

Higher

GCSE

Mathematics - Paper 6

J560/06: Paper 6 (Higher tier)

General Certificate of Secondary Education

Mark Scheme for November 2023

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. Annotations available in RM Assessor. These **must** be used whenever appropriate during your marking.

Annotation	Meaning
	Correct
	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed

M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1
B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign
BP	Blank page
SEEN	Seen

For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required. For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

Subject-Specific Marking Instructions

5. **M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.
6. The following abbreviations are commonly found in GCSE Mathematics mark schemes.
- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point e.g. 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
 - **isw** means **ignore subsequent working** after correct answer obtained and applies as a default.
 - **nfw** means **not from wrong working**.
 - **oe** means **or equivalent**.
 - **rot** means **rounded or truncated**.
 - **soi** means **seen or implied**.
 - **dep** means that the marks are **dependent** on the marks indicated. You must check that the candidate has met all the criteria specified for the mark to be awarded.
 - **with correct working** means that full marks **must not** be awarded without some working. The required minimum amount of working will be defined in the guidance column and **SC** marks given for unsupported answers.
7. Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.
8. Unless the command word requires that working is shown and the working required is stated in the mark scheme, then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.
- Do not award the marks if the answer was obtained from an incorrect method, i.e. incorrect working is seen and the correct answer clearly follows from it.
9. Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct. For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, e.g. $FT\ 180 \times (their\ '37' + 16)$, or $FT\ 300 - \sqrt{(their\ '52' + 72)}$. Answers to part questions which are being followed through are indicated by e.g. $FT\ 3 \times their\ (a)$.

10. In questions **with no final answer line**, make no deductions for wrong work after an acceptable answer (i.e. **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.
11. In questions **with a final answer line and incorrect answer given**:
- (i) If the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.
 - (ii) If the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
 - (iii) If the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded if there is no other method leading to the incorrect answer. Use the **M0**, **M1**, **M2** annotations as appropriate and place the annotation ✗ next to the wrong answer.
12. In questions **with a final answer line**:
- (i) If one answer is provided on the answer line, mark the method that leads to that answer. A correct step, value or state part of the method that leads to the given answer should be awarded **M0** and/or **B0**.
 - (ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.
 - (iii) If more than one answer is provided on the answer line and there is more than one method provided, award marks for the poorer response unless the candidate has clearly indicated which method is to be marked.
13. In questions **with no final answer line**:
- (i) If a single response is provided, mark as usual.

- (ii) If more than one response is provided, award marks for the poorer response unless the candidate has clearly indicated which response is to be marked.
14. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the **MR** annotation. **M** marks are not deducted for misreads. If a candidate corrects the misread in a later part, do not continue to follow through, but award **A** and **B** marks for the correct answer only.
15. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.
16. Ranges of answers given in the mark scheme are always inclusive.
17. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
18. If in any case the mark scheme operates with considerable unfairness consult your Team Leader.

Question			Answer	Marks	Part marks and guidance	
1	(a)	(i)	Points plotted at (3000, 460) and (1300, 320)	1		Half square tolerance Use overlay as guide
		(ii)	Positive	1		Ignore reference to strength
	(b)	(i)	Point at (1500, 730) circled	1		
		(ii)	The jigsaw took a long time for a small/similar number of pieces oe	1		See appendix Must include reference to both the time taken and the number of pieces
	(c)	(i)	Ruled line of best fit drawn	1		Condone good freehand Line must reach between (500, 120) and (500, 220) AND (4500, 540) and (4500, 660) (use overlay, not cutting diagonal lines)
		(ii)	<i>Their</i> straight line used to give number of pieces for 500 minutes	1 FT	Strict FT from their intended straight line of best fit	Tolerance ± 50 pieces ($\frac{1}{2}$ small square = 50 pieces) If intersection between vertical gridlines allow reading at either gridline e.g. 3340 may be 3300 or 3400 Mark to candidate's benefit
	(d)		[8000 pieces is] beyond the given data oe or the trend/pattern may not continue oe	1		See appendix Do not accept "It only goes up to 5000" or "It goes off the scale" or any suggestion that the graph is not big/accurate enough Interpret "it" as reference to scale/diagram unless otherwise qualified

