



Rewarding Learning

**General Certificate of Secondary Education
January 2020**

Mathematics

M4

Calculator Paper

Higher Tier

[GMC41]

MONDAY 13 JANUARY, 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.

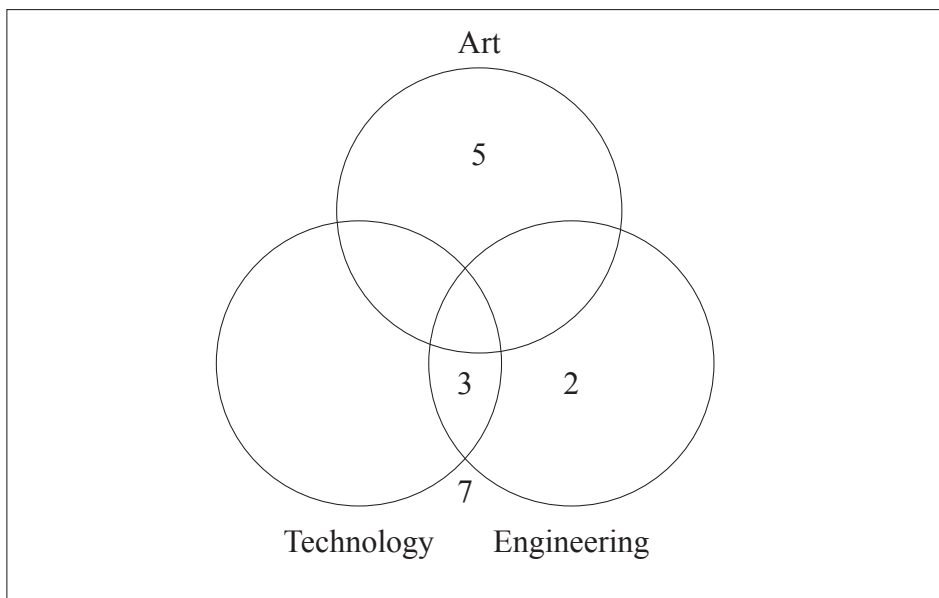
When the candidate misreads a question in such a way as to make the question easier only a proportion of the marks will be available (based on the professional judgement of the examining team).

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	$22 = \frac{w}{1.83^2}$ $w = 22 \times 1.83^2$ $w = 73.7$ (73.6758)	MA1 A1	2
2	$15x - 10 = 7x + 4$ $15x - 7x = 4 + 10$ $8x = 14$ $x = \frac{14}{8}$ or $1\frac{3}{4}$	MA1 MA1 MA1	3
3	$2 \times \pi \times 6 = 37.69911184$ $\frac{3}{4} \times 37.69911184 = 28.27433388$ $6^2 + 6^2 = 72$ $\sqrt{72} = 8.485281374$ $28.27433388 + 8.485281374 = 36.75(961525)$	MA2 MA1 MA1 MA1 MA1	6
4	3 and 16, or any factor of $48 \neq 1$ and 48 (allow A1 for combinations of 2, 24 or 4, 12 or 6, 8)	A2	2
5	$p^2 - 6p + 2p - 12$ $p^2 - 4p - 12$	MA1 A1	2

- 6 (a) 3 in T/E overlap A1
 5 in single A section A1
 2 in single E section A1
 7 in outer box section A1



- (b) $\frac{6}{20} \times 100$ MA1
 = 30% A1

- 7 (6, -2) A1 A1

- 8 $\pi \times 6^2 \times 15$ MA1
 1696.46(0033) cm³ A1 A1 units

- 9 115% = £98.90 MA1
 1% = £0.86 (or 100% = £86) MA1
 15% = £12.90 (£98.90 - £86) MA1

- 10 $\frac{x(x-2)}{3} \times \frac{6}{(x+4)(x-2)}$ MA2
 = $\frac{2x}{x+4}$ A1

AVAILABLE MARKS

6

2

3

3

3

			AVAILABLE MARKS
11	(a) $m = \frac{6}{4}$ or $\frac{3}{2}$ or 1.5	MA1	
	$c = 6$	A1	
	$y = 1.5x + 6$	MA1	
	(b) Any line of the form $y = 1.5x + c, c \neq 6$	A1	4
12	$\sin 24 = \frac{x}{16}$	MA2	
	$x = 6.5 \text{ km}$	A1	3
13	(a) All the raw data is still visible. (You can see all the test scores)	A1	
	(b) The main summary statistics are clear. (You can see the median and the quartiles)	A1	2
14	(a) $84 = 2 \times 2 \times 3 \times 7$ or $2^2 \times 3 \times 7$	A1	
	$154 = 2 \times 7 \times 11$	A1	
	(b) $\text{HCF} = 2 \times 7 = 14$	MA2	4
15	Graham $x - 1$ Darren $x - 2$	MA1	
	$x + \frac{1}{2}(x - 1) + \frac{1}{3}(x - 2) = 74$	MA1	
	$6x + 3(x - 1) + 2(x - 2) = 444$		
	$6x + 3x - 3 + 2x - 4 = 444$	MA1	
	$11x = 451$		
	$x = 41$	A1	
	Rory 41 golf balls Graham 20 golf balls Darren 13 golf balls	A1	5

