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General Certificate of Secondary Education
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Mathematics 4306

Specification A

Paper 2 Higher

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.

Set and published by the Assessment and Qualifications Alliance.

Glossary for Mark Schemes

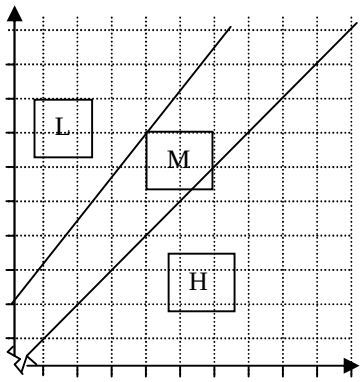
GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

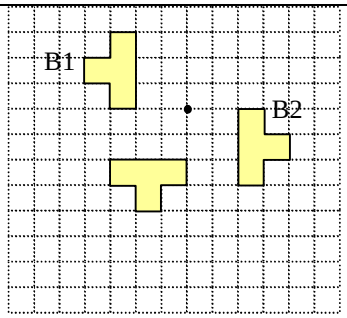
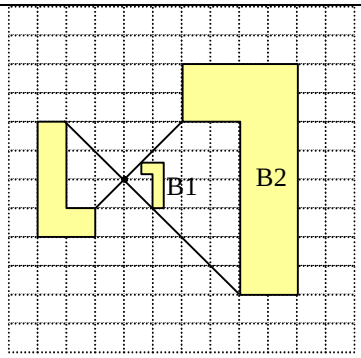
M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
M dep	A method mark dependent on a previous 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	Answers	Mark	Comment
1		B1	
	1.18 × 145	M1	
	171.10	A1	171.1 is A0
1 Alt1	$\frac{18}{100}$ × 145	M1	
	26.1	A1	$\frac{18}{100}$ × 145 M2
	171.10	A1ft	171.1 is A0 ft on 145 + their 26.1
1 Alt2	10% = 14.5 **and** 5% = 7.25 **and** 3% = 1.45 × 3	M1	Allow build up method for 18%. Allow arithmetic mistakes but must get to 18%
	14.5 + 7.25 + 3 × 1.45	M1	
	171.10	A1	171.1 is A0
2	Attempt at $\sum xf$ 12 + 5 + 12 + 56 + 48 + 45 + 50 (= 228)	M1	4 × 3 + 5 × 1 + … + 10 × 5 Allow one arithmetic error or omission of a product.
	Their 228 ÷ 30	M1Dep	12 + 5 + 12 + 56 + 48 + 45 + 50 ÷ 30 is M1, M0 unless recovered.
	7.6	A1	Allow 7 or 8 after 7.6 or 228 ÷ 30 seen
2 Alt	4 + 4 + 4 + 5 + 6 + ….. + 10 + 10	M1	Allow one missed value
	Their 228 ÷ 30	M1Dep	
	7.6	A1	Allow 7 or 8 after 7.6 or 228 ÷ 30 seen
3 (a)	Either ticked and prime can be odd or even stated or shown.	B1	Allow misreads of formula as pr or $(pr)^2$ or miscalculation as long as $p = 2$ and p = odd prime mentioned. eg $2 \times 3^2 = 36$ and $3 \times 3^2 = 81$
3 (b)	Any valid expression, eg $xy + z$	B1	Allow numbers if all variables used, eg $x + y + z + 1$, $2(x + y + z)$. Must use all three letters. $x \pm y \pm z$ is B0

Q	Answers	Mark	Comment
4	76 seen	B1	
	180 – 2 × their 76	M1	$x + 76 = 104$
	28	A1	
5 (a)	$x(x + 7)$	B1	
5 (b)	$15x + 40$	B1	
5 (c)	$6x + 3 - 2x + 6$	M1	Allow one sign or arithmetic error
	$4x + 9$	A1	
6	2.2 30 1.75	B2	B1 for 2
7	800 + 1200 + 1400 + 700 (= 4100)	M1	Allow one error, must have 4 values
	2 × their 4100 (= 8200)	M1	
	$\frac{130}{360}$ × their 8200	M1Dep	Dependent on first M1 then doubling or halving their 4100. eg 130 ÷ 360 × 2050 is M1 Accept 36% of 8200 or equivalent **NB** $\frac{130}{180}$ × 4100 is M3
	2950 to 2965	A1	(2952 is 0.36 × 8200)
	3000	B1	ft their value if possible to round to nearest 100 except for 740.3 rounded to 700 or 750 SC1 2800 or 2 × 1400 (no B mark for rounding to 3000)
8 (a)	0.5	B1	
8 (b)	$3y + 2y = 3 - 8$	M1	Allow one error
	$5y = -5$	A1	
	-1	A1ft	ft on one error only except for $y = -5$ which is only M1
9 (a)	2, 5, 10	B2	B1 for 2, eg 0, 2, 5

