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Rewarding Learning

General Certificate of Secondary Education
January 2019

Mathematics

M4

(With calculator)

Higher Tier

[GMC41]

TUESDAY 8 JANUARY, 9.15am–11.15am

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, readings 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 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 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.

1 $2 \times \pi \times 9 = 56.548(66776)$ MA1

$\dfrac{56.548(66776)}{4} = 14.137(16694)$ MA1

$14.14 + 18 = 32.14$ MA1 3

2 Boys total = sum = 65 MA1

Girls total = $8 \times 5 = 40$ MA1

Mean = $\dfrac{105}{15} = 7$ MA1 3

3 **(a)** $4500 = 2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 5$ M1 A1

a = 2 b = 3 A1

(b) $2 \times 3 = 6$ M1 A1 5

4 **(a)** 22 A1

(b) $30 < s \leqslant 40$ A1

(c) $25 \times 12 + 35 \times 16 + 45 \times 18 + 55 \times 2 + 65 \times 2 = (1910)$ M1 A1

$\dfrac{1910}{50}$ M1

$= 38.2$ A1 6

5 $91 - 84 = 7$ MA1

$\dfrac{7}{84} \times 100$ MA1

$8\frac{1}{3}$ or 8.33 (or 8.3) MA1

alternative solution

$\dfrac{91}{84} = 1.083$ MA1

108.33 (or 108.3) MA1

$(8\frac{1}{3}$ or) 8.33 (or 8.3) MA1 3

6 $AC^2 = 6^2 + 6^2$ MA1

   $AC^2 = 72$

   $AC = \sqrt{72}$ MA1

   $AC = 8.485$ A1

   $8.49 - 6 = 2.49\,\text{cm}$ MA1

alternative solution

   $\sin 45 = \dfrac{6}{x}$ MA1

     $x = \dfrac{6}{\sin 45}$ MA1

      $x = 8.48528...$ MA1

   $8.485 - 6 = 2.485$ MA1   4

7 Peter + Jack = 67.5% (or 27/40)   MA1

   Colin = 32.5% (or 13/40)   A1

   32.5% = £520   M1

   1% = £16   MA1

   100% = £1600   MA1   5

8 **(a)** $2cp(5p - 2)$ A1 A1

   (b) $(y - 1)(y + 1)$ A1

   (c) $(k - 3)(k + 1)$ A2

   (d) $(x - 2)[(x - 2) + 5]$ A1

       $(x - 2)(x + 3)$ A1

alternative solution

$(x - 2)(x - 2) + 5(x - 2) = x^2 - 4x + 4 + 5x - 10 = x^2 + x - 6$ A1

       $(x + 3)(x - 2)$ A1   7

AVAILABLE MARKS

			AVAILABLE MARKS

9 $6(x + 3) = 2(5x)$ MA1

     $6x + 18 = 10x$ MA1

     $18 = 4x$ MA1   5

     $x = 4\frac{1}{2}$ MA1

alternative solution

     $\frac{x + 3}{2} - \frac{5x}{6} = 0 \quad (\times 6)$

     $3(x + 3) - 5x = 0$ MA1

     $3x + 9 - 5x = 0$ MA1

     $9 = 2x$ MA1

     $x = 4\frac{1}{2}$ A1

alternative solution

     $\frac{3(x + 3)}{6} = \frac{5x}{6}$ MA1

     $3x + 9 = 5x$ MA1

     $9 = 2x$ MA1

     $x = 4\frac{1}{2}$ MA1   4

10 **(a)**   6 correct   A2 (4 correct A1)

