



Mark Scheme (Results)

Summer 2026

Pearson Edexcel International GCSE Mathematics A
4MA1/1H

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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**

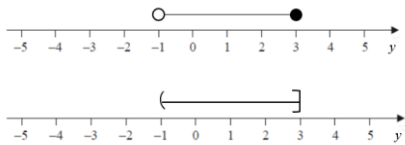
Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

Question	Working	Answer	Mark	Notes
1	$\frac{29}{7}(-)\frac{13}{5}$ or $(4)\frac{5}{35}(-)(2)\frac{21}{35}$ oe or $(4)\frac{5a}{35a}(-)(2)\frac{21a}{35a}$ oe		3	M1 for correct improper fractions or fractional part of numbers written correctly over a common denominator
	eg $\frac{145}{35} - \frac{91}{35}$ or $\frac{29 \times 5}{7 \times 5} - \frac{13 \times 7}{5 \times 7}$ or $\frac{29 \times 5 - 13 \times 7}{5 \times 7}$ or $\frac{145a}{35a} - \frac{91a}{35a}$ or $4\frac{5}{35} - 2\frac{21}{35} = 2\frac{-16}{35}$ oe or $2 + \frac{5}{35} - \frac{21}{35} = 2 - \frac{16}{35}$ oe or $3\frac{40}{35} - 2\frac{21}{35}$			M1 for correct fractions with a common denominator with subtraction sign present or for working with mixed numbers to the stage shown implies the first M1
	eg $\frac{145}{35} - \frac{91}{35} = \frac{54}{35} = 1\frac{19}{35}$ or $4\frac{5}{35} - 2\frac{21}{35} = 2\frac{-16}{35} = 1\frac{19}{35}$ or $4\frac{5}{35} - 2\frac{21}{35} = 3\frac{40}{35} - 2\frac{21}{35} = 1\frac{19}{35}$ If common denominator is not 35 then cancelling must be shown eg $\frac{290}{70} - \frac{182}{70} = \frac{108}{70} = \frac{54}{35} = 1\frac{19}{35}$ oe or $\frac{290}{70} - \frac{182}{70} = \frac{108}{70} = 1\frac{38}{70} = 1\frac{19}{35}$ oe or $4\frac{10}{70} - 2\frac{42}{70} = 2\frac{-32}{70} = 2\frac{-16}{35} = 1\frac{19}{35}$ oe	A fully correct solution shown		A1 dep on M2 for a correct answer from fully correct working If a student shows that $1\frac{19}{35} = \frac{54}{35}$ and has working that shows LHS = $\frac{54}{35}$ this can gain full marks NB: use of decimals scores no marks unless as a check
	Working required			Total 3 marks

Question	Working	Answer	Mark	Notes
2	eg $\cos 65 = \frac{x}{10}$ or $\tan 65 = \frac{10 \sin 65}{x}$ or $\sin(90 - 65) = \frac{x}{10}$ or $\frac{x}{\sin(90 - 65)} = \frac{10}{\sin 90}$ or $(x^2 =) 10^2 - (10 \sin 65)^2 (= 17.8(60...))$ or $(x^2 =) 10^2 - (9.06(307...))^2 (= 17.8(60...))$ or $(x^2 =) 10^2 + (10 \sin 65)^2 - (2 \times 10 \times 10 \sin 65 \times \cos 25) (= 17.8(60...))$ or $(x^2 =) 10^2 + 9.06^2 - (2 \times 10 \times 9.06 \times \cos 25) (= 17.8(60...))$		3	M1 for a correct trigonometrical statement for x or for a correct Pythagoras statement for x^2
	eg $(x =) 10 \cos 65$ or $(x =) \frac{10 \sin 65}{\tan 65}$ or $(x =) 10 \sin(90 - 65)$ or $(x =) \frac{10}{\sin 90} \times \sin(90 - 65)$ or $(x =) \sqrt{10^2 - (10 \sin 65)^2} (= \sqrt{17.8(60...)})$ or $(x =) \sqrt{10^2 - (9.06(307...))^2} (= \sqrt{17.8(60...)})$ or $(x =) \sqrt{10^2 + (10 \sin 65)^2 - (2 \times 10 \times 10 \sin 65 \times \cos 25)} (= \sqrt{17.8(60...)})$ or $(x =) \sqrt{10^2 + 9.06^2 - (2 \times 10 \times 9.06 \times \cos 25)} (= \sqrt{17.8(60...)})$			M1 for correct calculation to find x (implies the first M1)
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	4.23		A1 accept an answer in the range 4.22 – 4.23
				Total 3 marks

