GCSE MARKING SCHEME

AUTUMN 2022

GCSE
MATHEMATICS
UNIT 2 – HIGHER TIER
3300U60-1

INTRODUCTION

This marking scheme was used by WJEC for the 2022 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

WJEC GCSE MATHEMATICS

AUTUMN 2022 MARK SCHEME

Unit 2: Higher Tier	Mark	Comments
1. (Volume of cylinder =) $\pi \times 2{\cdot}3^2 \times 5$ $= 83(\cdot095\ldots.)$ (cm^3) or $26{\cdot}45\pi$ (Density of metal =) $423{\cdot}1 \div 83(\cdot095\ldots.)$ Accept an answer between 5 and 5·1 (g/cm^3)	M1 A1 M1 A1	May be seen or implied in later working. Accept an answer between 83 and 83·11 inclusive. FT 423·1 ÷ 'their volume of cylinder', provided not 5 or 2·3 (derived or stated). Ignore any attempt to change units (e.g. 423·1 ÷ 83 ÷ 1000). Mark final answer.
1. Alternative method: *(Density of metal =)* $\dfrac{423{\cdot}1}{\pi \times 2{\cdot}3^2 \times 5}$ *Accept an answer between 5 and 5·1 (g/cm^3)*	*M2* *A2*	*Award M1 for sight of* $\pi \times 2{\cdot}3^2 \times 5$. A1 for sight of $423.1/26.45\pi$ or $15.9(96\ldots)/\pi$ or any other simplified fraction with **one** step left to carry out.
2. One correct evaluation $1 \le x \le 2$ 2 correct evaluations $1{\cdot}15 \le x \le 1{\cdot}35$, (one value < 0, one value > 0) 2 correct evaluations $1{\cdot}15 \le x \le 1{\cdot}25$, (one value < 0, one value > 0) $x = 1{\cdot}2$	B1 B1 M1 A1	*Correct evaluation regarded as enough to identify if < 0 or > 0.* *Look out for testing* $x^3 + 5x = 8$ *or equivalent* *If evaluations not seen accept 'too high' or 'too low'.*

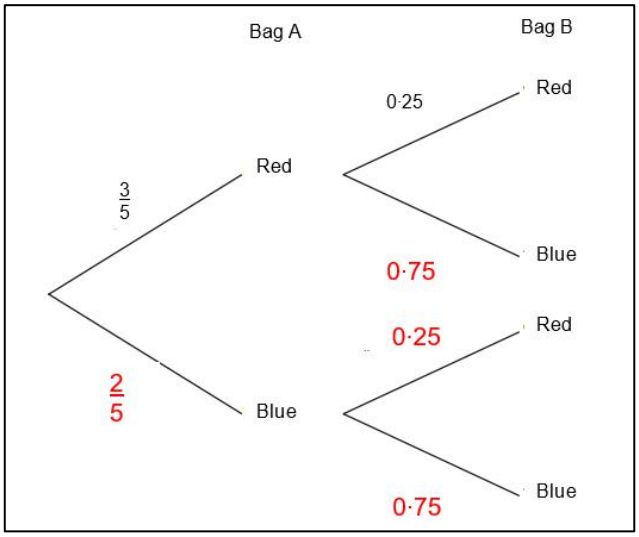
x	$x^3 + 5x - 8$
1	-2
1.1	-1.169
1.2	**-0.272**
1.3	**0.697**
1.4	1.744
1.5	2.875
1.6	4.096
1.7	5.413
1.8	6.832
1.9	8.359
2	10

1.15	-0.72913
1.22	-0.08415
1.23	0.010867
1.24	0.106624
1.25	**0.203125**
1.35	1.210375

