



Rewarding Learning

**General Certificate of Secondary Education
2023**

Mathematics

M4

Calculator Paper

Higher Tier

[GMC41]

FRIDAY 19 MAY, MORNING

**MARK
SCHEME**

GCSE MATHEMATICS

Introduction

The mark scheme normally provides the most popular solution to each question. Other solutions given by candidates are evaluated and credit given as appropriate; these alternative methods are not usually illustrated in the published mark scheme.

The marks awarded for each question are shown in the right hand column and they are prefixed by the letters **M**, **A** and **MA** as appropriate. The key to the mark scheme is given below:

M indicates marks for correct method.

A indicates marks for accurate working, whether in calculation, reading from tables, graphs or answers. Accuracy marks may depend on preceding M (method) marks, hence M0 A1 cannot be awarded, i.e. where the method is not correct no marks can be given.

MA indicates marks for combined method and accurate working.

A later part of a question may require a candidate to use an answer obtained from an earlier part of the same question. A candidate who gets the wrong answer to the earlier part and goes on to the later part is naturally unaware that the wrong data is being used and is actually undertaking the solution of a parallel problem from the point at which the error occurred. If such a candidate continues to apply correct method, then the candidate's individual working must be **followed through** from the error. If no further errors are made, then the candidate is penalised only for the initial error. Solutions containing two or more working or transcription errors are treated in the same way. This process is usually referred to as "follow-through marking" and allows a candidate to gain credit for that part of a solution which follows a working or transcription error.

Positive marking:

It is our intention to reward candidates for any demonstration of relevant knowledge, skills or understanding. For this reason we adopt a policy of **following through** their answers, that is, having penalised a candidate for an error, we mark the succeeding parts of the question using the candidate's value or answers and award marks accordingly.

Some common examples of this occur in the following cases:

- (a) a numerical error in one entry in a table of values might lead to several answers being incorrect, but these might not be essentially separate errors;
- (b) readings taken from candidates' inaccurate graphs may not agree with the answers expected but might be consistent with the graphs drawn.

When the candidate misreads a question in such a way as to make the question easier only a proportion of the marks will be available (based on the professional judgement of the examining team).

General Marking Advice

- (i) If the correct answer is seen in the body of the script and the answer given in the answer line is clearly a transcription error, full marks should be awarded.
- (ii) If the answer is missing, but the correct answer is seen in the body of the script, full marks should be awarded.
- (iii) If the correct answer is seen in working but a completely different answer is seen in the answer space, then some marks will be awarded depending on the severity of the error.
- (iv) Work crossed out but not replaced should be marked.
- (v) In general, 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 (with no solution offered on the answer line), mark the poorest answer.
- (vi) For methods not provided for in the mark scheme, give as far as possible equivalent marks for equivalent work.
- (vii) Where a follow through mark is indicated on the mark scheme for a particular part question, the marker must ensure that you refer back to the answer of the previous part of the question.
- (viii) Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures seen, e.g. the answer in the mark scheme is 4.65 and the candidate then correctly round to 4.7 or 5 on the answer line. Allow full marks for 4.65 seen in the working.
- (ix) Anything in the mark scheme which is in brackets (...) is not required for the mark to be earned, but if present it must be correct.
- (x) For any question, the range of answers given in the mark scheme is inclusive.

