\times\pi\times12^3-\frac{1}{2}\times\frac{4}{3}\times\pi\times9^3$ oe or $"1152\pi"-"486\pi"\left(=666\pi\right)$ oe or $\frac{\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times9^3}{2}$ oe or $\frac{"2304\pi"-"972\pi"}{2}\left(=\frac{1332\pi}{2}=666\pi\right)$ oe			M1
	Correct answer scores full marks (unless from obvious incorrect working)	2092		A1 2091 – awrt 2093
				Total 3 marks

23	$\left(\frac{dy}{dx} =\right) 2x-8$ or $(x-4)^2$….. or $\left(x =\right)\frac{-1+9}{2}$		5	M1 for using differentiation **or** completing the square **or** by symmetry
	$x = 4$ or (4, –25) or (4, …) or $\frac{p+q}{2} = 4$ oe			M1
	$q = -3$ **or** $p = 11$			A1
	$(k =)(-3)^2 - 8(-3) - 9$ **or** $(k =)(11)^2 - 8(11) - 9$			M1
	Working required	24		A1 dep on M2
				Total 5 marks

23	$p^2 - 8p - 9 = k$ **and** $q^2 - 8q - 9 = k$ or $(p - 9)(p + 1) = k$ **and** $(q - 9)(q + 1) = k$		5	M1
ALT 1	$(q+14)^2 - 8(q+14) - 9 = q^2 - 8q - 9$ **or** $(p-14)^2 - 8(p-14) - 9 = p^2 - 8p - 9$ **or** $(q + 14 - 9)(q + 14 + 1) = (q - 9)(q + 1)$ **or** $(p - 9)(p + 1) = (p - 14 - 9)(p - 14 + 1)$ oe			M1 for a correct equation in one variable
	$q = -3$ **or** $p = 11$			A1
	$(k =)(-3)^2 - 8(-3) - 9$ **or** $(k =)(11)^2 - 8(11) - 9$			M1
	Working required	24		A1 dep on M2
				Total 5 marks

23	$(q+14)^2-8(q+14)-9(=k)$ **or** $(p-14)^2-8(p-14)-9(=k)$		5	M1
ALT 2	$(q+14)^2-8(q+14)-9=q^2-8q-9$ **or** $(p-14)^2-8(p-14)-9=p^2-8p-9$			M1 for a correct equation in one variable
	$q=-3$ **or** $p=11$			A1
	$(k=)(-3)^2-8(-3)-9$ **or** $(k=)(11)^2-8(11)-9$			M1
	Working required	24		A1 dep on M2
				Total 5 marks

23	$y=(x-4)^2-16-9$ oe or $k=(x-4)^2-25$ oe or $x^2-8x-9-k=0$		5	M1
ALT 3	$(x=)4\pm\sqrt{k+25}$ or $(x=)\dfrac{--8\pm\sqrt{(-8)^2-(4\times1\times(-9-k))}}{2\times1}$ oe or $(x=)\dfrac{8\pm\sqrt{100+4k}}{2}$ oe			M1
	$4+\sqrt{k+25}-\left(4-\sqrt{k+25}\right)=14$ oe or $\dfrac{8+\sqrt{100+4k}}{2}-\left(\dfrac{8-\sqrt{100+4k}}{2}\right)=14$ oe			A1 for a correct equation in one variable
	$25+k=\left(\dfrac{14}{2}\right)^2$ oe			M1
	Working required	24		A1 dep on M2
				Total 5 marks