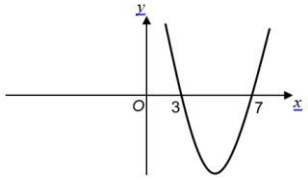
3.(a) Valid written explanation referring to negative values **representing sides** e.g. " $(4 \times 2 - 10 = -2)$ you can't have a negative value for a side" "x must be greater than 2·5 to have a positive value for the side"	E1	Allow "you can't have a negative length". Do not allow • calculations only • "it can't be negative" • "the value can't be negative".
3.(b) $14x - 4 - 2 \times (4x - 10)$ OR $14x - 4 - 8x + 20$ or equivalent	M2	May be seen on diagram. Award M1 for intention for a method e.g. $4x - 10 + 4x - 10 + \mathbf{?} = 14x - 4$ e.g. $14x - 4 = \mathbf{?} + 2 \times (4x - 10)$ e.g. incorrect use of brackets but a clear attempt at the correct calculation is seen: $14x - 4 - 8x - 20$.
(sum of both lengths=) $6x + 16$	A1	FT from M1: $14x - 4$ – 'their $2 \times [4x - 10]$' or equivalent, provided 'their $8x - 20$' can be expressed in the form $ax + b$, with a & b ≠ 0. Note: $14x - 4 - 8x - 20 = 6x - 24$ is awarded M1A1.
(length=) $3x + 8$	B1	May be seen on diagram. Mark final answer. FT 'their $6x + 16$' ÷ 2, provided in the form $ax + b$, with a & $b \neq 0$. Unsupported $3x + 8$ is awarded M2 A1 B1. If no marks awarded, award SC1 for a final answer of: • $3x + c$ ($c \neq 8$) • $kx + 8$ ($k \neq 3$ and positive).
Alternative method: *Sight of an appropriate* $7x - 2$ $7x - 2 - 4x + 10$	*B1* *M2*	*May be seen on diagram.* Award M1 for intention for a method e.g. $4x - 10 + \mathbf{?} = 7x - 2$ *$[14x - 4] \div 2 - [4x - 10]$ or equivalent* *e.g. incorrect use of brackets but a clear attempt at the correct calculation is seen*
(length=) $3x + 8$	*A1*	*May be seen on diagram.* Mark final answer. *Allow FT from M1.* Unsupported $3x + 8$ is awarded B1 M2 A1. If no marks awarded, award SC1 for a final answer of: • $3x + c$ ($c \neq 8$) • $kx + 8$ ($k \neq 3$ and positive).

4. <u>(Length of AB)</u> $18^2 = AB^2 + 10^2$ OR $(AB^2 =)$ $18^2 - 10^2$ or equivalent	M1	note: $(AB^2 =)$ $324 - 100$
$(AB^2 =)$ 224	A1	
$(AB =)$ 14·9(66…) or 15 or $4\sqrt{14}$ or $\sqrt{224}$ (cm)	A1	FT √'their 224' provided M1 gained for M1A0A1.
		Alternative method to find AB *A correct and complete method that would lead to a correct answer (using trigonometric relationships).* *M2*
(Area of the circle =) $\pi \times 9^2$	M1	*(AB =) 14·9(66…) or 15 or $4\sqrt{14}$ or $\sqrt{224}$ (cm) A1*
(Area of the triangle =) ½ × 10 × 14·9(66…) or equivalent	M1	Award M1 for sight of 75 or $20\sqrt{14}$. FT ½ × 10 × 'their *AB',* provided not 18 or 10. Accept any valid method that leads to a correct answer.
254.4(69…) (cm^2) or 81π **AND** 74·8(33..) or $20\sqrt{14}$ (cm^2)	A1	An answer between 254·3 and 254·51 (cm^2). Allow 254. Allow 75.
(Area of the shaded region = 254.4(69) – 74·8(33..) =) 179 to 180 (cm^2)	B1	Allow rounded or truncated answers. FT 'their area of a circle' – 'their triangle' (not 'their *AB*') provided at least one area M1 awarded previously.
<u>Alternative method to first calculate angle BCA and then use ½absinC to calculate the area of the triangle</u>		
(BCA =) $\cos^{-1}\frac{10}{18}$	*M2*	*M1 for $\cos BCA = \frac{10}{18}$ (= 0·555..)* ***Note:** An alternative correct use of a 'two-step' method that would lead to the correct answer for BCA (e.g. finding angle BAC first) is M2.* *A partial method is M0.*
Correct evaluation in the range 56·2 to 56·3	*A1*	*Allow 56 from correct working.* *Note: cos BCA = 0·55, BCA = 56·632… OR cos BCA = 0·56, BCA = 55·944… is awarded M2A0.*
(Area of the triangle =) *½ × 10 × 18 × sin(56·251…)*	*M1*	*FT 'their BCA' if previous M1 awarded.*
(Area of the circle =) $\pi \times 9^2$	*M1*	*An answer between 254·3 and 254·51 (cm^2).* *Allow 254.*
254.4(69…) (cm^2) or 81π ***AND*** *74·8(33..) or $20\sqrt{14}$ (cm^2)*	*A1*	*Allow 75.*
(Area of the shaded region = *254.4(69) – 74·8(33..) =)* *179 to 180 (cm^2)*	*B1*	*Allow rounded or truncated answers.* *FT 'their area of a circle' – 'their triangle' provided at least one area M1 awarded previously.*