Question		Working	Answer	Mark	Notes
3	(a)(i)		1, 2, 4, 5, 10, 15	1	B1 correct values with no omissions, additional values or repeated values, can be in any order
	(ii)		1, 2, 4	1	B1 correct values with no omissions, additional values or repeated values, can be in any order
	(b)	Acceptable eg 2 is in both sets 5 is a prime number and a factor of 20 2 and 5 are in A and C The prime numbers 2 and 5 are factors of 20 Set A contains 2 and/or 5 which is prime $A \cap C = \{2, 5\}$ Not acceptable eg there are numbers in the list that are factors of 20 and prime A and C both have 1 in them 1, 2 and 5 are in set A and set C 1 and 2 are prime and in A There are prime numbers in A 5 is prime 5 is prime and a multiple of 5	2 and/or 5 are both prime and factors of 20	1	B1 for a correct statement identifying 2 and/or 5 belonging to both set A (factors of 20) and set C (prime numbers)
					Total 3 marks

Question		Working	Answer	Mark	Notes
4		eg $\frac{60}{24}$ (= 2.5) oe or 150 minutes or 2 hours 30 minutes or 12×1.25 (=15) oe or $12 \times \frac{75}{60}$ (=15) oe		4	M1 for a method to work out the time taken to cycle 60 km in hours or minutes or for a method to work out the distance Henri runs Allow use of 1.15 or 1.4 for this mark
		eg $\frac{60}{24}$ (= 2.5) oe or 150 minutes or 2 hours 30 minutes AND 12×1.25 (=15) oe or $12 \times \frac{75}{60}$ (=15) oe OR eg $\frac{60}{24}$ (= 2.5) oe or 150 minutes or 2 hours 30 minutes AND 2:1 oe or 1:2 oe			M1 for a method to work out the time taken to cycle 60 km in hours or minutes and the distance Henri runs Allow use of 1.15 or 1.4 for this mark OR for a method to work out the time taken to cycle 60 km in hours and minutes and the ratio of times as 2:1
		$\frac{60 + "15"}{"2.5" + 1.25}$ oe or $\frac{75}{3.75}$ oe or $\frac{60 + "15"}{"150" + 75}$ (= 0.333...) oe or $\frac{75}{225}$ oe or $\frac{2 \times 24 + 12}{3}$ oe			M1 for a method to find the average speed for the whole race. This may be in km/h or km/min Allow use of 1.15 or 1.4 for this mark
		<i>Working required</i>	20		A1 dep on M2 and correct use of time conversion
					Total 4 marks

Question		Working	Answer	Mark	Notes
5	(a)		$8e^2 - 12e$	1	B1
	(b)	$f^2 - 6f + 3f - 18$		2	M1 for any 3 terms correct or for 4 out of 4 correct terms ignoring signs or for $f^2 - 3f \dots$ or for $\dots - 3f - 18$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$f^2 - 3f - 18$		A1
	(c)	eg $t + 2n = ax$ or $-ax = -2n - t$ or $\frac{t}{a} = x - \frac{2n}{a}$		2	M1 for a correct first step
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$x = \frac{t + 2n}{a}$		A1 oe eg $x = \frac{t}{a} + \frac{2n}{a}$, must see $x =$ either in working or on answer line
	(d)		Correct diagram	2	B2 for a fully correct diagram, accept (for an open circle and] for a closed circle (B1 for drawing a line from -1 to 3 or (indep) for an open circle or (at -1 or (indep) for a closed circle or] at 3)
					Total 7 marks

Question	Working	Answer	Mark	Notes
6		$64x^{15}y^{18}$	2	B2 for $64x^{15}y^{18}$ (B1 a single product with 2 of 64, x^{15}, y^{18} correct eg $64x^{15}y^n$ where $n \neq 18$ or $64x^m y^{18}$ where $m \neq 15$ or $px^{15}y^{18}$ where $p \neq 64$. One term can be missing with 2 correct for B1 eg $64x^{15}$ or $64y^{18}$ or $(4)x^{15}y^{18}$ or $ax^{15}by^{18}$ where a and b are integers as long as not added to any other terms)
				Total 2 marks

Question	Working	Answer	Mark	Notes
7	$1 - (0.12 + 0.16) (= 0.72)$ oe or $0.12 + x + 2x + 0.16 = 1$ oe or $3x + 0.28 = 1$ oe or $0.12 \times 500 (= 60)$ oe or $0.16 \times 500 (= 80)$ oe or $(0.12 + 0.16) \times 500 (= 140)$ oe		4	M1
	$(x =) "0.72" \div 3 (= 0.24)$ oe or $(2x =) "0.72" \div 3 \times 2 (= 0.48)$ oe or $(500 - "140") \div 3 (= 120)$ oe or $(500 - "140") \div 3 \times 2 (= 240)$ oe			M1
	$("0.24" + 0.16) \times 500$ oe or $[1 - (0.12 + "0.48")] \times 500$ oe or $("0.24" \times 500) + "80"$ oe or $500 - ["60" + "0.48" \times 500]$ oe or $"120" + "80"$ oe or $500 - ["60" + "240"]$ oe			M1 or for $\frac{200}{500}$ or $\frac{300}{500}$ or 300
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	200		A1 cao
				Total 4 marks

