



GCSE

Mathematics

Unit **J560/04**: Higher Tier Paper 4

General Certificate of Secondary Education

Mark Scheme for November 2017

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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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1. Annotations used in the detailed Mark Scheme.

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

These should be used whenever appropriate during your marking.

The **M**, **A**, **B** etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate these scripts to show how the marks have been awarded. It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

Subject-Specific Marking Instructions

- 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.
- Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', 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, ie incorrect working is seen and the correct answer clearly follows from it.

4. 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.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, eg FT $180 \times (\textit{their} '37' + 16)$, or FT $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$. Answers to part questions which are being followed through are indicated by eg FT 3 \times *their* (a).

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.

5. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.
6. The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **cao** means **correct answer only**.
- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 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).
- **nfw** means **not from wrong working**.
- **oe** means **or equivalent**.
- **rot** means **rounded or truncated**.
- **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.
- **soi** means **seen or implied**.

7. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.
8. As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).

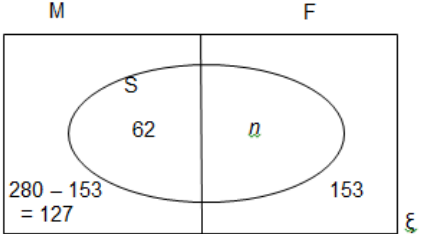
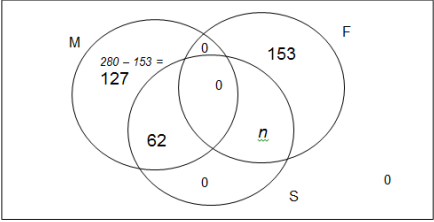
9. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the **MR** annotation. **M** marks are not deducted for misreads.
10. 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.
11. If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.
- If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.
- If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the **M0**, **M1**, **M2** annotations as appropriate and place the annotation ✗ next to the wrong answer.
12. Ranges of answers given in the mark scheme are always inclusive.
13. 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.
14. 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.

Question		Answer	Marks	Part marks and guidance	
1	(a)	93 ÷ 3 or 31 or 100 ÷ 3 or 33.3.. or 55 ÷ 1.55 or 3300 ÷ 93 or 35.5 or 35.48... or 55 ÷ 93 or 0.6 or 0.59...	1	accept any correct method	e.g. 106.45 lengths in 55 mins
		<i>their</i> 31 × 100 or 3100 or <i>their</i> 33.3... × 93 or <i>their</i> 35.5 × 3	1		
		<i>their</i> 3100 ÷ 60 soi by 51.6[6..] or 51.7 or 52 or 51[<i>min</i>] 40[<i>sec</i>] or 55 × 60 soi 3300 or 106[.5] or 106.45...	1		
		106.45 or 106[.5] > 100 or 51.6[6]...or 51.7 or 52 or 51[<i>min</i>] 40[<i>sec</i>] < 55 or 31[00] < 33[00] or So he can swim that distance	1		
	(b)	he swims at the same rate	1	accept any correct statement e.g. he does not slow down, no breaks	See appendices
	(c)	he will get tired/he will slow down/not take breaks	1	accept any correct statement	See appendices
2	(a)	(i)	a^4	1	
		(ii)	b^{15}	1	
	(b)		$x(6 - x)$	1	

Question		Answer	Marks	Part marks and guidance	
3	(a)	accurate perpendicular bisector at least from AB passing within 3 cm of C with two pairs of correct arcs	2	B1 for accurate perpendicular bisector B1 for any arc centre C Dep on B1 (bisector) and B2 (arc) scored above	tolerance ± 2 mm
		arc centre C, at least from BC to CD, with radius 3 cm	2		
		two points marked intersecting the arc and line	1		
	(b)	One of the points is not in his garden or only one is in his garden	1	accept any correct reason e.g. one point is behind the CD fence	
4	(a)	4 points correctly plotted	2	B1 for 2 or 3 points correctly plotted	tolerance ± 1 mm
	(b)	strong/good positive	1 1		
	(c)	71[.42...] to 71.4[3] nfw	4	B1 for 21 B1 for 15 M1 for $(their15) \div 21 \times 100$ oe If 0 scored SC1 for line 'y = x' drawn or if no points plotted in (a) SC1 for $\frac{12}{17}$	21 from $17 + 4$ FT their diagram
5	(a)	8 $\bar{2}$ $\bar{2}$ 8	2	B1 for any 2 correct	