Organisation and Communication.	OC1	For OC1, candidates will be expected to: • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical • write a conclusion that draws together their results and explains what their answer means
Accuracy of writing.	W1	For W1, candidates will be expected to: • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc
5. $YZ = \frac{7}{\cos 41(°)}$ or $7 \div \cos 41(°)$	M2	Award M2 for $YZ = 7 \div \sin 49$ (×sin90) or $\frac{7 (\times \sin 90)}{\sin 49}$ Award M1 for one of the following: • $\cos 41 = \frac{7}{YZ}$ • $\sin 49 = \frac{7}{YZ}$ • $\frac{YZ}{\sin 90} = \frac{7}{\sin 49}$.
= 9·27(…) or 9·28 (cm) or 9.3 (cm)	A1	Accept 9 (cm) from correct working. CAO.
5. Alternative method: ***Correct** use of 'two-step' method.*	*M2*	*A partial trigonometric method is M0.*
= 9·27(…) or 9·28 (cm) or 9.3 (cm)	*A1*	*Accept 9 (cm) from correct working.*
6. 25·55 (seconds) – 12·35 (seconds) OR 25·5 (seconds) – 12·4 (seconds) + 2 × 0·05 (sec)	M2	Award M2 for **USE** of the correct bounds. If many attempts are offered without a method/answer being identified, then mark the final attempt. If M2 not gained, award M1 A0 for correct **USE** of values $12{\cdot}3 \leq t < 12.4$ and $25.5 < t \leq 25{\cdot}6$. [Note: 25·54$\dot{9}$ is equivalent to 25·55 and with an answer of 13.2 (seconds) gains all 3 marks]
= 13·2 (seconds)	A1	CAO. Mark final answer. Unsupported 13·2 is awarded M2 A1.
7. $\frac{64}{160} \times 100$ OR $\frac{64}{1{\cdot}6}$ or equivalent	M1	Do not award M1 for 160% = 64.
= 40	A1	Award M1A1 for an embedded answer (e.g. $40 \times 1{\cdot}6 = 64$ or $\frac{64}{40} \times 100 = 160$), BUT only M1A0 if contradicted by stating original amount $\neq 40$. Unsupported 40 is awarded M1 A1. Unsupported 40% is awarded M0 A0.

8. (a) Complete diagram  	B2	Award B1 for **one** of the following: • 2/5 or equivalent on 'Blue' Bag A branch • 0·75 or equivalent on a correct 'Blue' Bag B branch.
8. (b)		Check diagram for answers. FT 'their 2/5' from bag A blue branch, only if between 0 and 1. FT 'their 0.75' from bag B blue branch, only if between 0 and 1.
Sight of $\frac{3}{5} \times 0{\cdot}25$ **OR** $\frac{2}{5} \times 0{\cdot}75$ or equivalent	B1	Award B1 for sight of 0·15 **OR** 0·3 or equivalent.
$\frac{3}{5} \times 0{\cdot}25$ **+** $\frac{2}{5} \times 0{\cdot}75$ or equivalent	M1	Award M1 for 0·15 + 0·3.
0·45 or 9/20 or equivalent ISW	A1	Only FT, provided answer is less than 1.
9. Method to eliminate one variable e.g. equal coefficients **AND** appropriate intention to add or subtract or use a method of substitution.	M1	Allow one error in one term (not the term with equal coefficients).
First variable found $x = -4$ or $y = 2$	A1	CAO. Answer must be whole number (e.g. not $x = -12/3$)
Substitute to find the 2nd variable.	m1	FT substitution of their '1st variable' if M1 gained.
Second variable found.	A1	If FT leads to a whole number answer, it must be shown as a whole number. Otherwise, accept a fraction. No marks for 'trial and improvement'. No marks for an unsupported answer.
10.(a) $10h^2 - 14ht + 15ht - 21t^2$	B2	Penalise alternative notation, such as tt for t^2, -1, once only. B1 for any three terms correct. $mh^2 + (1)ht + nt^2$, where m and n are integers (and provided not from incorrect working) implies the middle two terms correct.
$10h^2 + (1)ht - 21t^2$	B1	Mark final answer. Implies previous B2. FT their expression, provided it is a quadratic with 4 terms to consider and there are like terms to collect.
10.(b) $7(d + 5)^{10}$	B1	Mark final answer.

11. (Curved surface area of cone + curved surface area of hemisphere =) $\pi\times8\times17 + \frac{4}{2}\times\pi\times8^2$	M2	May be seen in parts. If M2 not awarded, award M1 for any of the following: • $\pi\times8\times17$ • sight of 136π or a value between 427 and 427·312 • $4/2\times\pi\times8^2$ • sight of 128π or a value between 401·9 and 402·2
(Total surface area =) Answer in the range 828·9 (cm^2) to 829·512 (cm^2) or 830 (cm^2) or 264π (cm^2)	A1	CAO Unsupported correct answer is awarded full marks.
12. $x = \frac{-(-7)\pm\sqrt{(-7)^2-4\times(59)\times(-13)}}{2\times(59)}$	M1	**This substitution into the formula must be seen for M1, otherwise award M0A0A0.** Allow one slip in substitution **for M1 only**, but must be correct formula.
$= \frac{7\pm\sqrt{3117}}{118}$	A1	Can be implied from the two correct, unrounded values of x, provided M1 awarded.
x = 0·53, x = –0·41	A1	CAO Both solutions required. Award SC3 for both roots correctly rounded using the trial and improvement method used correctly.
13. (Area scale factor =) $(719/241)^2$ OR $(241/719)^2$	B1	Or equivalent.
$2063 \times (719/241)^2$ OR $2063 \div (241/719)^2$	M1	FT 'their linear scale factor squared'.
=18362(·124…cm^2)	A1	CAO allowing only these values: 18000 OR 18300 up to 18800 OR 19000
= 1·8(…m^2)	B1	Strict FT of a correct conversion of 'their area' to m^2. Allow 1·9(…m^2) from correct working.
Alternative method *(Area of smaller shape = 2063÷10000 =) 0.2063 (m^2)*	*B1*	
(Area scale factor =) $(719/241)^2$ OR $(241/719)^2$	*B1*	*Or equivalent.*
$0.2063 \times (719/241)^2$ OR $0.2063 \div (241/719)^2$	*M1*	*FT 'their linear scale factor squared' AND Strict FT of 'their conversion of the smaller area' to m^2.*
= 1·8(…m^2)	*A1*	*Allow 1·9(…m^2) from correct working.*
14.(a) 68(°) AND alternate segment theorem.	B2	Do not accept 'alternate (angle) theorem' or 'alternate angles' only as the given angle property. 68(°) may be seen on the diagram at *ACB*. B1 for 68(°) Award B0 for any angle other than *ACB* clearly identified as 68(°)
Alternative method *Allow a **correct and complete method** that results in an angle of 68(·219…°) AND relevant angle property (e.g. angles on a straight line OR angles in a triangle OR using the sine rule).*	*B2*	*Allow B1 for a **correct and complete method** that results in an angle of 68(·219…°).*
14.(b) 1/2 × 7 × 13 × sin 68(°)	M1	FT 'their 68' identified as their *ACB* from part (a). Award M1 for a complete alternative method leading to a correct answer of 42·1(… cm^2) OR 42·2(cm^2).
= 42·1(86… cm^2) OR 42·2(cm^2)	A1	
15. An irrational number which correctly evaluates to between 9 and 10, for example: $\sqrt{90}$, π^2, $\sqrt{5}+7$, $\pi+6$, $\sqrt{107}-1$, $\sqrt[3]{823}$, 3π	B1	Number in the box takes precedence, otherwise the answer must be clearly identified. Allow B1 if the answer in the box is not irrational, but has clearly come from evaluating an irrational number e.g. 9·49(…), from evaluating $\sqrt{90}$.