Question			Answer	Marks	Part marks and guidance	
2			33[.3...]% oe nfww	4	M3 for $\frac{4}{12} [\times 100]$ OR M1 for 12 correct combinations shown and no repeats or for 4×3 or 12 [combinations] M1 for BG (£7), VS (£7), VG (£6), TG (£7) only or 4 [combinations less than £8] M1 for $\frac{\text{their number of combinations}}{\text{their number of meals}} [\times 100]$	Accept combinations of meals in any order or total costs shown. Combinations: BS, BC, BG, LS, LC, LG, VS, VC, VG, TS, TC, TG 12 used as denominator scores M1 Corresponding costs: 8, 9, 7, 9, 10, 8, 7, 8, 6, 8, 9, 7 4 used as numerator scores M1

Question			Answer	Marks	Part marks and guidance																
3			$\frac{1}{333}$, 3.1×10^{-3} , 0.36%, 0.03	4	B3 for all 4 expressed in an equivalent comparable form or B2 for 3 expressed in an equivalent comparable form or B1 for 2 expressed in an equivalent comparable form	Equivalent comparable form is either decimal, percentage or standard index form. Fractions only acceptable as comparable form with common denominators. For final answer, accept some or all given as equivalent form on answer line. eg. Full marks for 0.003[003...], 0.0031, 0.0036, 0.03 or $\frac{1}{333}$, $\frac{31}{10\,000}$, $\frac{9}{2500}$, $\frac{3}{100}$ Where choice of comparable form, mark to candidate's advantage.															
					Likely comparable form (award best row): <table><tr><td>0.36%</td><td>$\frac{1}{333}$</td><td>0.03</td><td>3.1×10^{-3}</td></tr><tr><td>0.36[%]</td><td>0.00003[003...][%]</td><td>3[%]</td><td>0.31[%]</td></tr><tr><td>0.0036</td><td>0.003[003...]</td><td>0.03</td><td>0.0031</td></tr><tr><td>3.6×10^{-3}</td><td>$3[.003...] \times 10^{-3}$</td><td>$3 \times 10^{-2}$</td><td>$3.1 \times 10^{-3}$</td></tr><tr><td>$\frac{11\,988}{3\,330\,000}$</td><td>$\frac{10\,000}{3\,330\,000}$</td><td>$\frac{99\,900}{3\,330\,000}$</td><td>$\frac{10\,323}{3\,330\,000}$</td></tr></table>		0.36%	$\frac{1}{333}$	0.03	3.1×10^{-3}	0.36[%]	0.00003[003...][%]	3[%]	0.31[%]	0.0036	0.003[003...]	0.03	0.0031	3.6×10^{-3}	$3[.003...] \times 10^{-3}$	3×10^{-2}
0.36%	$\frac{1}{333}$	0.03	3.1×10^{-3}																		
0.36[%]	0.00003[003...][%]	3[%]	0.31[%]																		
0.0036	0.003[003...]	0.03	0.0031																		
3.6×10^{-3}	$3[.003...] \times 10^{-3}$	3×10^{-2}	3.1×10^{-3}																		
$\frac{11\,988}{3\,330\,000}$	$\frac{10\,000}{3\,330\,000}$	$\frac{99\,900}{3\,330\,000}$	$\frac{10\,323}{3\,330\,000}$																		

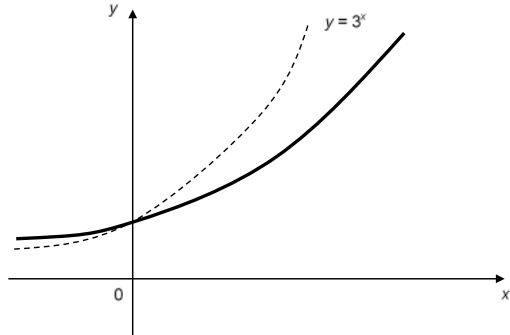
Question			Answer	Marks	Part marks and guidance	
4			175	3	M2 for $217 \div 1.24$ oe or B1 for 1.24 oe or for $217 = 124\%$	
5	(a)		5.95	2	M1 for $500 \times 1.19 \times 10^{-2}$ oe	
	(b)		190.7 to 190.8 or 191 nfw	4	M1 for $1.19 \times 10^{-2} \times 1000$ soi 11.9 [g] M1 for 0.21×0.297 oe soi 0.06237 or 0.0624 M1 for $\frac{\text{figs } 119}{\text{figs } 21 \times \text{figs } 297}$ or $\frac{\text{figs } 119}{\text{figs } 6237}$ or $\frac{\text{figs } 119}{\text{figs } 624}$	First two M1 marks may be seen as part of an embedded calculation e.g. $[0.06237 =] 21 \times 29.7 \div 100 \div 100$