Question		Answer	Marks	Part marks and guidance	
	(b)	correct curve which dips below the line $y = -4$	3	B2 for 6 or 7 points correctly plotted FT <i>their</i> table or B1 for 4 or 5 points correctly plotted FT <i>their</i> table	tolerance ± 2 mm for plotting and the curve through the correct points
	(c)	-2.7 to -2.5 1.5 to 1.7	2	B1 for each Correct answer or FT <i>their</i> graph	tolerance ± 2 mm
	(d)	correct ruled line	3	M2 for a correct unruled line or a line of gradient -2 or a line going through $(0, -1)$ or two further correct points in the table or plotted or M1 for one point correctly plotted or one further correct point in the table	points are x -3 -2 -1 0 1 2 3 y 5 3 1 -1 -3 -5 -7 tolerance ± 2 mm
	(e)	-3.9 to -3.7 $[0].7$ to $[0].9$	2	B1 for each Correct answer or FT <i>their</i> straight line	tolerance ± 1 mm
6		21	4	B1 for 6 and 9 M1 for <i>their</i> (6×5) M1 for <i>their</i> $(6 \times 5) - \text{their } 9$	implied by 6:30

Question		Answer	Marks	Part marks and guidance	
7		8	5	B3 for 20 and 36 M1 for $(36 - 20) \div 2$ OR M2 for $180 - (360 \div 18)$ soi by 160 or M1 for $360 \div 18$ soi 20 and M2 for $180 - (360 \div 10)$ soi by 144 or M1 for $360 \div 10$ soi 36	accept any correct method
8	(a)	$\frac{12}{15}$ oe	3	M1 for 15 [options] or indicating 15 M1 for 12 or indicating 12	this could be the product rule, table, listing or implied by answer of $\frac{n}{15}$ or $\frac{12}{m}$
	(b)	90	2FT	FT <i>their(a)</i> for 2 marks M1 for <i>their</i> $(3 \times 5) \times 6$	ie <i>their</i> total number of options $\times 6$

Question	Answer	Marks	Part marks and guidance																
<p>9</p>	<p>Finding the number in each category e.g. Venn diagram</p>  <p>and $n = 437 - \text{their}127 - 62 - 153$ or 95</p> <p>or two-way table</p> <table border="1" data-bbox="421 742 660 869"> <tr> <td></td> <td>S</td> <td>S'</td> <td></td> </tr> <tr> <td>M</td> <td>62</td> <td>127</td> <td>189</td> </tr> <tr> <td>F</td> <td>95</td> <td>153</td> <td>248</td> </tr> <tr> <td></td> <td>157</td> <td>280</td> <td>437</td> </tr> </table> <p>and a common representation to compare e.g. percentages $\frac{95}{248} \times 100 = 38.3\%.$</p> <p>and</p> <p>38[.3...] or 0.38[3...] [so No]</p>		S	S'		M	62	127	189	F	95	153	248		157	280	437	<p>6</p>	<p>B3 for 95 or B2 for 157 or B1 for 127 and M2 for $\frac{\text{their } 95}{\text{their } 95+153} [\times 100]$ or $[0].4 \times 248$ soi by 99.2 or M1 for $\frac{\text{their } 95}{n} (n > \text{their}95)$ or B1 for 248 A1 for 38[.3...] or 0.38[3...] to a maximum of 5 marks</p> <p>OR</p> <p>B3 for a complete and correct Venn diagram or table or B2 for a correct Venn diagram or table with n not calculated and M1 for a correct method to calculate n or B1 for Venn diagram or table with two correct values in the correct places and M1 for choosing a common representation to compare the statement with the comment e.g. decimals or percentages and A1 for one of the two numbers correct e.g. with percentages 38.3... or 40</p> <p>Note : $\frac{95}{248}$ scores 5 marks accept any correct method e.g.</p> 
	S	S'																	
M	62	127	189																
F	95	153	248																
	157	280	437																

Question		Answer	Marks	Part marks and guidance	
10	(a)	$\frac{17}{30}$	4	B2 for $\frac{17}{3}$ OR M2 for $30 \times 0.1 + 20 \times 0.5 + 10 \times 0.8 + 10 \times 0.3 + 30 \times 0.2$ soi by 30 or M1 for three correct frequencies from 3, 10, 8, 3 and 6. and M1 for $3 + 10 + 4$ or 17	It can be done with probabilities
	(b)	They were evenly spread out in the 40 – 50 class	1	accept any correct statement e.g. half the people in the 40 – 50 got over 45	
11		$y = \frac{80}{x^2}$ oe	3	M1 for $y = \frac{k}{x^2}$ oe B1 for $k = 80$	implied by $5 = \frac{k}{4^2}$ oe
12		24	4	B3 for 24.7 or 24.6[6...] OR B1 for 18.5 or 1850 B1 for 0.75 or 75 M1 for $their1850 \div their75$ oe soi by 24.7 or 24.6[6...] 	condone 18.49 or 1849 in this question $1750 \leq their1850 \leq 1850$ and $70 \leq their75 \leq 90$ allow work in metres e.g. use of 1.75, 1.85, .7, .9