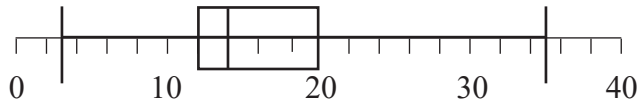
			AVAILABLE MARKS	
1	Option A:	$4500 \times 0.035 = 157.50$	MA1	5
		$4657.50 \times 0.035 = 163.01$		
		Interest = 320.51 or Amount = 4820.51	MA1	
	Option B:	$4500 \times 0.05 = 225$		
		$4725 \times 0.02 = 94.50$	MA1	
		Interest = 319.50 or Amount = 4819.50	MA1	
	Option A by £1.01		MA1	
2	(a) (i)	50	A1	
	(ii)	gradient = $\frac{150}{2}$ (or equivalent) = 75	M1 A1	
	(b)	The mini digger costs £75 a day to hire	A1	
3		$6y^2 - 14y - 8y$	MA1 MA1	
		$6y^2 - 22y$	MA1	3
4		Shaded = $\pi \times 6^2$	MA1	
		= 113.0973355 (= 36π)	A1	
		Semicircle = $\frac{1}{2} \times \pi \times 12^2 = 226.1946711$ (= 72π)	MA1	
		Unshaded = $226.1946711 - 113.0973355 = 113.0973356$ (= 36π)	MA1	4
5	(a)	$8 \times 7.5 + 3 \times 22.5 + 5 \times 37.5 + 4 \times 52.5 = 525$	MA2	
		= $\frac{525}{20}$	MA1	
		= 26.25	A1	
	(b)	Only an estimate because the data is grouped so we do not know the exact time	A1	5
6		application of Pythagoras	M1	
		$20^2 + 21^2 = 841$	A1	
		$28^2 = 784$ so no as conclusion	A1	3

			AVAILABLE MARKS
7	81.8% = 10225	MA1	3
	$10225 \div 81.8 \times 100$	MA1	
	= £12500	A1	
8	$4(2x - 5) + 9(3x + 1) = 10$	MA1	4
	$8x - 20 + 27x + 9 = 10$	MA1	
	$35x = 21$	MA1	
	$x = \frac{3}{5}$ or equivalent	A1	
9	$3^3 \times 5^2 \times 7$	M1A1	2
10	(a) $(x + 7)(x - 5)$	MA2	3
	(b) $x = -7$ or 5	MA1	
11	$m = \frac{16 - -2}{6 - 0}$	MA1	3
	= 3	A1	
	$y = 3x - 2$	MA1	
12	$\sin 35 = \frac{x}{7}$	MA1	4
	$x = 7 \sin 35$	M1	
	= 4.015(035054)	A1	
	$4.015 + 0.85 = 4.865$	MA1	
13	$2 \times \pi \times 3.4 = 21.3628(3004)$	MA1	3
	$21.3628 + 1 = 22.3628$	MA1	
	$22.3628 \times 12 = 268.35(39605)$	MA1	
	alternative solution		
	$2 \times \pi \times 3.4 \times 12 = 256.3539(605)$	MA2	
	$256.3539(605) + 1 \times 12 = 268.35(39605)$	MA1	

14 (a) UQ = 20

Min = 3

Box plot drawn



(b) Yes because 50% are below 14 so more than 50% are below 16 – majority

15 Max. distance = 62.5 km

Min. time = 1hr 10.5 mins = 1.175 hrs

Average speed = $\frac{62.5}{1.175}$ or $\frac{62.5}{70.5} \times 60$

= 53.19148936.....