Question			Answer	Marks	Part marks and guidance										
6			$a = 3, b = -13, c = -5$ with correct working	5	M1 for $(3x + 2)(x + c)$ soi B1 for $a = 3$ B1 for $c = -5$ AND M1 for $3c + 2$ or $3 \times \text{their } c + 2$ either alone or as coefficients of x in a full or partial expansion B1 for $b = -13$	Correct working requires evidence of at least one M1 Condone $3x + 2 \times x + c$ as soi Grid method for expanding e.g. <table><tr><td>x</td><td>x</td><td>c</td></tr><tr><td>$3x$</td><td>$3x^2$</td><td>$3cx$</td></tr><tr><td>2</td><td>$2x$</td><td>$2c$</td></tr></table> M1 for grid frame only if products seen M1 for shaded cells correct Accept $x(3c + 2)$ and $3cx + 2x$ ignore coefficient of x^2 and constant Condone embedded answers for b or c provided they are not then contradicted on answer line e.g. B1 for $(x - 5)$ and B1 for $-13x$ seen	x	x	c	$3x$	$3x^2$	$3cx$	2	$2x$	$2c$
						x	x	c							
$3x$	$3x^2$	$3cx$													
2	$2x$	$2c$													

Question			Answer	Marks	Part marks and guidance																																																
7			[0].7 oe with correct working	5	<u>By Equation:</u> M3 for $5k + 21$ and $10(5 - 1.5)k$ oe or M1 for $5k + 21$ M1 for $(5 - 1.5)k$ or $3.5k$ AND M1FT for $30k = 21$ If 0 or 1 scored, instead award SC2 for answer [0].7 with no working or insufficient working If 0 scored, instead award SC1 for $-\frac{140}{31}$ or $-4.516\dots$ to -4.52 as final answer <u>By Trials:</u> M4 for $5k + 21$ and either $10(5 - 1.5)k$ oe or $(5 - 1.5)k$ oe both correctly evaluated with $k = 0.7$ or M3 for $5k + 21$ and either $10(5 - 1.5)k$ oe or $(5 - 1.5)k$ oe both correctly evaluated in one trial with consistent k or M1 for $5k + 21$ correctly evaluated in one trial M1 for either $10(5 - 1.5)k$ oe or $(5 - 1.5)k$ oe correctly evaluated in one trial SC award marks as above				“correct working” requires evidence of at least M3 $5k + 21$ [M1] = $26k$ [isw, but ruled out of M3 and M1FT if $26k$ used] $5 - 1.5k = 3.5k$ [M1 bod] FT their linear equation in the form $ak + b = ck$ SC1 is from $\times 10$ of wrong function																																												
					<table><tr><th>k</th><th>$5k+21$</th><th>$10(5-1.5)k$</th><th>$(5-1.5)k$</th></tr><tr><td>0.5</td><td>23.5</td><td>17.5</td><td>1.75</td></tr><tr><td>0.6</td><td>24</td><td>21</td><td>2.1</td></tr><tr><td>0.7</td><td>24.5</td><td>24.5</td><td>2.45</td></tr><tr><td>0.8</td><td>25</td><td>28</td><td>2.8</td></tr><tr><td>0.9</td><td>25.5</td><td>31.5</td><td>3.15</td></tr><tr><td>1</td><td>26</td><td>35</td><td>3.5</td></tr><tr><td>2</td><td>31</td><td>70</td><td>7</td></tr><tr><td>3</td><td>36</td><td>105</td><td>10.5</td></tr><tr><td>4</td><td>41</td><td>140</td><td>14</td></tr><tr><td>5</td><td>46</td><td>175</td><td>17.5</td></tr><tr><td>10</td><td>71</td><td>350</td><td>35</td></tr></table>	k	$5k+21$	$10(5-1.5)k$	$(5-1.5)k$	0.5	23.5	17.5	1.75	0.6	24	21	2.1	0.7	24.5	24.5	2.45	0.8	25	28	2.8	0.9	25.5	31.5	3.15	1	26	35	3.5	2	31	70	7	3	36	105	10.5	4	41	140	14	5	46	175	17.5	10	71	350	35
k	$5k+21$	$10(5-1.5)k$	$(5-1.5)k$																																																		
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Question			Answer	Marks	Part marks and guidance	
8			ABF 60 equilateral/all angles equal	1	If 0 or 1 scored, instead award SC2 for all of these angles correct in template or on diagram If 0 scored, instead award SC1 for two of the first four angles correct in template or on diagram	Ignore other angles Accept in any order Condone spelling For full marks, must be convinced they are working forwards and not backwards
			FBC 120 straight line/line adds to 180	1		
			BCF 30 isosceles/ BCF=BFC and angles in triangle add to 180	1		
			ECD 60 equilateral/all angles equal	1		
			FCE 90 straight line and 180–30–60	1		
9			32 nfww	4	B3 for 24 : 16 and 18 : 16 both identified or M2 for trials leading to 24 : 16 or 18 : 16 or for two correct ratios identified with a common number of milk chocolates eg. 12 : 8 and 9 : 8 or M1 for at least two correct trials of $3p : 2p$ where $p > 1$ or for two correct ratios identified with a difference of six dark chocolates eg 15 : 10 and 9 : 8	May be expressed as dark = 24, milk = 16, etc. <u>Alternative method using algebra</u> M2 for $\frac{3k-6}{2k} = \frac{9}{8}$ oe or M1 for $3k - 6$ and $2k$ A1dep for $k = 8$, dep on M2 <u>Alternative method using algebra</u> M2 for $\frac{9m+6}{8m} = \frac{3}{2}$ oe or M1 for $9m + 6$ and $8m$ A1dep for $m = 2$, dep on M2