Question		Working	Answer	Mark	Notes	
8		$70 \div 1000 (= 0.07 \text{ or } \frac{7}{100}) \text{ oe}$ or $70 \times 60 \times 60 (= 252\,000) \text{ oe}$ or $\frac{60 \times 60}{1000} \text{ or } \frac{3600}{1000} \text{ or } \frac{18}{5} \text{ or } 3.6$ or $\frac{1000}{60 \times 60} \text{ or } \frac{1000}{3600} \text{ or } \frac{5}{18} \text{ or } 0.27(777\dots)$ or $70 \times \frac{60}{1000} (= 4.2) \text{ oe}$		3	M1 for one of $\div 1000$ (eg sight of 0.07) or ($\times 60 \times 60$) or $\times 3600 \text{ oe}$ ie correct conversion of distance units or of time units	M2 for $70 \times 3.6 \text{ oe}$ or $70 \div \frac{5}{18} \text{ oe}$
		$70 \times \frac{60 \times 60}{1000} \text{ oe}$ eg $(4200 \div 1000) \times 60 \text{ oe}$			M1 for a fully correct method	
		<i>Working required</i>	252		A1 cao dep on M1	
					Total 3 marks	

Question		Working	Answer	Mark	Notes
9	(a)		6.51×10^{-2}	1	B1
	(b)	$32 \times 10^{56+74}$ or $32 \times 10^{130} \text{ oe}$ or 3.2×10^n where $n \neq 131$ or $p \times 10^{131}$ where $1 \leq p < 10$		2	M1
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	3.2×10^{131}		A1
					Total 3 marks

Question	Working	Answer	Mark	Notes
10	$\begin{array}{l} -4x + 3y = 9 \\ \text{eg } 4x - 4y = -26 \\ \textbf{Subtracting} \\ (3y - -4y = 9 - -26 \text{ or } 7y = 35) \\ \textbf{or} \\ 4\left(\frac{2y-13}{2}\right) + 3y = 9 \\ \textbf{or} \\ 2\left(\frac{9-3y}{4}\right) - 2y = -13 \end{array}$	$\begin{array}{l} +8x + 6y = 18 \\ \text{eg } 6x - 6y = -39 \\ \textbf{Adding} \\ (8x + 6x = 18 + -39 \text{ or } 14x = -21) \\ \textbf{or} \\ 4x + 3\left(\frac{2x+13}{2}\right) = 9 \\ \textbf{or} \\ 2x - 2\left(\frac{9-4x}{3}\right) = -13 \end{array}$	3	M1 for a correct method to eliminate x or y: coefficients of x or y the same and the correct operation to eliminate is selected; if operator not written, the correct operation can be implied by 2 out of 3 terms correct (condone any one error in multiplication) or writing x or y in terms of the other variable and correctly substituting (condone missing brackets) NB: the mark is for the method and not for the result of the method. However, if the correct result of the method is seen, the mark can be awarded
	$\begin{array}{l} \text{eg } 4x + 3 \times "5" = 9 \\ \textbf{or} \\ 2x - 2 \times "5" = -13 \\ \textbf{or} \\ x = \frac{2 \times "5" - 13}{2} \\ \textbf{or} \\ x = \frac{9 - 3 \times "5"}{4} \end{array}$	$\begin{array}{l} \text{eg } 4 \times " -1.5 " + 3y = 9 \\ \textbf{or} \\ 2 \times " -1.5 " - 2y = -13 \\ \textbf{or} \\ y = \frac{2 \times " -1.5 " + 13}{2} \\ \textbf{or} \\ y = \frac{9 - 4 \times " -1.5 "}{3} \end{array}$		M1 dep on M1 for a correct substitution to find the value of the second variable using their value from a correct method to find the first variable or for repeating above method to find second variable
	Working required	$\begin{array}{l} x = -1.5 \\ y = 5 \end{array}$		A1 dep on M1 oe eg $-\frac{3}{2}$
				Total 3 marks

