Rewarding Learning

General Certificate of Secondary Education
2023

Mathematics

M3

Calculator Paper

Higher Tier

[GMC31]

FRIDAY 19 MAY, MORNING

MARK SCHEME

General Marking Instructions

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, 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 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 a candidate's 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.

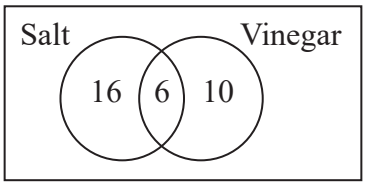
(viii) Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures seen, e.g. the answer in the mark scheme is 4.65 and the candidate then correctly rounds to 4.7 or 5 on the answer line. Allow full marks for 4.65 seen in the working.

(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.

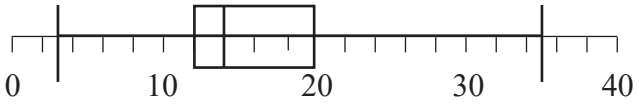
(x) For any question, the range of answers given in the mark scheme is inclusive.

			AVAILABLE MARKS
1	$8 + 8 + 8 + 8 + 4 = 36$ hours worked	MA1	
	$537.25 - 36 \times 11.50 = 123.25$	MA1	
	$123.25 \div 7.25$	MA1	
	17	A1	4
2	any correct simplified fraction or percentage	MA1	
	2 or 3 correct simplified fractions or percentages	MA1	
	$\frac{1}{2}, \frac{3}{10}, \frac{1}{2}, \frac{3}{4}$ **or** 50%, 30%, 50%, 75% all correct	MA1	
	No because face to face is highest	A1	4
3	**(a)** $2a + 3 + 2a + 3 + b - 5$	MA1	
	$4a + b + 1$	A1	
	(b) $30 - 9 - 1 = 20$ **or** $4a + 9 + 1 = 30$	MA1	
	$20 \div 4$ **or** $4a = 20$	MA1	
	5	A1	5
4	**(a)** 40% + 30% + 10% = 80% so 20% = other	MA1	
	20% of 30 = 6	MA1	
	(b) 144° cola 108° milk 36° water 72° other	MA2	
	Pie chart drawn and correctly labelled	MA2	6
5	**(a)** 1306 + 26 minutes + 18 minutes	M1	
	= 1350	A1	
	Has to wait 34 minutes	A1	
	(b) 1424 – 1509 = 45 mins ($\frac{3}{4}$ hr)	MA1	
	Speed = $\frac{54}{\frac{3}{4}}$ **or** 54 miles in 45 minutes		
	18 miles in 15 mins [or 1.2 miles in 1 min]	MA1	
	= 72	A1	6

			AVAILABLE MARKS
6	**(a)** $45 \times 24 \times 18$	M1	
	$= 19440$	A1	
	(b) $45^2 + 24^2$	MA1	
	$d^2 = 2601$ or $d = \sqrt{2601}$	MA1	
	$d = 51$cm	A1	5
7	$180 - 54 = 126$	MA1	
	$\frac{126}{180} \times 100$	MA1	
	70	A1	3
8	$4y + 8 = 22$ **or** $(y + 2) = \frac{22}{4}$	MA1	
	$4y = 14$ **or** $y + 2 = 5.5$	MA1	
	$y = 3.5$	A1	3
9	**(a)** 150 drinks cost 75 **or** $25 \times 3 = 75$ 180 crisps cost 36 **or** $15 \times 2.40 = 36$ 175 bars cost 35 **or** $35 \times 1 = 35$	M1	
	total cost = 146	MA1	
	(b) $115 \times 1.50 = 172.50$	MA1	
	35×80p $= 28$ 65×50p $= 32.50$ 60×30p $= 18$	M1	
	total income = 251	MA1	
	$251 - 146 = 105$	A1	6
10	angle BFE = 50, alternate	MA1	
	angle BEF = 80, angles on straight line add to 180°	MA1	
	angle EBF = 50, angle sum of triangle, so triangle is isosceles	MA1	3

			AVAILABLE MARKS
11	16 marked correctly on diagram 	MA1	
	$16 + 6 + 10 = 32$	MA1	
	$40 - 32 = 8$	MA1	3
	or		
	$22 + 10 = 32$, $40 - 32 = 8$ (no 16 on diagram)	M1A1 MA1	
12	**(a)** 2 | 3 3 6 7 8 3 | 2 6 7 8 8 4 | 0 2 5 6 7 9 9 Key: 2|3 = 23 5 | 1 3 8 6 | 2		
	M1 correct format for stem and leaf A1 accuracy A1 key		
	(b) Median will be lowered	A1	4
13	Option A: $4500 \times 0.035 = 157.50$	MA1	
	$4657.50 \times 0.035 = 163.01$ Interest = 320.51 **or** Amount = 4820.51	MA1	
	Option B: $4500 \times 0.05 = 225$		
	$4725 \times 0.02 = 94.50$	MA1	
	Interest = 319.50 **or** Amount = 4819.50	MA1	
	Option A by £1.01	MA1	5
14	**(a)** **(i)** 50	A1	
	(ii) gradient = $\frac{150}{2}$ (or equivalent) = 75	M1 A1	
	(b) The mini digger costs £75 a day to hire	A1	4
15	$6y^2 - 14y - 8y$	MA1 MA1	
	$6y^2 - 22y$	MA1	3

			AVAILABLE MARKS
16	Shaded = $\pi \times 6^2$	MA1	
	$= 113.0973355$ or 36π	A1	
	Semicircle = $\frac{1}{2} \times \pi \times 12^2 = 226.1946711$ (or 72π)	MA1	
	Unshaded = $226.1946711 - 113.0973355 = 113.0973356$ (or $72\pi - 36\pi = 36\pi$)	MA1	4
17	**(a)** $8 \times 7.5 + 3 \times 22.5 + 5 \times 37.5 + 4 \times 52.5 = 525$	MA2	
	$= \frac{525}{20}$	MA1	
	$= 26.25$	A1	
	(b) Only an estimate because the data is grouped so we do not know the exact time	A1	5
18	81.8% = 10225	MA1	
	$10225 \div 81.8 \times 100$	MA1	
	= £12500	A1	3
19	$4(2x - 5) + 9(3x + 1) = 10$	MA1	
	$8x - 20 + 27x + 9 = 10$	MA1	
	$35x = 21$	MA1	
	$x = \frac{3}{5}$ or equivalent	A1	4
20	$3^3 \times 5^2 \times 7$	M1A1	2
21	**(a)** $(x + 7)(x - 5)$	MA2	
	(b) $x = -7$ or 5	MA1	3
22	m = $\frac{16 - -2}{6 - 0}$	MA1	
	= 3	A1	
	$y = 3x - 2$	MA1	3

			AVAILABLE MARKS
23	$\sin 35 = \frac{x}{7}$	MA1	
	$x = 7 \sin 35$	M1	
	$= 4.015(035054)$	A1	
	$4.015 + 0.85 = 4.865$	MA1	4
24	$2 \times \pi \times 3.4 = 21.3628(3004)$	MA1	
	$21.3628 + 1 = 22.3628$	MA1	
	$22.3628 \times 12 = 268.35(39605)$	MA1	
	alternative solution		
	$2 \times \pi \times 3.4 \times 12 = 256.3539(605)$	MA2	
	$256.3539(605) + 1 \times 12 = 268.35(39605)$	MA1	3
25	**(a)** UQ = 20	MA1	
	Min = 3	MA1	
	Box plot drawn	A2	
			
	(b) Yes because 50% are below 14 so more than 50% are below 16 – majority	A1	5
		Total	**100**