Question			Answer	Marks	Part marks and guidance	
10	(a)		y is inversely proportional to x	1		
	(b)		$y = \frac{40}{x^4}$ oe	3	M1 for $y = \frac{k}{x^4}$ oe or $2.5 = \frac{k}{2^4}$ oe B1 for $[k =] 40$	
11			8.75 to 8.752 nfww	4	B2 for 670[.2...], 670.3 or $\frac{640}{3}\pi$ or M1 for $\frac{1}{3}\pi \times 8^2 \times 10$ AND M1 for $\sqrt[3]{their(\frac{1}{3}\pi \times 8^2 \times 10)}$ oe	Accept answer 8.8 after B2 seen <i>their</i> value must come from correct substitution into given formula
12	(a)		$\frac{29}{70}$ oe	2	B1 for $11 + 18$ or 29 or for $\frac{n}{25+11+18+16}$ or $\frac{n}{70}$ with $n < 70$	Accept 0.41[4...] or 41[.4...]%
	(b)		$\frac{11}{36}$ oe	2	B1 for $\frac{11}{n}$ with $n > 11$ or for $\frac{n}{25+11}$ or $\frac{n}{36}$ with $n < 36$	Accept 0.30[5..] to 0.31 or as %

Question			Answer	Marks	Part marks and guidance	
13	(a)			3	B1 for correct shape and same y – intercept B1 for sketch drawn below $y = 3^x$ for positive x-values or has shallower gradient (by eye) B1 for sketch drawn above $y = 3^x$ for negative x-values	
	(b)	(i)	eg. $\sin x$ should initially increase/be positive [after $x = 0$]	1	Other acceptable answers include: [The sketch is a] reflection of $y = \sin x$ [in the x -axis]; First turning point should be a maximum; $\sin x$ has a maximum at 90 [and then a minimum at 270].	
	(b)	(ii)	eg. $y = -\sin x$	1	Accept any other possibly correct equations such as: $y = -k \sin x$ or $y = \sin(-x)$ or $y = k \cos(x + 90)$	
14			28 nfww	4	B1 for 105 B1 for 7.5 M1 for $\frac{\text{their } (95 \text{ to } 105)}{\frac{1}{2} \times \text{their } (7.5 \text{ to } 8.5)}$ but not $\frac{100}{\frac{1}{2} \times 8}$	In part marks condone 104.99 or better for 105

Question			Answer	Marks	Part marks and guidance	
15	(a)		Taylor and square root of 9 is 3 and -3 oe	1		Accept: Taylor because Sasha only used the positive square root; Taylor because verification of -5. Do not accept: Two solutions expected for a quadratic; Sasha because ...