Question		Working	Answer	Mark	Notes
11		$\frac{1}{2}\pi r^2 = 227$ oe or $\pi r^2 = 227 \times 2$ oe or $r^2 = 144.5...$ or $r = \sqrt{144.5...} (= 12(.02...))$		5	M1 for a correct equation or a correct calculation to find the radius of the semicircle
		$\frac{2\pi \times "12"}{2}$ oe or $\pi \times "12" (= 37.6(99...))$ or $\pi \times "12.02..." (= 37.7(661...))$ or $\pi \times [\text{their radius}]$			M1 for a method to find the arc length of the semicircle ft their value for the radius as long as clearly identified (may be on the diagram or in the working)
		$\sqrt{15^2 - "12"^2} (= 9)$ or $\sqrt{15^2 - "12.02..."^2} (= 8.9(7...))$ $\sqrt{15^2 - [\text{their radius}]^2}$			M1 for a complete method to find the height of the right angled triangle ft their value for the radius as long as clearly identified (may be on the diagram or in the working)
		$"12"\pi + 2 \times 15 + 2 \times "9" (= 85.6(99...))$ or $"12.02..."\pi + 2 \times 15 + 2 \times "8.97..." (= 85.7(09...))$ or $"12"\pi + 48$ or $"12.02..."\pi + 48$ or $"37.6(99...)" + 15 + 15 + "8.97..." + "8.97..." (= 85.7(09...))$ or $[\text{arc length}] + 2 \times 15 + 2 \times [AB \text{ or } DE]$			M1 dep on M2 for a method to find the perimeter including at least the arc length and one length of 15 and one of <i>AB</i> or <i>DE</i> ft their values for the arc length and <i>AB</i> or <i>DE</i> as long as clearly identified (may be on the diagram or in working) allow the error of addition of the radius (<i>OB</i> or <i>OD</i>) or the diameter <i>BD</i>
		Correct answer scores full marks (unless from obvious incorrect working)	85.7		A1 accept an answer in the range 85.6 – 85.8
					Total 5 marks

Question		Working		Answer	Mark	Notes
12	(a)	For $2^{\frac{x}{3}}$ eg $\left(4^{\frac{1}{2}}\right)^{\frac{x}{3}}$ or $4^{\frac{x}{6}}$ or $\left(8^{\frac{1}{3}}\right)^{\frac{x}{3}}$ or $8^{\frac{x}{9}}$ or $\left(64^{\frac{1}{6}}\right)^{\frac{x}{3}}$ or $64^{\frac{x}{18}}$	For 8^x eg $\left(2^3\right)^x$ or 2^{3x} or $\left(4^{\frac{3}{2}}\right)^x$ or $4^{\frac{3x}{2}}$ or 8^{x+2} or 8^{2+x} or or $\left(64^{\frac{1}{2}}\right)^x$ or $64^{\frac{x}{2}}$		3	M1 for one correct application of an index rule involving $2^{\frac{x}{3}}$ or 8^x
		eg $\frac{x}{3} - 3x = 6$ oe or $\frac{x}{6} - \frac{3x}{2} = 3$ oe or $\frac{x}{9} - x = 2$ oe or $\frac{x}{18} - \frac{x}{2} = 1$ oe or $x - 9x = 18$ oe				M1 for setting up a correct equation This can be embedded in an index equation eg $2^{\frac{x}{3}-3x} = 2^6$ (the base on the LHS and the RHS must be the same)
		<i>Working required</i>		-2.25		A1 dep on M1 oe eg $-\frac{18}{8}$ or $-\frac{9}{4}$ or $-2\frac{1}{4}$

	(b)	$4t(t+5) = 4t^2 + 20t$ or $4t(2t-3) = 8t^2 - 12t$ or $(t+5)(2t-3) = 2t^2 - 3t + 10t - 15$ or $(2t^2 + 7t - 15)$		3	M1	for an expansion with only one error.	M2 for 3 (out of a maximum of 4) of $8t^3 - 12t^2 + 40t^2 - 60t$
		eg $(4t^2 + 20t)(2t-3) = 8t^3 - 12t^2 + 40t^2 - 60t$ or $(8t^2 - 12t)(t+5) = 8t^3 + 40t^2 - 12t^2 - 60t$ or $4t(2t^2 - 3t + 10t - 15) = 8t^3 - 12t^2 + 40t^2 - 60t$ or $4t(2t^2 + 7t - 15) = 8t^3 + 28t^2 - 60t$			M1	ft dep on M1 and a quadratic expression multiplied by a linear expression Allow one further error.	this can be implied by $8t^3 + 28t^2 \dots$ or $\dots + 28t^2 - 60t$ (M1 for 2 correct out of a maximum of 4)
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$8t^3 + 28t^2 - 60t$		A1	cao (terms may be in any order but must be simplified) dep on M1 ISW correct factorisation eg $2(4t^3 + 14t^2 - 30t)$ or $4(2t^3 + 7t^2 - 15t)$ Do not ISW incorrect simplification or subsequent division eg $4t^3 + 14t^2 - 30t$ or $2t^3 + 7t^2 - 15t$	
					Total 6 marks		

