



General Certificate of Secondary Education

Mathematics

M4

Calculator Paper

Higher Tier

[GMC41]

Assessment

**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**, **W** and **MW** as appropriate. The key to the mark scheme is given below:

M indicates marks for correct method.

W indicates marks for working.

MW indicates marks for combined method and working.

The solution to a question gains marks for correct method and marks for an accurate working based on this method. Where the method is not correct no marks can be given.

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 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
6	Area of large circle = $\pi \times 6^2 = 113.0973355$ Area of each semicircle = $\frac{1}{2} \times \pi \times 2^2 = 6.283185307$ Shaded area = $113.0973355 - 3 \times 6.283185307$ (must use 3 semicircles) = 94.24777961	M1 A1 MA1 M1 A1 5
7	Recognition for LCM of 250 and 450 Alternative $250 = 2 \times 5 \times 5 \times 5$ $450 = 2 \times 3 \times 3 \times 5 \times 5$ $LCM = 2 \times 3 \times 3 \times 5 \times 5 \times 5$ LCM = 2250 9 packets of coffee and 5 packets of tea $9 \times 4.20 + 5 \times 3.60$ = 55.80	M1 MA1 A1 MA1 M1 A1 5
8	The median is higher in Maths There is a similar range of marks in both subjects There is a greater interquartile range in Maths (or semi-interquartile range)	A1 A1 A1 3
9	$\sin 21 = \frac{x}{8.4}$ $x = 8.4 \sin 21$ $x = 3.01(0290776) \times 2 = 6.02(0581552)$ perimeter = $16.8 + 6.02(0581552) = 22.82(058155)$ accept any correct rounding, also correct base using cos rule	M1 MA1 MA1 MA1 4
10	$120.96 \div 72 \times 100$ (or equivalent) = 168	MA1 A1 2
11	$P = \frac{33\,000}{6000}$ or $\frac{8250}{1500}$ = 5.5	MA1 A1 2
12	$A = \frac{305}{360} \times \pi \times 3^2$ = 23.95 (464398) accept any correct rounding	MA1 A1 2

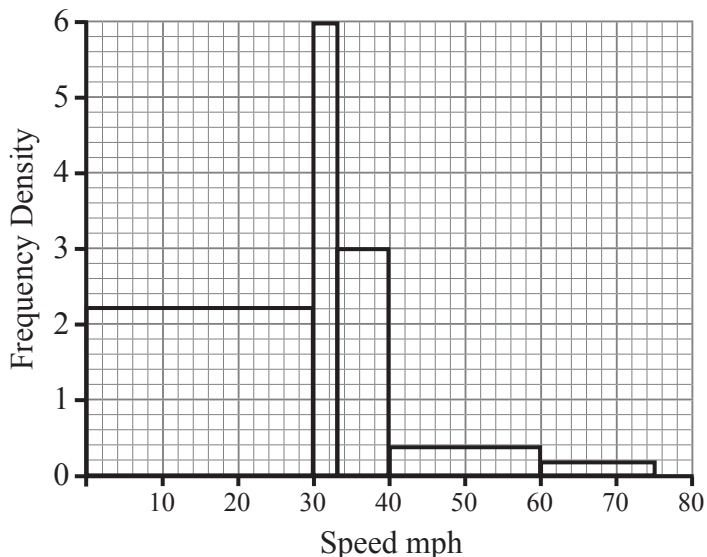
		AVAILABLE MARKS
13 $6(3x + 2) - 5(3x - 4) = 2$ $18x + 12 - 15x + 20 = 2$ $3x = -30$ $x = -10$	MA1 MA1 MA1 A1	
Alternative Solution:		
$\frac{6x}{5} + \frac{4}{5} - x + \frac{4}{3} = \frac{2}{15}$ $\frac{x}{5} = -2$ $x = -10$ follow for numerical errors, but not omission of key elements of method	MA2 MA1 A1	4
14 U.B. of distance = 200.5 m L.B. of time = 26.35 s (if both UBs and both LBs are shown, this first mark can still be awarded)	MA1 (for both)	
Average speed = $\frac{200.5}{26.35}$ (for second mark, must know to use distance UB and time LB) = 7.609108159 (final mark for accurate calculation)	MA1 A1	3
15 Gradient of BD = $-\frac{1}{3}$ $y = mx + c$ through (1, 5) MA means method of line, with accuracy of using (1, 5) (mark for 2 solutions)	MA1 MA1	
$5 = -\frac{1}{3} + c$ $c = 5\frac{1}{3}$ $y = -\frac{1}{3}x + 5\frac{1}{3}$ (final 2 marks also gained for correct line equation using formula with (1, 5) and $-\frac{1}{3}$: $(y - 5) = -\frac{1}{3}(x - 1)$)	MA1 A1	4
16 $(3x + 3)^2 + (2x - 1)^2 = (5x - 2)^2$ $9x^2 + 18x + 9 + 4x^2 - 4x + 1 = 25x^2 - 20x + 4$ $12x^2 - 34x - 6 = 0$ $(12x + 2)(x - 3) = 0$ $x = -\frac{1}{6}$ or $x = 3$ $x = 3$	MA1 MA1 MA1 A1	4