Question	Answer	Marks	Part marks and guidance	
(b)	4.30 and [0].70 with correct algebraic working	4	M2 for correct substitution into the formula, eg. $\frac{-(-5) \pm \sqrt{(-5)^2 - 4[1] \times 3}}{2[1]}$ oe allowing one error or for solving by completing the square eg. $\left(x - \frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 + 3 = 0$ oe and $x = \pm \sqrt{(-3) + \left(\frac{5}{2}\right)^2} + \frac{5}{2}$ oe or better or M1 for correct substitution into the formula, allowing two errors, or for completing the square eg. $\left(x - \frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 + 3 [= 0]$ oe or better and A1 for 4.30 or [0].70 nfww or for both solutions correct nfww but to more than 2 dp, to just 1 dp or in exact form If 0 scored, instead award SC1 for both answers correct or to more than 2 dp, to just 1 dp or in exact form with no working or insufficient working	

“Correct working” requires evidence
of at least **M2**

For oe allow better up to $\frac{5 \pm \sqrt{25-12}}{2}$

but do not allow $\frac{5 \pm \sqrt{13}}{2}$

Condone 5^2 for $(-5)^2$

eg. 4.30277... and 0.69722....

4.3 and 0.7, $\frac{5 \pm \sqrt{13}}{2}$

Question		Answer	Marks	Part marks and guidance	
16	(a)	$3^5 - 70 \times 3 - 150 = -117$ and $4^5 - 70 \times 4 - 150 = 594$ Sign change so solution between $x = 3$ and $x = 4$	3	M2 for $3^5 - 70 \times 3 - 150 = -117$ and $4^5 - 70 \times 4 - 150 = 594$ or M1 for $3^5 - 70 \times 3 - 150$ soi by -117 or $4^5 - 70 \times 4 - 150$ soi by 594 <u>Alternative method</u> After $x^5 - 70x = 150$ seen M2 for $3^5 - 70 \times 3 = 33$ and $4^5 - 70 \times 4 = 744$ A1 for $33 < 150$ and $744 > 150$ so solution between $x = 3$ and $x = 4$ OR M1 for $3^5 - 70 \times 3$ soi by 33 or $4^5 - 70 \times 4$ soi by 744 <u>Alternative method</u> SC3 for using an iterative equation that converges to a value in the range 3.25 and 3.35 and concluding statement that $3 < 3.25$ to $3.35 < 4$ oe or SC2 for using an iterative equation that converges to a value in the range 3.25 to 3.35	Accept other values of x used between 3 and 4 (see table in part (b)). For full marks, the two values need to produce a sign change or values either side of 150 if using alternative method. Examples just sufficient for third mark include: Change of sign $-117 < 0 < 594$ $x = 3$ gives an answer < 0 and $x = 4$ gives an answer > 0 Examples insufficient for third mark: so x lies between 3 and 4 If within part (a) candidates <u>refer to</u> their working in part (b), award marks for this final alternative method.