Question		Working	Answer	Mark	Notes
13	(a)		0.15, 0.85 0.2, 0.8 0.75, 0.25	2	B2 for all 3 correct pairs of probabilities on the correct branches. If not B2 then award B1 for at least one correct pair of probabilities on the correct branch NB: all values can be given as fractions
	(b)	“0.15” × “0.2” oe or $1 - (“0.15” \times “0.8” + “0.85” \times “0.75” + “0.85” \times “0.25”)$		2	M1ft ft their tree diagram provided both probabilities are < 1 for a correct method
		Correct answer scores full marks (unless from obvious incorrect working)	0.03		A1 ft oe eg $\frac{3}{100}$ or 3%
					Total 4 marks

Question	Working	Answer	Mark	Notes
14	1.2 or 0.9 or 1.2 <i>n</i> or 0.9 <i>n</i> where <i>n</i> is a number or a variable eg 1.2×100 or 0.9×100 or $1.2n \times \left(\frac{100-x}{100} \right) = 0.9n$		3	M1 for one correct multiplier, may be seen as part of a single term or calculation or part of an equation
	$0.9 \div 1.2 (= 0.75)$ oe or 75(%) $\frac{n \times 0.9}{n \times 1.2}$ where <i>n</i> is a number or variable or $1 - (0.9 \div 1.2) (= 0.25)$ or $\frac{100-x}{100} = \frac{0.9n}{1.2n}$ oe			M1 for a correct step to find the percentage decrease for October or for an answer of 75(%) or 0.25 this mark implies the first M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	25		A1
Total 3 marks				

Question	Working	Answer	Mark	Notes
15	$\frac{4 - -6}{-3 - 2} \left(= \frac{10}{-5} \right)$ oe or $\frac{-6 - 4}{2 - -3} \left(= \frac{-10}{5} \right)$		2	M1 method to find gradient. Condone correct gradient embedded in an equation eg $y = -2x + c$ or an expression eg $-2x$ or for an answer of 2 from $10 \div 5$ or from $-10 \div -5$
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	-2		A1 cao an answer of $y = -2x - 2$ scores M1 only
Total 2 marks				

Question		Working	Answer	Mark	Notes
16	(a)	$(BC^2 =) 25^2 + 73^2 - 2 \times 25 \times 73 \times \cos 65$ oe or $(BC =) \sqrt{25^2 + 73^2 - 2 \times 25 \times 73 \times \cos 65}$ OR $(BN =) 25 \sin 65 (= 22.6(576...))$ oe and $(NC = AC - AN =) 73 - 25 \cos 65 (= 62.4(345...))$ oe		3	M1 for values correctly substituted into the cosine rule OR finding the perpendicular height of the triangle and NC where N is the foot of the perpendicular on AC Allow truncated or rounded values for $AN = 25 \cos 65 = 10.5(654...)$
		Eg $25^2 + 73^2 - 1542(.556)$ or $625 + 5329 - 1542(.556)$ or $5954 - 1542(.556...)$ or $4411(.4433...)$ OR $"22.6..."^2 + "62.4..."^2$ or $513.(37...) + 3898.(07...)$			M1 clear evidence of correct order of operations used for the cosine rule (these calculations may be square rooted) OR a correct statement for BC^2 using Pythagoras from finding BN and NC
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	66.4		A1 accept an answer in the range 66.3 – 66.5
	(b)	$\frac{1}{2} \times 25 \times 73 \times \sin 65$ oe or $\frac{1}{2} \times "22.6" \times 73$ oe or $\frac{1}{2} (25 \cos 65 \times 25 \sin 65) + \frac{1}{2} ((73 - 25 \cos 65) \times 25 \sin 65)$ oe or $119(.694...) + 707(.311...)$ oe		2	M1
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	827		A1 Accept an answer in the range 824 – 829
					Total 5 marks

Question	Working	Answer	Mark	Notes
17	$20 - 8\sqrt{5} - 5\sqrt{20} + 2\sqrt{5}\sqrt{20}$ or $20 - 8\sqrt{5} - 5\sqrt{20} + 2\sqrt{100}$ or $20 - 8\sqrt{5} - 5\sqrt{20} + 20$ or $20 - 8\sqrt{5} - 10\sqrt{5} + 20$ or $20 - 4\sqrt{20} - 5\sqrt{20} + 20$ or $(4 - 2\sqrt{5})(5 - 2\sqrt{5})$ or $\sqrt{20} = \sqrt{4}\sqrt{5}$ or $\sqrt{20} = 2\sqrt{5}$ or $5\sqrt{20} = 5(\sqrt{4 \times 5})$ or $5\sqrt{20} = 10\sqrt{5}$		3	M1 for expansion of brackets with 3 out of 4 terms correct or 4 terms correct ignoring signs or for simplifying $\sqrt{20}$ may be seen before or after expansion of brackets or for writing $2\sqrt{5}$ as $\sqrt{20}$
	eg $20 + 20 - 18\sqrt{5} = 40 - 18\sqrt{5}$ or $20 - 4\sqrt{20} - 5\sqrt{20} + 20 =$ $40 - 9\sqrt{20}$			M1 dep on M1 for correct expansion of brackets with 3 or 4 terms shown in their expansion and correct simplification to two terms
	<i>Working required</i>	$40 - \sqrt{1620}$		A1 (dep on M2) accept $a = 40$ $b = 1620$ SCB1 for $40 - \sqrt{1620}$ gained with no method marks awarded SCB2 for $40 - \sqrt{1620}$ gained if you would award 1 st M1 but not 2 nd M1 (total 2 marks)
				Total 3 marks