- 17 $\sin 42^\circ = \frac{a}{4.5}$ $a = 3.011$ (or b using cos) MA1
 $b^2 = 4.5^2 - 3.011^2$ $b = 3.344$ (or $a = 3.011$ by Pythagoras) MA1
 or $\cos 42^\circ = \frac{b}{4.5}$ $b = 3.344$ (or a using sin)
 $\tan 18^\circ = \frac{3.011}{c}$ $c = 9.267$ MA1
 $b + c = 3.344 + 9.267 = 12.611$ MA1
 $x^2 = 12.611^2 - 6.4^2$ $x = 10.9$ MA1

- 18 Median A1
 Because the median is unaffected by extreme values MA1
 (and there is no mode) 2

- 19 (a) 38° A1
 Because angles in the same segment are equal MA1
 (b) 90° A1
 Because the angle in a semi-circle is 90° MA1
 (c) 76° A1
 Because the angle at the centre is twice the angle at the circumference MA1 6

- 20 (a) F.D. = 2.2, 6, 3, 0.4, 0.2 (all freq densities correct) MA1
 Correct labels and scales A2
 5 correct bars (see below) A1



(follow through numerical error, e.g. one FD calculation error could lead to 3 marks)

- (b) $\frac{21}{116} \times 50$ MA1
 $= 9$ A1

AVAILABLE MARKS

5

2

6

Speed(s)	Frequency	Mid-point	Mid-point \times frequency
$0 < s \leq 40$	20	20	400
$40 < s \leq 60$	100	50	5000
$60 < s \leq 66$	21	63	1323
$66 < s \leq 70$	12	68	816
$70 < s \leq 80$	5	75	375
$80 < s \leq 100$	4	90	360
Total	162		8274

MA3

(follow through for numerical errors if method correct, deduct 1 mark per error)

$$\text{Mean} = \frac{8274}{162}$$

$$= 51.1 \text{ mph}$$

MA1

(d) 30 mph zone: $\frac{32}{116} \times 100 = 27.6\%$

60 mph zone: $\frac{21}{162} \times 100 = 13.0\%$

MA1

So over twice the percentage were speeding in the 30 mph zone (or similar conclusion)

MA1

12

21 $(3x - 2y)(5x + 4y)$

MA2

2

22 $33(4x - 1) = (2x + 5)(4x - 1) + 22(2x + 5)$

MA2

$$132x - 33 = 8x^2 - 2x + 20x - 5 + 44x + 110$$

$$8x^2 - 70x + 138 = 0 \quad (\text{3rd mark for reaching quadratic})$$

MA1

$$2(4x - 23)(x - 3) = 0 \quad (\text{4th mark for factorising quadratic})$$

MA1

$$\text{So } x = 5.75 \text{ or } x = 3 \quad (\text{5th, 6th mark for 2 solutions})$$

A1 A1

6

follow through for numerical errors, but not wrong methods

23 $\frac{2(4x^2 - 9)}{(2x + 3)(3x - 1)}$ (1 mark for factorising bottom line)

MA1

$$= \frac{2(2x + 3)(2x - 3)}{(2x + 3)(3x - 1)}$$
 (1 mark for completely factorising top line)

MA1

$$= \frac{2(2x - 3)}{(3x - 1)} \quad \text{or} \quad \frac{4x - 6}{(3x - 1)} \quad (\text{final mark for cancellation})$$

MA1

3

24 Volume of large cone = $\frac{1}{3} \times \pi \times 10^2 \times 30 = 3141.592654$

Volume of small cone = $\frac{1}{3} \times \pi \times r^2 \times 3r = 3.141592654r^3$

$3141.592654 - 3.141592654r^3 = 2855$

$3.141592654r^3 = 286.5926536$

$r^3 = 91.22527495$

$r = 4.5$

(work must be shown but do not penalise early rounding;
correct answer with no work gains no marks)

MA1

AVAILABLE
MARKS

MA1

M1 A1

MA1

A1

6

Total

100