



**General Certificate of Secondary Education
2023**

Mathematics

M4

Calculator Paper

Higher Tier

[GMC41]

TUESDAY 21 NOVEMBER, 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 solution to a question gains marks for correct method and marks for accurate working based on this method. 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 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.

It should be noted that where an error trivialises a question, or changes the nature of the skills being tested, then as a general rule, it would be the case that not more than half the marks for that question or part of that question would be awarded; in some cases the error may be such that no marks would be awarded.

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 a candidate's 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 examiner).

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 rounds 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	(a) negative	A1	2
	(b) outlier	A1	
2	$85^2 + 110^2$	M1	5
	$\sqrt{19325}$ or $x^2 = 19325$	MA1	
	139.014.....	A1	
	$1000 \div 139.014..... = 7.193.....$	MA1	
	8	A1	
3	$0.5 \times 9 \times 4$	MA1	2
	18	A1	
4	(a) 4	A1	4
	(b) 15	A1	
	(c) $9 + 2 = 11$ people 176	MA1 A1	
5	(3, 5.5)	A1 A1	2
6	(a) 5	A1	3
	(b) Any 2 comparisons made, e.g. 0 miles = £4.40 and 2 miles = £6.00 So 2 miles = £1.60 1 mile = 80p or £0.80 (answer must include appropriate units)	MA1 MA1	

			AVAILABLE MARKS	
7	(a) 30% of £1200 = £360	MA1		
	£1200 – £360 = £840 (alternative $0.7 \times 1200 = 840$)	MA1		
	5% of £840 = £42			
	£840 – £42 = £798	MA1		
	(b) 35% of 1200 = £420	MA1		
	1200 – 420 = 780			
	No	MA1		
	alternative solution			
	Saving £1200 – £798 = £402	MA1		
	35% of 1200 = £420			
No (he is incorrect)	MA1			
alternative solution				
Saving £1200 – £798 = £402	MA1			
$\frac{402}{1200} \times 100 = 33.5\%$				
No (he is incorrect)	MA1	5		
8	$\frac{x}{3} = 7$	MA1		
	$x = 21$	MA1		2
9	$60 = 2^2 \times 3 \times 5$ or $2 \times 2 \times 3 \times 5$	MA1		
	$36 = 2^2 \times 3^2$ or $2 \times 2 \times 3 \times 3$	MA1		
	LCM = $2 \times 2 \times 3 \times 3 \times 5 = 180$	MA1		3
10	$x^2 + 7x - 44 = 0$	MA1		
	$(x + 11)(x - 4) = 0$	MA1		
	$x = -11$ or $x = 4$			
	$x = 4$ only on answer line as cannot have negative length	MA1		3
11	$\frac{3(3x - 1) + 11 - 7x}{6}$			
	$\frac{9x - 3 + 11 - 7x}{6}$	MA1 for either of first 2 lines		
	$\frac{2x + 8}{6}$	MA1		
	$\frac{2(x + 4)}{6} = \frac{x + 4}{3}$	MA1		3

			MA2	AVAILABLE MARKS
12	D: $y = 4x$ Allow MA1 for 2 correct (C) $y = 4x + 5$	A: $y = 5 - 4x$ B: $y = 5$	A1 A1	4
13	$\frac{240}{0.32}$ 750 N/m ²		MA1 A1 A1	3
14	$(\pi \times 5^2 =)$ 78.53981634 $\frac{2}{3} \times 78.53981634$ 52.35 (987756)		MA1 MA1 A1	3
15	(a) using 25, 31 IQR = 6 (b) median because it is not affected by the extreme value		A1 A1 A1A1	4
16	(a) 38 or 39 (b) reading at 34 gives 36 90 - 36 = 54		A1 A1 A1	3
17	(a) There are significantly different amounts of people in each age group or to make sure each age is represented fairly (b) $\frac{340}{1584} \times 100 = 21.4$ 21 – 30 21 31 – 40 45 41 – 50 26 Over 50 8		MA1 MA1 A2	4
18	$\sin 31 = \frac{AB}{6.2}$ AB = 3.19(3236064) $\tan 55 = \frac{3.19(3236064)}{BD}$ BD = 2.24		MA1 A1 MA1 A1	4

