Rewarding Learning

General Certificate of Secondary Education
November 2021

Mathematics

M4

(With calculator)

Higher Tier

[GMC41]

MONDAY 29 NOVEMBER, 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 the 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.

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	Base of right-angled triangle = 2cm	MA1	
	$2^2 + y^2 = 5^2$	MA1	
	$4 + y^2 = 25$		
	$y^2 = 21$	MA1	
	$y = \sqrt{21}$		
	$y = 4.58(2575695)$	MA1	4
2	**(a)** $2^2 \times 3^3 \times 5^2$	A1	
	(b) No because not all the prime factors are squared or alternative No because 2700 is not a square number	A1	2
3	speed = $\frac{5}{\left(\frac{24}{60}\right)}$ or $5 \div 0.4$	MA1	
	$= 12.5$ km/hr	A1	2
	alternative solution		
	5 km = 24 minutes ($\div 4$)		
	1.25 km = 6 mins ($\times 10$)	MA1	
	12.5 km = 60 mins = 1 hour	A1	
4	$152\,650 - 104\,760 = 47\,890$	MA1	
	$\frac{47\,890}{152\,650} \times 100 = 31.3724\ldots.$	MA1	
	31.4	A1	3
5	$49 \times 1.04 = 50.96$	MA1	
	$49 \times 1.04^2 = 52.998\ldots..$ or equivalent method	MA1	
	$49 \times 1.04^3 = 55.118\ldots..$ or equivalent method	MA1	
	3	A1	4
6	$18 \times 1.5 + 45 \times 4.5 + 37 \times 7.5 + 19 \times 10.5 + 4 \times 13.5$	MA2	
	$= \frac{760.5}{123}$	MA1	
	$= 6.18$	A1	4
7	The estimate for her own blood pressure is reliable as it lies within given readings on the scatter graph but the reading for her father is not as reliable as it lies outside the given readings on the scatter graph (or some similar explanation relating to extrapolation/interpolation).	A2	2

			AVAILABLE MARKS
8	$4c = 2c + 11$	MA1	
	$2c = 11$	MA1	
	$c = 5.5$	A1	
	22	A1	4
9	$4 \times \pi \times 6^2$	MA1	
	$= 452.38(93421)$	A1	2
10	$\tan\theta = \frac{15}{8}$	M1 A1	
	$\theta = 61.92(751306)$	A1	
	largest angle = 123.85(50261)	A1	4
11	**(a)** IQR = 13	MA1	
	Max drawn at 48 (13 + 25 = 38 + 10)	MA1	
	(b) Range may have been affected by an extreme high/low value	A1	
	(c) 75%	A1	
	(d) On average Mrs. Clarke's class got higher scores and their scores were less spread out/more consistent.	A2	6
12	**(a)** $\frac{236}{300} \times 15\,000 = 11\,800$	MA1	
	(b) An overestimate as the proportion among 17-year-olds is likely to be higher than other age groups or the population as a whole (or similar explanation).	A1	
	(c) Selecting the 300 people randomly where sample would not be biased towards age, e.g. 300 people along street one afternoon.	A1	3
13	multiply by 15 $3(2x - 1) + 5(4x + 5) = 100$	MA1	
	$6x - 3 + 20x + 25 = 100$	MA1	
	$26x = 78$	MA1	
	$x = 3$	A1	4
	Alternative Solution:		
	$\frac{3(2x-1)+5(4x+5)}{15} = \frac{100}{15}$	MA1	
	$6x - 3 + 20x + 25 = 100$	MA1	
	$26x = 78$	MA1	
	$x = 3$	A1	

			AVAILABLE MARKS
14	103.5% = £150 075	MA1	
	1% = £1450	MA1	
	= £145 000	A1	3
15	**(a)** $6x^2 + 4x - 15x - 10$	MA2	
	$6x^2 - 11x - 10$	A1	
	(b) $\frac{(x+7)(x-7)}{2(x-7)}$	MA1	
	$\frac{x+7}{2}$	A1	
	(c) $8x^2 - 12x + 2x - 3$	MA1	
	$4x(2x-3) + 1(2x-3)$	MA1	
	$(4x+1)(2x-3)$	A1	8
16	$8(24-x) = 4x^2$	MA2	
	$192 - 8x = 4x^2$	MA1	
	$4x^2 + 8x - 192 = 0$ **or** $x^2 + 2x - 48 = 0$	MA1	
	$(x+8)(x-6) = 0$	MA1	
	$x = 6$	A1	6
17	curved surface area = $\frac{50}{360} \times 2 \times \pi \times 8 \times 20 = 139.626....$	M1 A1	
	sides = $2 \times 8 \times 20 = 320$	MA1	
	$\pi \times 8^2$ (= 201.061...)	MA1	
	area sector AOB = $\frac{50}{360} \times \pi \times 8^2 = 27.925....$	M1 A1	
	total area = 2(27.925....) + 139.626.... + 320 = 515(.47687....)	MA1	7
18	$m = -\frac{1}{3}$	MA1	
	$y = -\frac{1}{3}x + c$		
	$1 = -3 + c$		
	$c = 4$	MA1	
	$y = -\frac{1}{3}x + 4$	A1	3
19	Using Alternate Segment Theorem angle on circumference is $2x$	MA2	
	Angle at centre is double the angle on the circumference so AOB = $4x$	MA1	3
	alternative solution		
	$<OAB = 90 - 2x$ angle between tangent and radius is 90°	MA1	
	$<ABO = 90 - 2x$ angles in isoceles triangle equal	MA1	
	$<AOB = 180 - (90 - 2x) - (90 - 2x) = 4x$ angles in triangle add to 180°	MA1	

			AVAILABLE MARKS
20	$2x^2 - 6xy + xy - 3y^2$	MA1	
	$2x(x - 3y) + y(x - 3y)$	MA1	
	$(2x + y)(x - 3y)$	MA1	3
21	$T_{min} = \frac{105}{47.5}$	MA2	
	= 2.210526316 hrs	A1	
	= 2 hr 13 min	A1	4
22	$\frac{x(a+2) - y(a+2)}{(x-y)(x+y)}$		
	$\frac{(a+2)(x-y)}{(x-y)(x+y)}$	MA1	
		MA1	
	$\frac{(a+2)}{(x+y)}$	A1	3
23	$\frac{(x-3)(x+2) - (2x+1)(x+4)}{(x+4)(x+2)} = 3$	MA1	
	$\frac{x^2 - x - 6 - 2x^2 - 9x - 4}{x^2 + 6x + 8} = 3$	MA2	
	$-x^2 - 10x - 10 = 3x^2 + 18x + 24$	MA1	
	$4x^2 + 28x + 34 = 0$	MA1	
	$x = \frac{-28 \pm \sqrt{28^2 - 4 \times 4 \times 34}}{8}$	M1	
	$x = -1.56, -5.44$	A2	8
24	**(a)** $100 \times 4 + 100 \times 11 = 1500$		
	Area of 1500 = frequency of 150	MA1	
	Area of 1 unit = frequency of 0.1 **or**		
	1 large square = FD of 0.5	MA1	
	$100 \times 4.2 + 200 \times 1.2 = 660$	MA2	
	(b) Total = $150 + (100 \times 1.5) + (200 \times 3) + (100 \times 4.2)$		
	$+ (300 \times 1.2)$	MA1	
	$= 1680$	A1	
	$\frac{110}{1680} \times n = 11$	MA1	
	$n = 168$	A1	8
		Total	**100**