16 $8 = 4m + 5$

$$m = \frac{3}{4}$$

gradient of perpendicular line = $-\frac{4}{3}$

$$y = -\frac{4}{3}x + c$$

$$2 = 4 + c$$

$$c = -2$$

$$y = -\frac{4}{3}x - 2$$

MA1

AVAILABLE
MARKS

MA1

A2

A1

5

MA1

MA1

MA1

A1

4

MA1

MA1

MA1

MA1

4

		AVAILABLE MARKS												
17	(a) (i) $p = 36^\circ$	A1												
	(ii) $q = 54^\circ$	A1												
	(b) $ARP = 55$, two tangents equal so isosceles triangle	MA1												
	$PRQ = 60$, adjacent or straight line	MA1												
	$BPQ = 60$, alternate segment	MA1												
	$BQP = 60$, 2 tangents; isosceles or alternate segment theorem so $PBQ = 60$, angles in triangle : equilateral	MA1												
	alternative solution													
	$RCQ = 50$, two tangents equal so isosceles triangle	MA1												
	$ABC = 60$, angles in a triangle	MA1												
	$BPQ = BQP = 60$, 2 tangents so isosceles triangle or alternate segment theorem	MA1												
	Equilateral	A1												
		6												
18	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">54</td> <td></td> <td style="text-align: center;">30</td> </tr> <tr> <td></td> <td style="text-align: center;">9</td> <td style="text-align: center;">19</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">A1</td> <td style="text-align: center;">A1</td> <td style="text-align: center;">A1</td> </tr> </table>		54		30		9	19			A1	A1	A1	
	54		30											
	9	19												
	A1	A1	A1											
			3											
19	(a) $\left(\frac{2}{3}x - 10\right)\left(\frac{2}{3}x + 10\right)$ allow [1] for $\frac{2}{3}x$, 10 used	MA2												
	(b) $a(3x - y)(2x + 3y)$	A1 A1 A1												
			5											
20	$A = \frac{1}{2}(2x - 1 + 3.5)(5x - 4)$ $\frac{1}{2}(2x + 2.5)(5x - 4) = 19.5$ $5x^2 + 2.25x - 5 = 19.5$ $5x^2 + 2.25x - 24.5 = 0$ or $(20x^2 + 9x - 98 = 0)$ $x = \frac{-2.25 \pm \sqrt{(2.25)^2 - 4 \times 5 \times (-24.5)}}{10}$ $x = 2$	MA1 M1 A2												
	height = 3m length = 6m	A1												
			6											

		AVAILABLE MARKS
21 (a) (i)	freq of 4 and 48	A2
	(ii) first freq = 4 so bar height fd completed at 0.1	A1
(b)	$\frac{1}{2}(140) = 70\text{th value}$	
	$(4 + 48 =) 52 + 33 = 85$ so median in 60–70 group	MA1
	$\frac{18}{33} \times 10 = 5.45$	M1 A1
	$60 + 5.45 = 65.45$ mins	MA1
		7
22	$\frac{3}{3x-1} = \frac{5(2x+3)-4}{2x+3}$	M1 A1
	$\frac{3}{3x-1} = \frac{10x+11}{2x+3}$	MA1
	$(3x-1)(10x+11) = 3(2x+3)$	MA1
	$30x^2 + 17x - 20 = 0$	MA1
	$x = \frac{-17 \pm \sqrt{17^2 - 4(30)(-20)}}{60}$	MA1
	$x = 0.58$ or -1.15	A1
	alternative Solution	
	$\frac{3(2x+3)+4(3x-1)}{(3x-1)(2x+3)} = 5$	M1 A1
	$\frac{18x+5}{6x^2+7x-3} = 5$	MA1
	$30x^2 + 35x - 15 = 18x + 5$	MA1
	$30x^2 + 17x - 20 = 0$	MA1
	$x = \frac{-17 \pm \sqrt{17^2 - 4(30)(-20)}}{60}$	MA1
	$x = 0.58$ or -1.15	A1
		7

$$23 \quad \frac{1}{3} \times \pi \times 5.25^2 \times h = 497$$

$$h = 17.21904908$$

$$l^2 = 17.21904908^2 + 5.25^2$$

$$l = 18.00161524$$

$$\frac{\theta}{360} \times 2 \times \pi \times 18.00161524 = 2 \times \pi \times 5.25$$

$$\theta = 105$$

alternative solution

$$\frac{1}{3} \times \pi \times 5.25^2 \times h = 497$$

$$h = 17.21904908$$

$$l^2 = 17.21904908^2 + 5.25^2$$

$$l = 18.00161524$$

$$\frac{\theta}{360} \times \pi \times 18.00161524^2 = \pi \times 5.25 \times 18.00161524$$

$$\theta = 105$$

MA1

A1

MA1

A1

MA2

A1

MA1

A1

MA1

A1

MA2

A1

Total

AVAILABLE
MARKS

7

100