Question		Working	Answer	Mark	Notes
18		$(2x-3)(2x+3)$ or $(2x+3)(x-4)$		3	M1 for correct factorisation of either the numerator or the denominator
		$(2x-3)(2x+3)$ and $(2x+3)(x-4)$			M1 for correct factorisation of the numerator and denominator
		<i>Working required</i>	$\frac{2x-3}{x-4}$		A1 (dep on M2) fully correct factorising and cancelling No ISW
					Total 3 marks

Question		Working		Answer	Mark	Notes	
19	(a)	$M = kp^2$ oe eg $k = \frac{M}{p^2}$	$hM = p^2$ oe eg $h = \frac{p^2}{M}$		3	M1 NB $M = p^2$ or $M \propto p^2$ on its own is not enough to score M1 Constant of proportionality must be a symbol such as k	M2 for $2 = k \times 5^2$ oe or $2h = 5^2$ oe
		$2 = k \times 5^2$ oe or $k = \frac{2}{25}$ oe	$2h = 5^2$ oe or $h = \frac{25}{2}$ oe			M1 For correct substitution of M and p into a correct formula Allow use of $\propto$ in place of = for M marks	
			Correct answer scores full marks (unless from obvious incorrect working)			$M = \frac{2p^2}{25}$	A1 oe but must be $M =$ eg $M = 0.08p^2$ award 3 marks if answer is $M = kp^2$ on the answer line and $k = \frac{2}{25}$ oe is clearly seen in the body of the script
	(b)			18	1	B1	ft for their value of k if $M = kp^2$ $k \neq 1$
						Total 4 marks	

Question	Working	Answer	Mark	Notes
20	$100 - 0.5$ or 99.5 or $100 + 0.5$ or 100.5 or $1.68 - 0.005$ or 1.675 or $1.68 + 0.005$ or 1.685 or $0.5 - 0.05$ or 0.45 or $0.5 + 0.05$ or 0.55		5	B2 for all 6 correct (B1 for 3, 4 or 5 correct) Allow $100.4\dot{9}$ or $100.4\bar{9}$ for 100.5 Allow $1.684\dot{9}$ or $1.684\bar{9}$ for 1.685 Allow $0.54\dot{9}$ or $0.54\bar{9}$ for 0.55 The value of each bound may be embedded in $v = 2\left(\frac{s}{t}\right) - u$
	$2\left(\frac{100.5}{1.675}\right) - 0.45$ or $2\left(\frac{100 + 0.5}{1.68 - 0.005}\right) - (0.5 - 0.05)$			M1 for correct substitution into the <i>UB</i> (=119.55) $v = 2\left(\frac{s}{t}\right) - u$ where $100 < s \leq 100.5$ $1.675 \leq t < 1.68$ $0.45 \leq u < 0.5$
	$2\left(\frac{99.5}{1.685}\right) - 0.55$ or $2\left(\frac{100 - 0.5}{1.68 + 0.005}\right) - (0.5 + 0.05)$			M1 for correct substitution into the <i>LB</i> (=117.55...) $v = 2\left(\frac{s}{t}\right) - u$ where $99.5 \leq s < 100$ $1.68 < t \leq 1.685$ $0.5 < u \leq 0.55$
	<i>Working required</i>	120		A1 dep on M2 120 and correct upper bound (119.55) and correct lower bound (117.55...) seen
Total 5 marks				

Question		Working	Answer	Mark	Notes
21		$x(3x)(13.5 - 2x)$ or $3x^2(13.5 - 2x)$ or $x(40.5x - 6x^2)$ or $3x(13.5x - 2x^2)$ or $40.5x^2 - 6x^3$		5	M1 for an expression for the volume of the cuboid
		$\left(\frac{dV}{dx} = \right) 81x - 18x^2$			M1 ft for differentiating an expression to find $81x$ or $\pm 18x^2$ (must come from a cubic in the form $40.5x^2 \pm ax^3$ or $bx^2 \pm 6x^3$ where $a \neq 0$ and $b \neq 0$)
		$81x - 18x^2 = 0$ oe			M1 ft dep on previous M1 for equating their $\frac{dV}{dx}$ to zero
		$(x =) 4.5$			A1 oe dep on M2 for a correct value of x
		<i>Working required</i>	273.375		A1 oe eg $\frac{2187}{8}$ dep on M2 accept 273 – 273.4 Both A marks can be awarded for 273.375 if 4.5 is not seen provided M2 has been awarded
					Total 5 marks