Question		Answer	Marks	Part marks and guidance
13	(a)	4 5	4	<p>B2 for one correct solution</p> <p>OR</p> <p>B1 for $x^2 - 9x + 20 = 0$</p> <p>M2 for $(x - 4)(x - 5) = 0$ or use of the formula with at most one error</p> <p>or</p> <p>M1 for two factors which when expanded give two terms correctly or use of the formula with at most two errors</p> <p>if 0 scored SC1 for correctly factorising <i>their</i> quadratic expression</p>
	(b)	$6x^3 + 23x^2 - 33x + 10$	4	<p>M3 for a fully correct method with at most one error e.g. $(2x^2 + 9x - 5)(3x - 2) = 6x^3 + 27x^2 - 15x - 4x^2 - 18x + 10$ or better</p> <p>or</p> <p>M2 for a correct method to multiply two brackets e.g. $2x^2 + 10x - x - 5$ or $3x^2 + 15x - 2x - 10$ or better</p> <p>or</p> <p>M1 for a correct method with at most two errors or a correct method to multiply two brackets with at most one error</p>

Question		Answer	Marks	Part marks and guidance	
14		32.6 or 32.56 or 32.556...	5	M2 for $\sqrt{(11^2 + 6^2)}$ soi by 12.52 to 12.53 or M1 for $[\dots]^2 = 11^2 + 6^2$ and M2 for $\tan [\dots =] 8 \div \text{their } 12.52$ or M1 for $8 \div \text{their } 12.52$	accept any correct and full method note: HB = 14.866...
15		$\frac{(4 + 2\sqrt{5})(\sqrt{5} + 1)}{(\sqrt{5} - 1)(\sqrt{5} + 1)}$ $(4\sqrt{5} + 4 + 10 + 2\sqrt{5})$ oe or better $(5 - \sqrt{5} + \sqrt{5} - 1)$ oe or better $\frac{6\sqrt{5} + 14}{4} = \frac{3\sqrt{5} + 7}{2}$	M1 M1 M1 A1	condone one error soi by 5 -1 or 4 condone one error	bracket expansion could be in a table i.e. dividing by 2
16	(a)	$(x - 3)^2 + 11$ final answer	3	B1 for $(x - 3)^2$ B2 for +11 or FT <i>their</i> $(x - 3)^2$	
	(b)	(3, 11)	2	B1FT for each part	FT <i>their</i> $(x - a)^2 + b$ e.g. (a, b)

Question		Answer	Marks	Part marks and guidance	
17	(a)	<p>Attempt to use the cosine formula</p> $[\dots]^2 = 14^2 + 18^2 - 2 \times 14 \times 18 \cos 46 \text{ oe}$ <p>or</p> <p>cosine formula with at most 2 errors or correct cosine formula starting cos</p> $[\dots] = \frac{14^2 + 18^2 - [\dots]^2}{2 \times 18 \times 14}$ <p>13.03...</p>	<p>M1</p> <p>M2</p> <p>or</p> <p>M1</p> <p>A1</p>		<p>Evidenced by the formula e.g. $a^2 = b^2 + c^2 - 2bc \cos A$ or better</p>
	(b)	35.48 to 35.6	3	<p>B1 for $180 - 78 - 81$ or 21</p> <p>M1 for $\frac{13.0\dots}{\sin 21} = \frac{[\dots]}{\sin 78}$ oe or better</p>	<p>could be on diagram</p> <p>accept any correct method</p>
18		-1.85 [0].18	4	<p>M2 for $\frac{-5 \pm \sqrt{5^2 - 4 \times 3 \times -1}}{2 \times 3}$ or better and condone one error</p> <p>or</p> <p>M1 for the formula with at most two errors and</p> <p>A1 for -1.85 or [0].18 or for both answers correct but to more than 2dp. e.g. 0.180... and -1.847...</p>	<p>Accept any correct algebraic method e.g. completing the square</p> $3\left[x^2 + \frac{5}{3}x + \frac{1}{3}\right] = 0$ $3\left[\left(x + \frac{5}{6}\right)^2 - \frac{13}{36}\right] = 0$

APPENDIX

Exemplar responses for Q1(b)

Response	Mark
It took an equal amount of time per length	1
He can swim the other lengths at the same speed	1
He took 31 seconds to swim each length	1 BOD
He didn't stop for a break	1
Every 3 equals 93 sec – every 1 equals 31 sec	1 BOD
He could swim more lengths in under 55 minutes	0
He can swim exactly 3 lengths in 93 secs without losing a couple of seconds	0
Needs to swim faster	0
He swam 3 lengths in 1 min 33sec	0
He's a quick swimmer	0
That he could/couldn't do it	0
That $93 \div 3 = 31$ and $100 \times 31 = 3100$ which is less than 55 min	0

Exemplar responses for Q1(c)

Response	Mark
Runs out of breath	1
He gets tired/slower	1
He may need a break	1
He may not be able to swim that far	1
He would have to maintain a constant speed	1 BOD
He may not keep going at the same speed (doesn't say why)	1 BOD
Not enough practice	0
He may take longer to swim 100 lengths	0
He's not a good swimmer	0

Exemplar responses for Q6(b)

Response	Mark
One does not lie inside his garden	1
One is outside of the fence	1
Only one lies in his garden	1

Exemplar responses for Q9(b)

Response	Mark
They were evenly spread out in the 40 – 50 class	1
Half are under 45 and half are over 45	1

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