Question		Answer	Marks	Part marks and guidance																																																																		
	(b)	Examples: when $x = 3.1$ $y = -80[.7\dots]$, so $3.1 < p < 4$ when $x = 3.5$ $y = 130[.2\dots]$, so $3 < p < 3.5$ when $x = 3.1$ $y = -80[.7\dots]$ and when $x = 3.5$ $y = 130[.2\dots]$, so $3.1 < p < 3.5$	3	Dependent on achieving at least M2 M2 for one further value of y evaluated correctly, possibly rot or truncated to 2 or more sf, for a value of x such that $3 < x < 4$ OR M1 for working shown to calculate one further value of y for a value of x such that $3 < x < 4$ <u>Alternative method</u> After $x^5 - 70x = 150$ seen Award marks as for the main method, but with one evaluation being < 150 and the other being > 150 Note after SC considered in part (a): if SC2 was awarded then they must use a value of x that produces a smaller interval than $3 < x < \text{their } x\text{-value in (a)}$ or their $x\text{-value in (a)} < x < 4$ If 0 scored, instead award SC1 or SC2 if evidence for M1 or M2 has not been credited in part (a)	<table><tr><th>x</th><th>$x^5 - 70x$</th><th>$x^5 - 70x - 150$</th></tr><tr><td>3.1</td><td>69.292</td><td>-80.708</td></tr><tr><td>3.2</td><td>111.544</td><td>-38.456</td></tr><tr><td>3.25</td><td>135.091</td><td>-14.909</td></tr><tr><td>3.26</td><td>140.004</td><td>-9.996</td></tr><tr><td>3.27</td><td>144.986</td><td>-5.014</td></tr><tr><td>3.28</td><td>150.038</td><td>0.038</td></tr><tr><td>3.29</td><td>155.16</td><td>5.16</td></tr><tr><td>3.3</td><td>160.354</td><td>10.354</td></tr><tr><td>3.31</td><td>165.62</td><td>15.62</td></tr><tr><td>3.32</td><td>170.958</td><td>20.958</td></tr><tr><td>3.33</td><td>176.369</td><td>26.369</td></tr><tr><td>3.34</td><td>181.854</td><td>31.854</td></tr><tr><td>3.35</td><td>187.414</td><td>37.414</td></tr><tr><td>3.4</td><td>216.354</td><td>66.354</td></tr><tr><td>3.5</td><td>280.219</td><td>130.219</td></tr><tr><td>3.6</td><td>352.662</td><td>202.662</td></tr><tr><td>3.7</td><td>434.44</td><td>284.44</td></tr><tr><td>3.75</td><td>479.077</td><td>329.077</td></tr><tr><td>3.8</td><td>526.352</td><td>376.352</td></tr><tr><td>3.9</td><td>629.242</td><td>479.242</td></tr></table> A correct narrower range scores 0 unless accompanied by the relevant correct calculations. Calculations in support of $x = 3$ or $x = 4$ need not be repeated from part (a)			x	$x^5 - 70x$	$x^5 - 70x - 150$	3.1	69.292	-80.708	3.2	111.544	-38.456	3.25	135.091	-14.909	3.26	140.004	-9.996	3.27	144.986	-5.014	3.28	150.038	0.038	3.29	155.16	5.16	3.3	160.354	10.354	3.31	165.62	15.62	3.32	170.958	20.958	3.33	176.369	26.369	3.34	181.854	31.854	3.35	187.414	37.414	3.4	216.354	66.354	3.5	280.219	130.219	3.6	352.662	202.662	3.7	434.44	284.44	3.75	479.077	329.077	3.8	526.352	376.352	3.9	629.242	479.242
x	$x^5 - 70x$	$x^5 - 70x - 150$																																																																				
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Question			Answer	Marks	Part marks and guidance	
17			4 nfw	4	M3 for $\sqrt{\frac{2704}{2500}}$ oe soi by 1.04 or M2 for $\frac{2704}{2500}$ oe soi by 1.08... or M1 for $2500x^2 = 2704$ <u>Alternative method</u> M3 for $[r=] 100 \sqrt{\frac{2704}{2500}} - 100$ or M2 for $\left[\left(\frac{100+r}{100}\right)^2 = \right] \frac{2704}{2500}$ or M1 for $2500 \times \left(\frac{100+r}{100}\right)^2 = 2704$ oe	Condone 4% as final answer for full marks May be done in stages Allow any letter in place of x. Condone use of r for M1 May be done in stages Equivalents for $\frac{100+r}{100}$ may be seen, eg. $1 + \frac{r}{100}$

Question			Answer	Marks	Part marks and guidance	
18			6.67 or 6.670 to 6.671	4	B1 for [BAC =] 45 soi AND M2 for [BC=] $\frac{8 \times \sin (45 \text{ or } \textit{their BAC})}{\sin 58}$ or M1 for $\frac{BC}{\sin (45 \text{ or } \textit{their BAC})} = \frac{8}{\sin 58}$ oe	Accept 6.7 with working May be seen on diagram or within M2/M1 expressions

Question			Answer	Marks	Part marks and guidance	
19			31.6[2...] with correct working	5	B1 for at least 4 correct frequencies from 6, 18, 11, 13, 12, 14 B1 for at least 4 correct midpoints from 5, 15, 25, 35, 45, 55 M1 for $\sum mf$ using <i>their</i> midpoints and <i>their</i> frequencies so by 30+270+275+455+540+770 or by 2340 M1dep for <i>their</i> $\frac{\sum mf}{74}$ If 0 or 1 scored, instead award SC2 for final answer 31.6[2...] with no working or insufficient working If 0 scored, instead award SC1 for 2340 with no working or insufficient working	Accept 32 with correct working Correct working requires at least evidence of B1 B1 M1 May be implied by correct products seen 30, 270, 275, 455, 540, 770 May be implied by correct products seen 30, 270, 275, 455, 540, 770 <i>their</i> midpoints must lie in the range of <i>t</i> for each interval Lower: [0 or 6]+180+220+390+480+700 Upper: 60+360+330+520+600+840 Allow one error in calculation <i>their</i> frequencies must not be the cumulative frequencies dep on first M1

Question			Answer	Marks	Part marks and guidance	
20	(a)		BD = EF or BD = $2t$ and [opposite sides of a] rectangle [are equal]	1	For two marks, $2t$ must be seen in at least one statement as BD or on the diagram as BD	
			BC = BD [= $2t$] and radii [of a sector/circle]	1		
20	(b)		ABF = 55 and AB = $5t$	B1		Stated or seen on diagram
			$\frac{their 55}{360} \times 2\pi \times their 5t$	M1		All M marks may be seen within a summarising expression
			$\frac{35}{360} \times 2\pi \times 2t$	M1		
			$5t + 2t + 5t + 2t$	M1		Condone $10t + 4t$, $7t + 7t$ etc but not $14t$
			$\frac{35}{360} \times 2\pi \times 2t + \frac{55}{360} \times 2\pi \times 5t$ $+ 5t + 2t + 5t + 2t$ $= \frac{23}{12}\pi t + 14t$	A1		

Question			Answer	Marks	Part marks and guidance	
21			$\frac{x+5}{x-3}$	5	M4 for $\frac{x(x+3)(x+5)}{x(x+3)(x-3)}$ or $\frac{(x+3)(x+5)}{(x+3)(x-3)}$ OR M2 for $[x](x+3)(x+5)$ or M1 for $[x](x(x+5)+3(x+5))$ or $[x](x(x+3)+5(x+3))$ or for $[x](x+a)(x+b)$ where $a+b=8$ or $ab=15$ and M1 for $[x](x+3)(x-3)$ or $\frac{x(x^2+8x+15)}{x(x^2-9)}$ or $\frac{x^2+8x+15}{x^2-9}$ or for $x^2+8x+15$ and x^2-9 or any other partially factorised form of the numerator or denominator	For M2 and M1 marks, if written as a quotient, condone $[x]$ not being consistently present in both or cancelled out from both Also award M2 and M1 marks for factorising without first factorising $[x]$. eg. $(x^2+3x)(x+5)$ earns M2

APPENDIX**Question 1b(ii)**

Statement	Reason	Mark
It has a small number of pieces but takes a long time to complete		1
It took the longest even though it only had 1500 pieces	Assume time	1
Because it took the most minutes even with low pieces		1
It had the most amount of time to complete	No reference to number of pieces	0
It took more time than others	No reference to number of pieces	0
It took the most amount of time for a 1500 piece puzzle	Too specific not referencing other puzzles and, thus, incorrect	0
It took the most amount of time compared to other puzzles	No reference to number of pieces. Just like saying "It took longest"	0
Most average area for this puzzle piece most average number and time taken	Garbled	0
It is furthest away from the line of best fit and the rest of the results	True depending on the line calculated/drawn but there will always be one such point and not all will be an outlier	0
Because it is not near the points towards the line	Getting there but which points are they thinking of?	0
It doesn't fit the trend	Vague	0
It doesn't follow the correlation of the other points	Doesn't explain why and others could do the same	0

Question 1d

Statement	Reason	Mark
It only goes up to 5000 and it may differ with a much larger jigsaw	First part does not score the mark but BOD second part recognises trend not continuing	1
She shouldn't because on of (<i>none of?</i>) the pieces is nowhere near the other pieces so she will get it wrong.	BOD beyond the data and not referring to scale	1
8000 is beyond the range, her data only provides up to 5000 pieces	Ok as references data not scale	1
Her values aren't great enough	Not clearly saying that these are beyond data. Could be referring to scales	0
The graph doesn't go that far	Referring to scales	0
The pieces could be easier so less time	Incorrect on all counts	0
There's not 8000 pieces, it only goes up to 5000	It taken to be a reference to scale	0
8000 is not on the diagram	Referring to size of diagram and not range of the data	0
The data wasn't given	Unclear, as this may mean that 8000 is not a plotted point	0

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