Rewarding Learning

General Certificate of Secondary Education
2022

Mathematics

M4

Calculator Paper

Higher Tier

[GMC41]

TUESDAY 24 MAY, MORNING

MARK SCHEME

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.

COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021-2022 only.

			AVAILABLE MARKS
1	$34.2 \times 12 = 410.4$	MA1	
	0.83×410.4	MA1	
	$= 340.632$	A1	3
2	5% of 1600 = £80 → £1680	MA1	
	5% of 1680 = £84 → £1764	MA1	
	5% of 1764 = £88.20 → £1852.20	MA1	3
3	**(a)** mid-point × freq. = $(10 \times 31) + (30 \times 19) + (50 \times 10) + (70 \times 14) + (90 \times 12) + (110 \times 6)$	MA2	
	Mean $= \frac{4100}{92}$	MA1	
	$= 44.565(2173913043)$	A1	
	(b) $0 < t \leq 20$	A1	
	(c) $20 < t \leq 40$	A1	6
4	**(a)** £20	A1	
	(b) any valid comparison, e.g. £5 for 200 mins	M1	
	= 2.5 p	A1	
	(c) $T = 20 + 0.025\,m$	A2	5
5	$x^2 + 5x - 3x - 15$	MA1	
	$x^2 + 2x - 15$	MA1	2
6	distances 44, 52	MA1	
	$d^2 = 44^2 + 52^2$	MA1	
	$d^2 = 4640$	MA1	
	$d = 68.1(1754546)$	A1	4

			AVAILABLE MARKS
7	$\frac{10-(x+10)}{2}$	MA1	
	$=-\frac{x}{2}$	A1	
	Alternative solution		
	$5-\frac{x}{2}-\frac{10}{2}$	MA1	
	$=-\frac{x}{2}$	A1	2
8	64% = 45360	M1	
	100% = 70875 or 1% = 708.75	MA1	
	36% = 25515	MA1	
	$\frac{4}{5}\times 25515 = 20412$	MA1	4
9	**(a)** 6, 16, 41, 78, 110, 139, 166, 180	A1	
	(b) Plot all points correctly (30, 6) (60, 16) (90, 41) etc.	MA2	
	Line/curve through points	MA1	
	(c) **(i)** Reading from graph (approx. = 132)	MA1	
	(ii) Readings from graph subtracted (approx. 176 – 93 = 83)	MA2	
	(d) On average pupils spend more time on their phones than staff Pupils' results/data are more spread out Max time spent by pupils a lot more than staff (240 mins compared to 160 mins) (or any other valid comparisons)	A1 A1 A1	10

			AVAILABLE MARKS
10	Multiplying by 4		
	$y + 3 - 8 = 2(3 - 2y)$	MA1	
	$y + 3 - 8 = 6 - 4y$	MA1	
	$5y = 11$	MA1	
	$y = \frac{11}{5} = 2\frac{1}{5}$	MA1	
	Alternative solution		
	$\frac{1}{4}y + \frac{3}{4} - 2 = \frac{3}{2} - y$	MA1	
	$\frac{1}{4}y + y = \frac{3}{2} + 2 - \frac{3}{4}$	MA1	
	$\frac{5}{4}y = 2\frac{3}{4}$	MA1	
	$y = 2\frac{1}{5}$	MA1	4
11	**(a)** $\frac{5-(-1)}{2-(-1)} = \frac{6}{3}$ or 2	MA1	
	c = 1	A1	
	$y = 2x + 1$	A1	
	(b) $y = -\frac{1}{2}x - 1$	A1 A1	5
12	$(4n + 3)^2 - (3n + 4)^2$		
	$= 16n^2 + 24n + 9 - (9n^2 + 24n + 16)$	MA1	
	$= 7n^2 - 7$	A1	
	$= 7(n^2 - 1)$	MA1	
	$= 7(n - 1)(n + 1)$	MA1	
	Alternative solution		
	$(4n + 3)^2 - (3n + 4)^2$		
	$= (4n + 3 + 3n + 4)(4n + 3 - (3n + 4))$	MA1 MA1	
	$= (7n + 7)(n - 1)$	A1	
	$= 7(n + 1)(n - 1)$	MA1	4