24	(i)		$-10\mathbf{a}+2\mathbf{b}$	1	B1 or $2\mathbf{b}-10\mathbf{a}$ Must be simplified
	(ii)		$\frac{15}{2}\mathbf{a}+\frac{5}{2}\mathbf{b}$	1	B1 oe eg $7\frac{1}{2}\mathbf{a}+2\frac{1}{2}\mathbf{b}$ or $7.5\mathbf{a}+2.5\mathbf{b}$ Must be simplified
	(iii)	eg $\left(\overrightarrow{OR}="k"\overrightarrow{OP}=\right)"k"\left("\frac{15}{2}\mathbf{a}+\frac{5}{2}\mathbf{b}"\right)$ oe		4	M1 ft from part (ii) for $\overrightarrow{OR}$ $\overrightarrow{OP}$ must be in terms of **a** and **b** (lower case)
		eg $\left(\overrightarrow{OR}=\overrightarrow{OA}+\overrightarrow{AR}=\right)10\mathbf{a}+"\lambda"\left("-10\mathbf{a}+2\mathbf{b}"\right)\left(=\left(10-10"\lambda"\right)\mathbf{a}+2"\lambda"\mathbf{b}\right)$ oe or $\left(\overrightarrow{OR}=\overrightarrow{OQ}+\overrightarrow{QR}=\right)2\mathbf{b}-"\mu"\left("-10\mathbf{a}+2\mathbf{b}"\right)\left(=10"\mu"\mathbf{a}+\left(2-2"\mu"\right)\mathbf{b}\right)$ oe			M1 ft from part (i) for another path for $\overrightarrow{OR}$ $\overrightarrow{AQ}$ must be in terms of **a** and **b** (lower case)
		eg $\frac{15}{2}"k"=10-10"\lambda"$ oe **and** $\frac{5}{2}"k"=2"\lambda"$ oe or $"\lambda"=\frac{5}{8}$ oe or $\frac{5}{2}"k"=2-2"\mu"$ **and** $\frac{15}{2}"k"=10"\mu"$ oe or "*k*" = 0.5 oe			M1 for **correct** equations (not followed through equations)
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{15}{4}\mathbf{a}+\frac{5}{4}\mathbf{b}$		A1 oe eg $3\frac{3}{4}\mathbf{a}+1\frac{1}{4}\mathbf{b}$ or $3.75\mathbf{a}+1.25\mathbf{b}$
					Total 6 marks

25		$(y=)\,2(x^2-12x)+7$ **or** $(y=)\,2\left(x^2-12x+\frac{7}{2}\right)$ **or** $\frac{y-7}{2}=x^2-12x$	$(x=)\,2(y^2-12y)+7$ **or** $(x=)\,2\left(y^2-12y+\frac{7}{2}\right)$ **or** $\frac{x-7}{2}=y^2-12y$			M1 for a correct first step in order to complete the square For each method mark the function must be correct
		eg $(y=)\,2\left((x-6)^2-6^2\right)+7$ **or** $(y=)\,2\left((x-6)^2-6^2+\frac{7}{2}\right)$ **or** $(y=)\,2(x-6)^2-65$ oe **or** $\frac{y-7}{2}=(x-6)^2-6^2$ oe	eg $(x=)\,2\left((y-6)^2-6^2\right)+7$ **or** $(x=)\,2\left((y-6)^2-6^2+\frac{7}{2}\right)$ **or** $(x=)\,2(y-6)^2-65$ oe **or** $\frac{x-7}{2}=(y-6)^2-6^2$ oe			M1 dep on M1
		$(x-6)^2=\frac{y+65}{2}$ oe **or** $(x-6)^2=\frac{y-7}{2}+6^2$ oe	$(y-6)^2=\frac{x+65}{2}$ oe **or** $(y-6)^2=\frac{x-7}{2}+6^2$ oe			M1
		Correct answer scores full marks (unless from obvious incorrect working)		$6+\sqrt{\frac{x+65}{2}}$	4	A1 oe eg $6+\sqrt{\frac{x-7}{2}+36}$ Must be in terms of x M3A0 for $6\pm\sqrt{\frac{x+65}{2}}$ or $6\pm\sqrt{\frac{y+65}{2}}$ or $6+\sqrt{\frac{y+65}{2}}$
						Total 4 marks
Note: Allow candidates to swap *x* and *y* when finding the inverse						

25 ALT		$2x^2-24x+7-y(=0)$			M1 for a correct first step
		$(x=)\dfrac{24\pm\sqrt{576-8(7-y)}}{4}$ or $(x=)\dfrac{24+\sqrt{576-8(7-y)}}{4}$	$2\left((x-6)^2-6^2\right)+7-y(=0)$ or $2\left((x-6)^2-6^2+\dfrac{7}{2}\right)-y(=0)$		M1 dep on M1
		$(x=)6\pm\sqrt{\dfrac{y+65}{2}}$	$(x-6)^2=\dfrac{y+65}{2}$		M1
		Correct answer scores full marks (unless from obvious incorrect working)	$6+\sqrt{\dfrac{x+65}{2}}$	4	A1 oe eg $6+\sqrt{\dfrac{x-7}{2}+36}$ Must be in terms of x M3A0 for $6\pm\sqrt{\dfrac{x+65}{2}}$ or $6\pm\sqrt{\dfrac{y+65}{2}}$ or $6+\sqrt{\dfrac{y+65}{2}}$
					Total 4 marks
Note: Allow candidates to swap *x* and *y* when finding the inverse					

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom