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General Certificate Secondary of Education
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Mathematics 4306/2H

Paper 2 Higher Tier

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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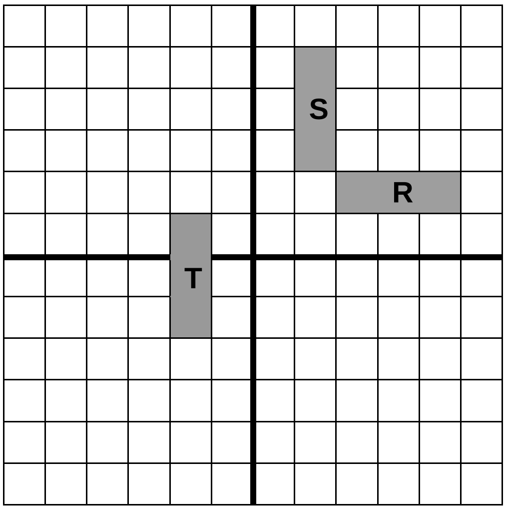
Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
ft	Follow through marks. Marks awarded following a mistake in an earlier step.
SC	Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth.
oe	Or equivalent. Accept answers that are equivalent. eg, accept 0.5 as well as $\frac{1}{2}$

Q	Answer	Mark	Comments
1	9.05263…… , $\frac{172}{19}$	B1	9.052631579
1(b)	9 or 9.1 or 9.05	B1ft	ft Their answer to (a) if given to at least 4 sf and rounded to 1, 2 or 3 sf
2	18 ÷ 5	M1	oe
	1400 ÷ 300	M1	oe 100 in 10 mins so 14 × 10 = 140
	3.6 **and** 2.33…	A1	3 h 36 m (216 mins) **and** 2 h 20 m (140 mins)
	Total of 5.8 to 6.25	A1	5 h 48 m to 6 h 15 m
Alt 2	18 ÷ 5	M1	3.6 or 2.33
	1400 ÷ 300	M1	oe 100 in 10 mins so 14 × 10 = 140
	$2.33 \approx 2\frac{1}{2}$ h **and** $3.6 \approx 3\frac{1}{2}$ h	A1	oe
	Total is $2\frac{1}{2}$ h + $3\frac{1}{2}$ h = 6	A1	
3	47 ÷ 5 (9.4)	M1	Sight of 9.4 and / or 37.6 is M1
	Adam 37.60 and Beth 9.40	A1	9.4 or 37.6 is A0
4(a)	24	B1	
4(b)	$\frac{1}{5}$	B2	B1 Any equivalent fraction even if decimal values such as $\frac{2.5}{12.5}$, $\frac{10}{50}$ or 20% or 0.2 B1 For 1 out of 5 or 1 in 5 Allow incorrect cancelling such as $\frac{10}{50} = \frac{2}{5}$ gets B1 B0 For 10 out of 50 1 : 5 or 1 : 4 or any ratio is B0
4(c)	$\frac{1500}{50}$ × 22, 44% of 1500	M1	oe 840 seen is M1 by implication
	660	A1	$\frac{660}{1500}$

Q	Answer	Mark	Comments
5	Distance 14.8 – 15.2	B1	
	Bearing 245 to 249	B2	Allow –111 to –115 for B2 B1 For 111 to 115 B1 For 65 to 69
6(a)	$6w - 12$	B1	
6(b)	$x(x - 3)$	B1	$(x - 3)(x + 0)$
6(c)	$3y - 3 - 2y - 8$	M1	Allow one sign or arithmetic error Allow one expansion error for M1 but only on constant term. Both y terms must be expanded correctly or it is M0
	$y - 11$	A1	
6(d)	$12z + 3 = 21$ or $4z + 1 = 7$	M1	Allow one sign or arithmetic error but not an expansion error ie, do not award if expansion is $12z + 1$ (See SC below)
	$12z = 18$	A1	$4z = 6$
	$(z =)\ 1\frac{1}{2}$, $\frac{18}{12}$, $\frac{3}{2}$, 1.5	A1ft	oe ft On one error only **SC** $12z + 1 = 21$ $12z = 20$ $z = 1.67$ oe
7	$(2 \times)\ 2x + 3 + x - 2$	M1	
	Their $3x + 1 = 16$ or their $6x + 2 = 32$	M1 Dep	
	5	A1ft	ft On one error and first M awarded

Q	Answer	Mark	Comments
8(a)	Sq ✓ ✓ ✗ RH ✓ ✗ ✓ KI ✗ ✗ ✗	B3	B2 5-8 correct B1 3 or 4 correct
8(b)	Diagonals do not cross at right angles. Opposite sides parallel but of different lengths. No lines of symmetry Can't be folded	B1	Any valid property of a parallelogram not shared by the other 3 **Do not** follow through an incorrect table. For example if they say that all quads do not have rotational symmetry of order 2 in the table and give this as a unique property of the parallelogram, this is B0
9	Sight of 0.85	B1	
	178.5 ÷ 0.85	M1	Digits 21 imply M1
	210	A1	Condone 210.0
Alt 9	85% = 178.5	M1	
	1% = 178.5 ÷ 85	A1	2.1
	210	A1	
10(a)		B2	Do not penalise for no labelling or incorrect labelling if shape is in a correct position to score B2 or B1 B1 For line $y = x$ drawn or B1 For reflection in $y = -x$ to get (–2, –1), (–2, –2), (–5, –1), (–5, –2)
10(b)		B2	B1 For any translation of S of $\begin{pmatrix} 3 \\ y \end{pmatrix}$ or $\begin{pmatrix} x \\ -4 \end{pmatrix}$ where x and $y \neq 0$ B1 For translation $\begin{pmatrix} -4 \\ -3 \end{pmatrix}$ to get (–3, 2), (–2, 2), (–3, –1), (–2, –1) NB B0 for reflection in y axis or x axis

Q	Answer	Mark	Comments
11	786 ÷ 3 × 2	M1	oe
	524	A1	
	Their 524 + 786 ÷ 2 (= 917)	M1 Dep	oe 524 × 2 + 786 (= 1834)
	11921 ÷ (their 917)	M1 Dep	11921 ÷ 1834 (= 6.50)
	13	A1	
Alt 1 11	786 ÷ 3 × 2	M1	oe
	524	A1	
	4 : 3 or 2 : 1.5 seen **and** 11921 ÷ 7 × 4 or 11921 ÷ 3.5 × 2 (= 6812)	M1 Dep	oe
	6812 ÷ 524	M1 Dep	
	13	A1	
Alt 2 11	Miscopy of ratio adults : children as 3:2		Maximum 3/5
	1179 adults	M1	
	1179 + 786 ÷ 2 = 1572	M1 Dep	
	11921 ÷ 1572 = £7.58	A1	

Q	Answer	Mark	Comments
12(a)	All equally likely circled	B1	
	Valid explanation such as dice has no memory so any values equally likely It's a fair dice so not biased	B1 Dep	
12(b)(i)	5	B1	
12(b)(ii)	0.42 plotted or 0.42 seen	B1	Allow either calculation or plot as this is a lead in to part (b)(iii) Accuracy of plot to $\frac{1}{2}$ square accuracy
12(b)(iii)	16 or 17	B1	Do not accept decimals.
12(b)(iv)	No ticked and reason 0.42 > 0.16 or 42 > 17 Should be about a sixth and 0.4 is bigger than this In 100 throws there should be about 16 sixes and there are more than this	B1	oe Need a comparison with a sixth If Yes ticked it is B0 If neither box ticked but answer makes it clear that dice is biased give B1

Q	Answer	Mark	Comments
13(a)	Fully correct graph. Graph must pass from at least (–4, –10) to (4, 14)	B3	B2 Any graph gradient 3 B1 Any graph passing through (0, 2)
Alt 1 13(a)	Evidence of finding a pair of points by substituting a value for x and finding y	M1	Any correct coordinate
	Graph passing through (0, 2)	A1	
	Straight line graph from (–4, –10) to (4, 14)	A1	
Alt 2 13(a)	(0, 2) marked	B1	
	Evidence of attempt to draw gradient 3 from (0, 2)	M1	
	Straight line graph from (–4, –10) to (4, 14)	A1	
13(b)	$y = -2x - 1$	B3	**Must have y =** ie, $-2x - 1$ on answer line is B2
Alt 13(b)	Evidence of attempt to find gradient	M1	Triangles on graph (1 : 2) etc
	Gradient of –2	A1	
	$y = -2x - 1$	A1	**Must have y =** oe eg, $y + 2x = -1$, $y + 2x + 1 = 0$ **SC1** Any equation of form $y = mx - 1$ **SC2** Any equation of form $y = -mx - 1$

Q	Answer	Mark	Comments
14(a)	Attempt to find cumulative frequencies 6, 21, 47, 79, 94, 100	M1	Allow one error
	Plotting their cumulative frequencies against the upper class boundary	M1 Dep	If a cumulative frequency 'histogram' drawn then this scores M1, M0 unless appropriate points clearly marked or correct curve drawn in which case it is M1, M1Dep
	Correct cumulative frequency diagram. Can be curve or polygon. Curve must be smooth and all points correct to ±1mm ($\frac{1}{2}$ square)	A1	
14(b)	30.5 to 31.5	B1ft	Answer in range give B1 otherwise ft Their graph if first M awarded and graph 'increasing' Follow through their total if line drawn at halfway value and correct value for median read from graph. eg if their total is 110 and they read from 55
14(c)	Sight of 22 and 39 or horizontal lines drawn from 75 and 25 to graph and vertical lines from these points to axis.	M1	Could be marks on graph and allow ft from their graph if first M awarded in (a) ft their total if lines drawn across and down at $\frac{1}{4}$ and $\frac{3}{4}$ values of their total
	16.5 to 17.5	A1ft	ft Their graph if first M awarded and graph 'increasing'. Allow reading from 25 and 75 or 25.5 and 75.5 Follow through their total if M1 awarded
Alt 14(c)	$30 + (40 - 30) \times 28 \div 32$ $- 20 + (30 - 20) \times 4 \div 26$	M1	Allow interpolation even though question states 'Use the graph'
	17 or 17.2	A1	

Q	Answer	Mark	Comments
15(a)	Either	B1	
15(b)	Testing any prime value for p, p must be squared	M1	Any correct, non-prime value of n for a prime value of p implies M1 eg, 10, 2 or 15, 3 or 55, 7 but will get A0 **NB** 1 is not prime so 7, 1 is M0, A0
	31, 5 or 127, 11 or 367, 19 or 967, 31 etc	A1	Values wrong way round implies M1, A0
15(c)	$p^2 = n - 6$ or $n - 6 = p^2$	M1	Correct reverse flow diagram is M1
	$p = \sqrt{(n-6)}$ and / or $p = -\sqrt{(n-6)}$ or $\sqrt{(n-6)} = p$	A1	**Must have p = on answer line** Square root must be over all terms. ie, $p = \sqrt{n} - 6$ is M0, A0 without working. Allow ± in front of root. SC1 $p = \sqrt{(n+6)}$

16	Testing a value between 3 and 3.4685 inclusive to at least whole number accuracy	M1	$3 \Rightarrow 51$, $3.1 \Rightarrow 56.482$, $3.2 \Rightarrow 62.336$, $3.3 \Rightarrow 68.574$, $3.4 \Rightarrow 75.208$
	Testing a value between 3.469 and 4 inclusive to at least whole number accuracy	M1	$3.5 \Rightarrow 82.25$, $3.6 \Rightarrow 89.712$, $3.7 \Rightarrow 97.606$, $3.8 \Rightarrow 105.944$ $3.9 \Rightarrow 114.738$, $4 \Rightarrow 124$
	Testing a value to at least 2dp that confirms 3.5 is root accurately to at least whole number accuracy	M1 Dep	$3.45 \Rightarrow 78.67725$, $3.46 \Rightarrow 79.383472$
	Stating answer as 3.5	A1	Award A1 if any M awarded
Alt 16	Testing a value between 3 and 3.4685 inclusive to at least whole number accuracy	M1	$3 \Rightarrow -29$, $3.1 \Rightarrow -23.158$, $3.2 \Rightarrow -17.664$, $3.3 \Rightarrow -11.426$, $3.4 \Rightarrow -.792$
	Testing a value between 3.469 and 4 inclusive to at least whole number accuracy	M1	$3.5 \Rightarrow 2.25$, $3.6 \Rightarrow 9.712$, $3.7 \Rightarrow 17.606$, $3.8 \Rightarrow 25.944$ $3.9 \Rightarrow 34.738$, $4 \Rightarrow 44$
	Testing a value to at least 2dp that confirms 3.5 is root accurately to at least whole number accuracy.	M1Dep	$3.45 \Rightarrow -1.32275$, $3.46 \Rightarrow -0.616528$
	Stating answer as 3.5	A1	Award A1 if any M awarded

Q	Answer	Mark	Comments
17	21.5 and 18.5	B1	Ignore an upper limit for Al and lower limit for Bob
	45 × their 21.5 or 54 × their 18.5	M1	ft Their limits if they are attempts at lower and upper limits
	Their 967.5 and their 999	A1ft	
	$967.5 \le l < 999$	A1ft	Must be Al's smallest and Bob's biggest
18	5 × 12 (= 60)	B1	
	Slant height = 13	B1	
	π × 5 × their slant height ÷ 2 (= $32\frac{1}{2}\pi$) (102.05 to 102.115)	M1	Allow their slant height only if calculated from Pythagoras eg $10^2 + 12^2 = \sqrt{244} = 15.62$
	$\pi \times 5^2 \div 2$ (= $12\frac{1}{2}\pi$) (39.25 to 39.275)	M1	
	201– 201.4, 45π + 60	A1	
19	$\frac{1}{2}h(a+b) = \frac{5}{3} \times \frac{1}{2}bh$	M1	
	$\cancel{\frac{1}{2}}\cancel{h}(a+b) = \frac{5}{3} \times \cancel{\frac{1}{2}}b\cancel{h}$	M1	Evidence of cancelling $\frac{1}{2}$ and h
	$3a + 3b = 5b$	A1	oe eg, $a + b = 1\frac{2}{3}b$
	$a = \frac{2}{3}b$	A1	If given as a decimal then $a = 0.66b$ is minimum accuracy acceptable Must have a = on answer line
Alt 19	Area PQS : area QRS = $\frac{2}{3}$: 1	M1	oe eg, PQS is $\frac{2}{3}$ QRS
	Triangles have same height	M1	
	$\frac{1}{2}ah = \frac{1}{2} \times \frac{2}{3} \times bh$	A1	oe
	$a = \frac{2}{3}b$	A1	If given as a decimal then $a = 0.66b$ is minimum accuracy acceptable. Must have a = on answer line

Q	Answer	Mark	Comments
20	Any fd × width	M1	Allow M1 if scales misread, eg, 2.3 × 10 but no further marks can be scored.
	26, 42, 68, 55, 50, 42 or all six products.	A1	Allow 2 errors or omissions
	283	A1	
21	$(ax \pm 1)(bx \pm 1)$ for top line	M1	$ab = 6$
	$(3x - 1)(2x + 1)$	A1	oe
	$(2x + 1)(2x - 1)$	B1	$(-2x + 1)(-2x - 1)$
	$\frac{3x \quad 1}{2x \quad 1}, \frac{1 \quad 3x}{1 \quad 2x}$	A1	Do not award if contradictory fw seen
22(a)	$\frac{17}{6}$, $2\frac{5}{6}$, 2.8, 2.83 …	B1	
22(b)	x = 70.5 to 70.6	B1	If 70.6 given as answer in (a) and not stated in (b) then allow the *B* *A* = 19.4 to 19.5 Check diagram
	180 – 45 – their x (= 64.4)	M1	*BDA* = 180 – 45 – their 19.4 (= 115.6) Check diagram
	$\frac{BD}{\sin \text{their } 70.6} = \frac{6}{\sin \text{their } 64.4}$	M1Dep	$\frac{BD}{\sin \text{ their } 19.4} = \frac{17}{\sin \text{ their } 115.6}$ Allow sines on top
	$BD = \frac{6 \times \sin \text{ their } 70.6}{\sin \text{ their } 64.4}$	M1Dep	$BD = \frac{17 \times \sin \text{ their } 19.4}{\sin \text{ their } 115.6}$
	6.26 – 6.3	A1	

Q	Answer	Mark	Comments
23	*OX* = 15	B1	Check diagram
	XY = 10	B1	Check diagram 10 seen without 15 is 2 marks
	'Their 10'^{2} – 9^2	M1	Their 10 must be bigger than 9
	4.359, $\sqrt{19}$	A1	
	8.717 …, 8.72, 8.7, $2\sqrt{19}$	A1	
Alt 23	*OX* = 15	B1	Check diagram
	XY = 10	B1	Check diagram 10 seen without 15 is 2 marks
	$2 \times \cos^{-1}(9 \div 10)$ (= 51.68 …)	M1	
	Their $51.68 \div 360 \times 2 \times \pi \times 10$	M1 Dep	
	9, 9.0, 9.02 …	A1	