



**General Certificate of Secondary Education  
2024**

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**Mathematics**

**M4**

**Calculator Paper**

**Higher Tier**

**[GMC41]**

**TUESDAY 19 NOVEMBER, 9.15AM – 11.15AM**

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**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 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	4% of 18000 = 720	18000 + 720 = 18720	MA1
	4% of 18720 = 748.80	18720 + 748.80 = 19468.80	MA1
	4% of 19468.80 = 778.75(2)	19468.80 + 778.75(2) = 20247.55(2)	
	Answer 3 years		A1
<b>alternative solution</b>			
	1.04 <sup>2</sup> × 18000 = 19468.80		M1A1
	1.04 <sup>3</sup> × 18000 = 20247.55		
	Answer 3 years		A1
2	110 = 55 × 2		
	x = 2 × 5 or 2 × 11 answer 10 or 22 (accept either)		M1 A1
<b>alternative solution</b>			
	For LCM 110, x must be 2 or 10 or 22 or 110 so 10 or 22		M1 A1
3	14a – 6 = 8a + 3	perimeter	MA1, equation M1
	6a = 9		MA1
	1.5		A1
4	(a) (0,19000),(1,14000) plotted and joined		A1
	(1,14000) joined to (6,4000)		A1
	(b) 4		A1
5	π × 82 = 257.61(05976)		MA1
	257.6105976 ÷ 2 = 128.8(052988)		MA1
	128.8052988 + 82 = 210.8(052988)		MA1
6	h <sup>2</sup> + 12 <sup>2</sup> = 15 <sup>2</sup>		MA1
	h <sup>2</sup> = 81		MA1
	h = 9 cm		MA1
	$\frac{1}{2}(6 + 18) \times 9 = 108$		M1 A1
7	31% left – Spain		A1
	46% right – France		A1
8	Range increases by 2 so either 10 or 53 lessons		A1
	Median has decreased so new value must be below old median		
	= 10 lessons		A1
9	18 – x = 12 – 6x		MA1
	5x = –6		MA1
	x = –1.2		A1

				AVAILABLE MARKS					
<b>10</b>	90% = 227700	MA1							
	100% = 253000	MA1							
	115% = 253000	MA1							
	100% = 220000	MA1		4					
<b>11</b>	$\tan \alpha = \frac{5.3}{2.2}$	MA1							
	$\alpha = 67.456\dots$	A1							
	No	A1		3					
<b>12</b>	base = $\pi \times 7^2 = 49\pi = 153.93804$								
	top = $\pi \times 2.5^2 = 6.25\pi = 19.63495408$	MA1							
	curved surface area large = $2 \times \pi \times 7 \times 8 = 112\pi = 351.8583772$	MA1							
	curved surface area small = $2 \times \pi \times 2.5 \times 4 = 20\pi = 62.83185307$	MA1							
	mid area = $49\pi - 6.25\pi = 134.3030859$	MA1							
	total = 722.566(3103)	A1							
	<b>alternative solution</b>								
	$2 \times 153.93804 + 351.858772 + 62.83185307$	M1 A1, MA1, MA1							
	Total = 722.566(3103)	A1		5					
<b>13</b>	(a) Journey time	20	25	30	35	45	60		
	Cum freq	7	18	36	45	49	50	A1	
	(b) Graph							M1 A1	
	(c) $24 \approx 16$ and $38 \approx 47$	(use candidate's graph readings)						A1	
	$47 - 16 = 31$							MA1	5
<b>14</b>	$50 = 2 \times 5 \times 5$								
	$65 = 5 \times 13$							MA1	
	$2 \times 5 \times 5 \times 13 = 650$							MA1	
	10 minutes 50 seconds							MA1	3
<b>15</b>	(a) $61^\circ$ because Alternate Segment Theorem	A1	A1						
	(b) $58^\circ$ because BAC is isosceles and angles in a straight line add up to $180^\circ$	A1	A1						
	(c) $64^\circ$ because two tangents drawn from the same point form an isosceles triangle	A1	A1						6

		MA1 MA1	AVAILABLE MARKS
16	$\frac{14.25^2}{2 \times 9.805}$ 10.35504844	A1	3
17	Gradient of perpendicular = $-\frac{1}{3}$ $y = -\frac{1}{3}x + c$ $2 = -\frac{1}{3}(-3) + c$ $c = 1$ $y = -\frac{1}{3}x + 1$	MA1  M1 A1 MA1	4
18	(a) $\frac{1}{2}(2x + 1)(3x - 4) = 10.5$ $6x^2 - 8x + 3x - 4 = 21$ $6x^2 - 5x - 25 = 0$  (b) $(2x - 5)(3x + 5) = 0$ or $x = \frac{5 \pm \sqrt{(-5)^2 - 4(6)(-25)}}{12}$  $x = \frac{5}{2}$ AB = 3.5 BC = 6	MA1 MA1 MA1  MA1 A1  A1	6
19	$\frac{2(x^2 - 16)}{3x^2 - 11x - 4}$ $\frac{2(x+4)(x-4)}{(3x+1)(x-4)}$  $\frac{2(x+4)}{3x+1}$	MA1  MA1 MA2  MA1	5

			AVAILABLE MARKS
20	$\frac{2x(x-1)+4(3x+1)}{(3x+1)(x-1)} = \frac{5}{2}$	M1 A1	8
	$\frac{2x^2-2x+12x+4}{3x^2-3x+x-1} = \frac{5}{2}$	MA1	
	$\frac{2x^2+10x+4}{3x^2-2x-1} = \frac{5}{2}$		
	$15x^2-10x-5 = 4x^2+20x+8$	MA1	
	$11x^2-30x-13 = 0$	MA1	
	$x = \frac{30 \pm \sqrt{(-30)^2 - 4(11)(-13)}}{22}$	MA1	
	$x = 3.11$ <b>or</b> $-0.38$	A1 A1	
21	(a) Bar drawn to 1.6 for $35 < t \leq 50$	MA1	14
	Bar drawn to 1.2 for $50 < t \leq 60$	MA1	
	(b) 36, 8	A1 A1	
	(c) 90 squares = 36	M1	
	values 16 20 54 84 12	A1	
	midpoint values used 10 40 75 105 150	MA1	
	$\frac{(16 \times 10) + (20 \times 40) + (54 \times 75) + (84 \times 105) + (12 \times 150)}{186}$	M1 A1	
	84.03	A1	
	(d) (i) $\frac{84}{186} \times x = 14$	M1	
	31	A1	
(ii) $\frac{6}{186} \times 31 = 1$	M1 A1		
22	$\frac{1}{3} \pi (3r)^2 (18) - \frac{1}{3} \pi r^2 (6) = 196$	MA1 MA1 MA1	7
	$54\pi r^2 - 2\pi r^2 = 196$	MA1	
	$52\pi r^2 = 196$		
	$r^2 = 1.199783417$	MA1	
	$r = 1.095346254$	MA1	
	$d = 6.572077527$	A1	
	<b>Total</b>		