Question		Working	Answer	Mark	Notes
22	(a)	$9 \div 15 (=0.6)$ or a correct value on the FD scale or 10 small squares = 1 apple oe or 25 small squares (1 large square) = $9 \div 3.6 = 2.5$ apple oe or 29 or 21 or 17		3	M1 for use of area to represent frequency or one correct frequency from the 3 additional bars needed, may be seen written on the bar
		$9 + 10 \times 2.9 + 5 \times 4.2 + 5 \times 3.4$ or $9 + 29 + 21 + 17$ or $9 + 0.1 \times (10 \times 29 + 5 \times 42 + 5 \times 34)$ or $(90 + 290 + 210 + 170) \times 0.1$ or $(3.6 + 11.6 + 8.4 + 6.8) \times 2.5$			M1 (dep on M1) for a fully correct method, allow one error in products or number of squares but must be the sum of 4 parts
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	76		A1
	(b)	$\frac{15}{12 + 25 + 15}$ or $\frac{150}{120 + 250 + 150}$ or $\frac{6}{4.8 + 10 + 6}$ oe		2	M1 method to find correct probability or an answer of $\frac{n}{52}$ where $n < 52$ or $\frac{15}{m}$ where $m > 15$ or $\frac{p}{520}$ where $p < 520$ or $\frac{150}{q}$ where $q > 150$ or $\frac{r}{20.8}$ where $r < 20.8$ or $\frac{6}{s}$ where $s > 6$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{15}{52}$		A1 oe accept 0.28(846...) or 28(.8...) % rounded or truncated
					Total 5 marks

Question	Working	Answer	Mark	Notes
23	$\frac{12}{x} \times \frac{x-12}{x-1}$ oe or $\frac{x-12}{x} \times \frac{12}{x-1}$ oe		5	M1 for a correct expression for P(P,Y) or P(Y,P)
	$2\left(\frac{12}{x} \times \frac{x-12}{x-1}\right) = \frac{18}{47}$ oe or $\frac{12}{x} \times \frac{x-12}{x-1} + \frac{x-12}{x} \times \frac{12}{x-1} = \frac{18}{47}$ oe			M1 for a correct equation for $P(P,Y) + P(Y,P) = \frac{18}{47}$ This M mark implies first M mark
	$18x^2 - 1146x + 13536 (=0)$ oe or $9x^2 - 573x + 6768 (=0)$ oe or $3x^2 - 191x + 2256 (=0)$ oe			M1 dep on M2 simplified to a 3 term quadratic ($ax^2 + bx + c (=0)$ in any form) with at least 2 coefficients (a or b or c) are correct
	$(3x - 47)(x - 48) (=0)$ or $x = \frac{- -191 \pm \sqrt{(-191)^2 - (4 \times 3 \times 2256)}}{2 \times 3}$ or $3\left[\left(x - \frac{191}{6}\right)^2 - \left(\frac{191}{6}\right)^2\right] + 2256 (=0)$ $\left(x + \frac{-191}{2 \times 3}\right)^2 - \left(\frac{-191}{2 \times 3}\right)^2 + \frac{2256}{3} (=0)$			M1 ft dep on first M1 for solving <i>their</i> 3-term quadratic equation using any method – if factorising, allow brackets which expand to give 2 out of the 3 terms correct. If using the formula or completing the square allow one sign error and some simplification as far as $(x =) \frac{191 \pm \sqrt{36\,481 - 27\,072}}{6}$ or $3\left(x - \frac{191}{6}\right)^2 - \frac{9409}{12} (=0)$ Award this mark for answers of 48 and $\frac{47}{3}$ dep on M3
	<i>Working required</i>	48		A1 cao, dep on first 3 M marks. Do not award if non-integer solution also given.
Total 5 marks				