			AVAILABLE MARKS
13	$\tan 25° = \frac{105}{x}$	MA2	
	$x = \frac{105}{\tan 25°}$	MA1	
	$x = 225.2\,\text{m}$	A1	
	Alternative solution		
	$\tan 65° = \frac{x}{105}$	MA2	
	$x = 105 \tan 65°$	MA1	
	$x = 225.2\,\text{m}$	A1	4
14	$x - 2 = \pm \sqrt{10}$	MA1	
	$x = 2 \pm \sqrt{10}$	MA1	
	$x = 5.16$ or -1.16	A1 A1	
	Alternative solution		
	$x^2 - 4x + 4 = 10$ $x^2 - 4x - 6 = 0$	MA1	
	$\frac{x = 4 \pm \sqrt{40}}{2}$	MA1	
	$x = 5.16$ or -1.16	A1 A1	4
15	**(a)** Angle POQ = 106° because the angle at the centre is twice the angle at the circumference	A2	
	(b) Angle PQR = 65° Alternate Segment Theorem	MA1	
	Angle PQO = 37° isosceles triangle (radii equal)	MA1	
	Angle OQR = 65 – 37 = 28°	MA1	5
16	**(a)** 4 bars correctly drawn with FDs 3.2, 3.6, 5, 3.2	MA4	
	(b) Representative of the data	A1	
	(c) $\frac{9}{15}$ of 75 or 9 x 5 (=45)	MA1	
	$\frac{61}{183} \times 30 = 10$	M1 A1	8

			AVAILABLE MARKS
17	**(a)** $(5 - 0.1t)(5 + 0.1t)$	MA2	
	(b) $ab - ac + bd - cd$		
	$a(b - c) + d(b - c)$	MA1	
	$(a + d)(b - c)$	A1	4
18	$\frac{260}{40} = 6.50$		
	$6.50 + 0.65 = 7.15$	MA1	
	$\frac{7.15 \times h - 260}{260} \times 100 = 4.5$		
	or $\left(\frac{260}{100} \times 4.5 + 260 = 271.70\right)$	MA1	
	$7.15h = 271.70$		
	$h = 38$	MA1	
	$\frac{2}{40} \times 100 = 5\%$	MA1	4
19	$V = \frac{1}{3} \times \pi \times (2r)^2 \times 56 - \frac{1}{3} \times \pi \times r^2 \times 28$	MA2	
	$V = 205.25(072)\ r^2$	MA1	
	$205.25(072)\ r^2 = 16625$		
	$r^2 = 81$	MA1	
	$r = 9$ cm	A1	5

				AVAILABLE MARKS
20	**(a)**	$\frac{6x+5}{12x+31} = \frac{x}{4x-1}$	MA1	
		$(6x + 5)(4x – 1) = x(12x + 31)$	M1	
		$24x^2 + 20x – 6x – 5 = 12x^2 + 31x$	A1	
		$24x^2 – 12x^2 + 20x – 6x – 31x – 5 = 0$	A1	
		$12x^2 – 17x – 5 = 0$		
	(b)	$(4x + 1)(3x – 5) = 0$	MA1	
		$x = -\frac{1}{4}$ or $x = \frac{5}{3}$	A1	
		x cannot be negative length on triangle so $x = \frac{5}{3}$		
		$\sin p = \frac{6\left(\frac{5}{3}\right) + 5}{12\left(\frac{5}{3}\right) + 31}$ or $\frac{15}{51}$	MA1	
		$p = 17.1$	A1	8
21		$\frac{2}{3+a} - \frac{5}{3-a} = 1$	MA1	
		$\frac{2(3-a) - 5(3+a)}{(3+a)(3-a)} = 1$	MA1	
		$6 – 2a – 15 – 5a = 9 – a^2$	MA1	
		$a^2 – 7a – 18 = 0$	MA1	
		$(a – 9)(a + 2) = 0$	MA1	
		$a = 9$ or $–2$	A1	6
			Total	**100**