			AVAILABLE MARKS		
19	(a)	$3 \times x(2x + 1) + 2 \times x^2 = 140$ $6x^2 + 3x + 2x^2 = 140$ $8x^2 + 3x - 140 = 0$	M1 A1 MA1	7	
	(b)	$(x - 4)(8x + 35) = 0$ $x = 4$ $9 \times 4 \times 4 = 144$	MA2 A1 A1		
		Alternative Solution			
		$x = \frac{-3 \pm \sqrt{3^2 - 4 \times 8 \times (-140)}}{16}$ $x = 4$ $9 \times 4 \times 4 = 144$	MA2 A1 A1		
20		$\frac{23.205}{5.45}$ 4.257798165	MA1 MA1 A1	3	
21		Angle PQR = 68° Angle POR = 136° $x = 22^\circ$ $y = 27^\circ$	Alternate Segment Theorem Angle at centre is twice the angle at the circumference Isosceles triangle Angles in quadrilateral add up to 360°	A1 MA1 A1 MA1 MA1 MA1	6
		Alternative Solution			
		Angle PRO = 22° $x = 22^\circ$ Angle POR = 136° Angle PQR = 68° $y = 27^\circ$	Tangent/radius 90° Isosceles triangle Angle at centre = $2 \times$ angle at circumference Angles in quadrilateral add up to 360°	MA1 MA1 A1 A1 MA1 MA1	
22		$a(4x - 5y)(2x + y)$	MA1 M1 A1	3	
23		$\frac{4(2x - 3) + 5(3x + 1)}{(3x + 1)(2x - 3)} = \frac{1}{3}$ $\frac{8x - 12 + 15x + 5}{6x^2 - 9x + 2x - 3} = \frac{1}{3}$ $\frac{23x - 7}{6x^2 - 7x - 3} = \frac{1}{3}$ $6x^2 - 7x - 3 = 69x - 21$ $6x^2 - 76x + 18 = 0$ $x = \frac{76 \pm \sqrt{(-76)^2 - 4 \times 6 \times 18}}{12}$ $x = 12.43$ or 0.24	M1 A1 MA1 MA1 MA1 M1 A1	7	

			AVAILABLE MARKS
24 (a)	$4(4x) = 48$		
	$16x = 48$		
	$x = 3$ (i.e. 1 FD square = 3)	MA1	
	$14 \leq w < 18 \quad 4 \times 25 \times 3 = 300$		
	$18 \leq w < 20 \quad 2 \times 41 \times 3 = 246$	MA1	
	$20 \leq w < 21 \quad 1 \times 8 \times 3 = 24$	A1	
	$300 + 246 + 24 = 570$		
(b)	$894 \div 2 = 447\text{th value}$		
	$447 - 204 = 243$ into the group $14 \leq w < 18$	A1	
	$14 + \frac{243}{300} \times 4$	MA1	
	17.24	A1	6
25	$\frac{x^2(x-3)}{(x+3)(x-3)} = \frac{x^2}{x+3}$	MA1 MA1	3
26	$l^2 = 9^2 + r^2$ $l = \sqrt{81 + r^2}$	MA1	
	S.A. of cone = $\pi r^2 + \pi r l$ $\pi r^2 + \pi r \sqrt{81 + r^2}$	MA1	
	S.A. of hemisphere = $\pi r^2 + \frac{1}{2}(4\pi r^2)$ $= 3\pi r^2$	MA1	
	$3\pi r^2 = \pi r^2 + \pi r \sqrt{81 + r^2}$	MA1	
	$2\pi r^2 = \pi r \sqrt{81 + r^2}$		
	$2r = \sqrt{81 + r^2}$	MA1	
	$4r^2 = 81 + r^2$		
	$r = 3\sqrt{3}$ (5.1961524230)	A1	6
Total			100