WITH REPLACEMENT				
23	$\frac{12}{x} \times \frac{x-12}{x}$ oe or $\frac{x-12}{x} \times \frac{12}{x}$ oe		5	M0
	$2\left(\frac{12}{x} \times \frac{x-12}{x}\right) = \frac{18}{47}$ oe or $\frac{12}{x} \times \frac{x-12}{x} + \frac{x-12}{x} \times \frac{12}{x} = \frac{18}{47}$ oe			M1 for a correct equation for $P(P,Y) + P(Y,P) = \frac{18}{47}$ This M mark DOES NOT imply the first M mark
	$18x^2 - 1128x + 13536 (=0)$ oe or $9x^2 - 564x + 6768 (=0)$ oe or $3x^2 - 188x + 2256 (=0)$ oe			M1 dep on previous M1 simplified to a 3 term quadratic ($ax^2 + bx + c (=0)$ in any form) with at least 2 coefficients (a or b or c) are correct
	$(x =) \frac{- -188 \pm \sqrt{(-188)^2 - (4 \times 3 \times 2256)}}{2 \times 3}$ or $3\left[\left(x - \frac{188}{6}\right)^2 - \left(\frac{188}{6}\right)^2\right] + 2256 (=0)$ oe or $(x =) \frac{188 \pm 4\sqrt{517}}{6}$ or $\left(x + \frac{-188}{2 \times 3}\right)^2 - \left(\frac{-188}{2 \times 3}\right)^2 + \frac{2256}{3} (=0)$ or $(x =) 46(.491756)$ and $16(.174910)$			M1 fit dep on second M1 for solving <i>their</i> 3-term quadratic equation using any method – if factorising, allow brackets which expand to give 2 out of the 3 terms correct. If using the formula or completing the square allow one sign error and some simplification as far as $(x =) \frac{188 \pm \sqrt{35344 - 27\,072}}{6}$ or $3\left(x - \frac{188}{6}\right)^2 - \frac{2068}{3} (=0)$ Award this mark for both values of x dep on M2
	<i>Working required</i>			A0
				Total 3 marks

Question	Working	Answer	Mark	Notes
24	(a)	$-3(x+4)^2 \dots\dots$ or $-3[(x+4)^2 \dots\dots]$ or $-3\left(x + \frac{-24}{2 \times -3}\right)^2 + \dots\dots$	3	M1 for a start to completing the square or correct substitution into $a\left(x + \frac{b}{2a}\right)^2 + \dots\dots$ from the formula $a\left(x + \frac{b}{2a}\right)^2 - \frac{(b)^2}{4a} + c$
		$-3[(x+4)^2 - 4^2] \dots\dots$ or $-3[(x+4)^2 - 4^2 \dots\dots]$ or $-3[(x+4)^2 - 16 \dots\dots]$ or $-3\left(x + \frac{-24}{2 \times -3}\right)^2 - \frac{(-24)^2}{4 \times -3} \dots\dots$ or $-3(x+4)^2 + 48 \dots\dots$		M1 for correctly completing the square but terms do not need to be simplified and 10 may or may not be present or correct simplification of the first two parts of $a\left(x + \frac{b}{2a}\right)^2 - \frac{(b)^2}{4a} (+c)$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$58 - 3(x+4)^2$	A1 oe eg $-3(x+4)^2 + 58$
	(b)		$(-3, 58)$	1 B1 ft their expression in part (a)
	(c)		$x = -3$	1 B1 ft their expression in part (a) or ft their x coordinate in part (b)
Total 5 marks				

Question		Working	Answer	Mark	Notes
25		$(FB =) \frac{12}{\sin 30} (= 24) \text{ oe or } (FB =) \frac{12 \sin 90}{\sin 30} (= 24) \text{ or}$ $(AB =) \frac{12}{\tan 30} (= 12\sqrt{3} = 20.78...) \text{ and } (FB =)$ $\sqrt{12^2 + (12\sqrt{3})^2} (= 24)$		5	M1 method to find an expression for the length of FB
		$(BT =) \frac{2}{3} \times 24 (= 16)$			M1 dep on M1 for using the ratio 3 : 2 to find an expression for the length of BT
		$(FT =) \sqrt{24^2 + 16^2} (= 8\sqrt{13} = 28.8...) \text{ oe or}$ $(FT =)$ $\sqrt{24^2 + 16^2 - 2 \times 24 \times 16 \times \cos 90} (= 8\sqrt{13} = 28.8...) \text{ oe or}$ $(AT =) \sqrt{(12\sqrt{3})^2 + 16^2} (= 4\sqrt{43} = 26.2...) \text{ oe or}$ $(AT =)$ $\sqrt{(12\sqrt{3})^2 + 16^2 - 2 \times (12\sqrt{3}) \times 16 \times \cos 90} (= 4\sqrt{43} = 26.2...) \text{ oe}$			M1 dep on first M1 for a complete method to find an expression for the length of FT or AT ft their value of BT from incorrect use of the ratio
		$\sin ATF = \frac{12}{8\sqrt{13}} \text{ oe or } \tan ATF = \frac{12}{4\sqrt{43}} \text{ oe or}$ $\cos ATF = \frac{4\sqrt{43}}{8\sqrt{13}} \text{ oe}$			M1 dep on M2 method to find $\sin ATF$ or $\cos ATF$ or $\tan ATF$ ft their value of FT or AT from their value of BT from incorrect use of the ratio
		Working required	24.6		A1 dep on M2 for answer in the range 24.5 to 24.7
					Total 5 marks