         lines/curve   A1

   (b)   reading at 40 to give 47   MA1

         $\frac{3}{50} = 6\%$ MA1   5

11 $\cos P = \frac{5.4}{13}$ M1 A1

     $P = 65.45646012$ A1

     $R = 24.54353988$ A1

     $41°$ A1

alternative solution

     $\sin R = \frac{5.4}{13}$ M1 A1

     $R = 24.54353988$ A1

     $P = 65.45646012$ A1

     $41°$ A1   5

			AVAILABLE MARKS
12	Gradient of given line $= -\dfrac{2}{3}$	MA1	
	Gradient of perp line $= \dfrac{3}{2}$	MA1	
	Equation is $y = \dfrac{3}{2}x - 4$	MA1	3
13	$\dfrac{3x(x-2y)}{(4x-3y)(x-2y)}$	MA1	
	Answer $= 3x / (4x - 3y)$	MA1	2
14	$\tan 69 = \dfrac{x}{130}$	MA1	
	$x = 130 \tan 69 = 338.662$m	A1	
	$\tan 76 = \dfrac{y}{130}$	MA1	
	$y = 130 \tan 76 = 521.402$m	A1	
	distance $= 183$	A1	5
15	Min speed $= 735.5/4.55$	MA1	
	$= 161.6483516$	A1	
	Max speed $= 736.5/4.45$	MA1	
	$= 165.505618$	A1	4
16 **(a)**	FDs 0.25 0.8 1.6 3.8 1.6 1.8 1.8	MA1	
	Labels and scales	A1	
	7 bars correct	MA1	
(b)	$\dfrac{35}{40} \times 64 = 56$	MA1	
	$56 + 36 + 45 = 137$	MA1	
(c)	Weights less than $95\,\text{g} = 64 + 38 + 24 + 8 + 5 = 139$	MA1	
	Number less than $40\,\text{g} = \dfrac{2}{3} \times 24 + 8 + 5 = 29$	MA1	
	Number in sample $= \dfrac{70}{139} \times 29 = 14.6$ (accept 14 or 15)	MA1	

	AVAILABLE MARKS

(d)

weights	frequency	wf
5	26	130
12.5	16	200
17.5	15	262.5
27.5	21	577.5
40	37	1480
50	24	1200
57.5	6	345

Correct mid points and frequencies   MA1 MA1
Correct wf column   MA1

Mean = 4195 ÷ 145 = 28.93 g   MA1

(e) median at $\frac{145}{2}$ = 72.5th   **or**   median at $\frac{146}{2}$ = 73rd
72.5th is in the group 20–35   73rd is in the group 20–35   MA1

Median = $20 + \left(\frac{15.5}{21}\right)15 = 31.1$ median = $20 + \left(\frac{16}{21}\right)15 = 31.4$ MA2   15

17 (a) (i) Angle ROT = 72°   A1

  (ii) Angle OTR = 18°   A1

  (iii) Angle QSR = 54   A1

 (b) (i) ACD = 59°   A1

    Because ABC = 59° – angle at centre is twice angle on circumference
    (allow angle at circumference is half the angle at the centre)   MA1
    So ACD = 59° – angle in alternate segment   MA1

    alternative solution

    AOC is isosceles so OCA = 31°   MA1

    OCD is 90°   MA1

    ACD = 90 – 31 = 59°   A1

  (ii) BAC = x A1

    BCA = 180° – (x + 59°)   MA1

    = 121° – x A1   9

		AVAILABLE MARKS

18 CSA of frustum $= \pi \times 9 \times 15 \quad - \pi \times 3 \times 5$

$\qquad\qquad\qquad\qquad = 376.9911184$ M1 A1

Area of top and base $= 9\pi + 81\pi \quad = 282.7433388$ MA1

Total area $\qquad\qquad\qquad = 659.73(44578)$ A1   4

19 Let fraction A be $\dfrac{x}{(x+3)}$ MA1

Then fraction B is $\dfrac{x+4}{(x+7)}$ MA1

Then $\quad \dfrac{x+4}{(x+7)} - \dfrac{x}{(x+3)} = \dfrac{1}{8}$ MA1

$\dfrac{(x+4)(x+3) - x(x+7)}{(x+7)(x+3)} = \dfrac{1}{8}$ MA1

$x^2 + 7x + 12 - x^2 - 7x = \dfrac{1}{8}(x^2 + 10x + 21)$

$96 = x^2 + 10x + 21$

$x^2 + 10x - 75 = 0$ MA1

$(x + 15)(x - 5) = 0$ MA1

$x = -15 \ \text{ or } \ x = 5$ MA1

So A is $\dfrac{5}{8} \left(\text{or } \dfrac{-15}{-12}\right)$ MA1   8

Total   **100**