16. $kp(k+p)(k-p)$	B3	Mark final answer for B3. Award B2 for a correct expression involving two binomial factors, e.g. $(k-p)(k^2p+kp^2)$ or $k(k+p)(kp-p^2)$ or $(k^2+kp)(kp-p^2)$ Allow B2 for $kp(k\ldots p)(k\ldots p)$ Award B1 for any of the following: • $(k+p)(k-p)$ • $k(k\ldots p)(kp\ldots p^2)$ • $k(kp\ldots p^2)(k\ldots p)$ • $kp(k^2-p^2)$ $k(k^2p-p^3)$ OR $p(k^3-kp^2)$ is B0
17.  Tick box ✓	B1	If more than one graph indicated, award B0.
18.(a) $\frac{1}{9}\times\frac{1}{8}\times\frac{2}{7}$ $=\frac{2}{504}\left(=\frac{1}{252}\right)$	M1 A1	M0 for sight of this method used more than once in the solution. ISW if the fractional answer is simplified, otherwise mark final answer. Accept decimal answer of 0·0039(…) OR 0·004 If M0, award SC1 for sight of $\frac{1}{9}\times\frac{1}{8}\times\frac{2}{7}$ OR $\frac{2}{504}\left(=\frac{1}{252}\right)$ as part of their solution.
18.(b) (['O' AND 'O' AND any other letter] OR ['N' AND 'N' AND any other letter]) $3\times\frac{2}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)+3\times\frac{2}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)$ OR $3\times\frac{4}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)$ or equivalent $=\frac{12}{72}\left(=\frac{1}{6}\right)$	M2 A1	M1 for $3\times\frac{2}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)$ OR $\frac{2}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)+\frac{2}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)$ OR $\frac{4}{9}\times\frac{1}{8}\left(\times\frac{7}{7}\right)$ ISW Accept decimal answer of 0·16(6…) OR 0·17 If no marks, award SC1 for any one of the following answers (from working with replacement): Either 'O' or 'N' chosen — 168/729 or 56/243 ISW Any letter is chosen twice — 288/729 or 32/81 ISW 2 or more cards 'O' or 'N' — 184/729 ISW Any letter is chosen 2 or more times — 309/729 or 103/243 ISW
19. Sight of $ab+ac^2+de-dc^2$ $ac^2-dc^2=f-ab-de$ OR $ab+de-f=dc^2-ac^2$ $c^2(a-d)=f-ab-de$ OR $ab+de-f=c^2(d-a)$ $c^2=\frac{f-ab-de}{a-d}$ OR $c^2=\frac{ab+de-f}{d-a}$ $c=\pm\sqrt{\frac{f-ab-de}{a-d}}$ OR $c=\pm\sqrt{\frac{ab+de-f}{d-a}}$	 B1 B1 B1 B1 B1	FT until 2nd error for equivalent level of difficulty. Allow sight of multiplication signs within expressions and allow multiplication by 1 at any stage. For expanding brackets For isolating terms in c^2. FT a formula with four or more terms AND with at least two terms in c^2. For factorising. For isolating 'their c^2' by division. For taking the square roots. Allow omission of $\pm$. Mark final answer.

20. (x^2 or BC^2 =) $19^2 + 29^2 - 2\times19\times29\times\cos36°$ (x or BC =) 17·6(199…cm)	M1 A2	Penalise premature approximation, PA -1, once only. A1 for (x^2 or BC^2 =) 310·4(6…) OR $x = \sqrt{310 \cdot 4(6\ldots)}$ Award A2 if $x = \sqrt{310 \cdot 4(6\ldots)}$ is used correctly in subsequent work, but only A1 if an incorrect evaluation is used.
(sin BCD =) $\frac{19\times\sin 36°}{17\cdot6(199\ldots)}$ OR (cos BCD =) $\frac{17\cdot6(199\ldots)^2 + 29^2 - 19^2}{2\times17\cdot6(199\ldots)\times29}$	M2	FT 'their derived 17·6(199…)' . M1 for $\frac{\sin BCD}{19} = \frac{\sin 36°}{17\cdot6(199\ldots)}$ or equivalent OR M1 for $19^2=17\cdot6(199\ldots)^2+29^2-2\times17\cdot6(199\ldots)\times29\times\cos BCD$
(BCD =) 39·3(3…°)	A1	
(Area of sector=) $\frac{39\cdot3(3\ldots)}{360} \times \pi \times 17\cdot6(199\ldots)^2$ Accept answers in the range 106(cm^2) to 107(cm^2)	M1 A1	FT for possible M1 A1, provided M1 M2 or M1 M1 previously awarded. Must be from correct working.