		AVAILABLE MARKS	
16 (a)	$(2x + 4)(4x - 7) + 5(2x - 1) = 47$	MA2	
	$8x^2 - 14x + 16x - 28 + 10x - 5 = 47$	MA1	
	$8x^2 + 12x - 80 = 0$		
	$2x^2 + 3x - 20 = 0$	A1	
	or		
	$(2x + 4)(4x - 2) - 25 = 47$	MA2	
	$8x^2 + 16x - 4x - 8 - 25 = 47$	MA1	
	$8x^2 + 12x - 80 = 0$		
	$2x^2 + 3x - 20 = 0$	A1	
(b)	$(2x - 5)(x + 4) = 0$ or $x = \frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times (-20)}}{4}$	MA1	
	$x = 2.5 \text{ cm}$	A1	6
17	$2(4x^2 - 25y^2)$	MA1	
	$2(2x - 5y)(2x + 5y)$	MA2	3
18	Height of triangles $h^2 = 10^2 - 6^2$ $h = 8 \text{ cm}$	M1 A1	
	Surface Area = $4(12 \times 80) + (12 \times 12) + 4\left(\frac{1}{2} \times 12 \times 8\right)$	MA2	
	$= 4176 \text{ cm}^2$	MA1	5
19 (a)	Year 8 $\frac{182}{661} \times 50 = 13.76 = 14$	M1 A1	
	Year 9 9		
	Year 10 11		
	Year 11 8		
	Year 12 7 (+ 1 added to any year group)	MA2	
(b)	Advantage: representative of the data	A1	
	Disadvantage: time consuming	A1	6

- 20 (a) 132° because opposite angles in a cyclic quadrilateral add up to 180° A1 A1
- (b) 96° (or 264°) because the angle at the centre is twice the angle on the circumference A1 A1
- (c) 48° because of the Alternate Segment Theorem (or $90 - 42 = 48^\circ$ using tangent/radius and angles in isosceles triangle ABC) A1 A1

21 $\frac{4}{2x-3} = \frac{2+2(3x+1)}{3x+1}$ MA1

$\frac{4}{2x-3} = \frac{6x+4}{3x+1}$ MA1

$(2x-3)(6x+4) = 4(3x+1)$ MA1

$12x^2 - 10x - 12 = 12x + 4$ MA1

$12x^2 - 22x - 16 = 0$ MA1

$6x^2 - 11x - 8 = 0$

$x = \frac{11 \pm \sqrt{(-11)^2 - 4 \times 6 \times (-8)}}{12}$ MA1

$x = 2.39$ or -0.56 A1

Alternative method:

$\frac{4(3x+1) - 2(2x-3)}{(2x-3)(3x+1)} = 2$ MA1 MA1

$\frac{12x+4-4x+6}{6x^2-7x-3} = 2$ MA1

$8x+10 = 12x^2-14x-6$ MA1

$12x^2-22x-16 = 0$ MA1

$6x^2 - 11x - 8 = 0$

$x = \frac{11 \pm \sqrt{(-11)^2 - 4 \times 6 \times (-8)}}{12}$ MA1

$x = 2.39$ or -0.56 A1

AVAILABLE
MARKS

6

7

22 Gradients $\frac{10-7}{-1-a}, \frac{-6-7}{9-a}$

MA1 MA1

$$\frac{10-7}{-1-a} \times \frac{-6-7}{9-a} = -1$$

MA1

$$3 \times (-13) = (9-a)(-1-a) \times (-1)$$

MA1

$$39 = -9 - 8a + a^2$$

$$a^2 - 8a - 48 = 0$$

MA1

$$a = 12 \text{ or } -4$$

A1

6

23 $m = \frac{\sqrt{5.145}}{9.3835}$

MA1 MA1

$$m = 0.2417284856$$

A1

3

24 (a)

Time (minutes)	Frequency
$20 \leq t < 26$	3
$26 \leq t < 29$	9
$29 \leq t < 33$	8
$33 \leq t < 39$	15
$39 \leq t < 44$	23
$44 \leq t < 49$	4

Allow MA1 for 1 correct, MA2 for 3 correct, MA3 for 4 correct

MA4

(b)

Mid interval	Mid interval \times Frequency
23	69
27.5	247.5
31	248
36	540
41.5	954.5
46.5	186

M1 A1

$$\text{Mean} = \frac{2245}{62}$$

MA1

36.21 minutes

A1

8

Total

100