Q	Answers	Mark	Comment
9 (b)	$6n - 1$	B2	B1 for $6n$. A non simplified but equivalent expression is B1
10	All three drawn correctly	B2	B1 for 1 or 2 drawn correctly
	$\frac{1}{2}$ × their base × their height	M1Dep	Dependent on a B1. Their 3 lines must form a triangle
	12.5	A1ft	oe ft from a triangle with a horizontal line and a vertical line. **NB** answer is correct from $y = -2$ and $x = 3$ so only give 3/4 for this.
11	16×4 (= 64)	B1	
	$\pi \times 8^2 \div 2$	M1	$\pi \times 16^2 \div 2$ or $\pi \times 6^2 \div 2$
	100.48 to 100.57	A1	32π
	164.48 to 164.57, $64 + 32\pi$	A1ft	ft if an area of a rectangle calculated with a length of 16 and any other width. eg 152.52 to 152.56 comes from using 6 as radius and height so scores 2/4 196.53 is 3/4 164 or 165 with working
12 (a)	$x^2 - 2x - 3x + 6$	B1	
12 (b)	Either $(2)^2 - 5(2) + 6$ $= 4 - 10 + 6$ or $(2 - 2)(2 - 3) = 0 \times -1$	B1	
12 (c)	3	B1	
13 (a)	High	B1	
13 (b)	30	B1	

Q	Answers	Mark	Comment
13 (c)		B1	Line from (18, 18) to (36, 36) (40, 40) Allow one square inaccuracy.
		B1	Areas marked with a line passing between (16, 19) and (19, 16) **and** (38, 34) and (34, 38)
14	Sight of 0.85	B1	85% = 30.60 M1
	36	B1Dep	36 seen is 2/3
	5.40	B1Dep	5.4 is B0
14 Alt	85% = 30.60	M1	
	100% = 36	A1	$\frac{0.15}{0.85} \times 30.6$ is M2
	5.40	A1Dep	5.4 is B0
15 (a)	$2x < 8$	M1	Allow $2x \leq 8$ or $2x < 6$ for M1
	$x < 4$	A1	$4 > x$ Must be stated as answer
15 (b)	$x > -3$	B1	
15 (c)	$-2, -1, 0, 1, 2, 3$	B1ft	ft their (a) and (b) or correct answer

Q	Answers	Mark	Comment
16	Reference to looking up results and noting times of goals for a sample	B1	Count how many goals were scored in the first half and in the second half (B2)
	Reference to calculating total number of goals in both halves	B1	'Work out how many were scored in each half' Count how many goals were scored in the first half and in the second half (B2)
	Sample size of at least 15	B1	For a season or Saturday or for a weekend
	Reference to a comparison and an interpretation	B1	'See which is the greater total or which average is bigger to test the hypothesis' Work out an average NB if a scattergraph used to compare then reference must be made to the axes being 'first half' and 'second half'
	Reference to making a conclusion based on data	B1	If the second half had more goals or a bigger average then it is correct. NB if a scattergraph used to make a conclusion then reference must be made to the gradient of the LOBF being > (or less) than 1.
17 (a)		B2	B1 Clockwise rotation about P
17(b)		B2	B1 for at least 2 rays marked from corners through the centre and beyond B1 for any correct enlargement sf − 2 but in wrong position or enlargement sf − 0.5 about C.
18 (a)	$2 \times 10^7 \times 42$	M1	oe
	$= 8.4 \times 10^8$ $(8 - 8.5 \times 10^8)$	A1	840 000 000 allow 84×10^7 etc. Digits 84 imply M1

Q	Answers	Mark	Comment
18 (b)	Their $8.4 \times 10^8 \times 18 \div 2.5 \times 10^8$	M1	$= 1.512 \times 10^{10}$ $(1.44 - 1.512 \times 10^{10}) \div 2.5 \times 10^8$
	60.48	A1	Allow rounding as figures are estimates $57 - 61$. Digits 6048 (or 57… to 61…) imply M1
19(a)	0.7, 0.3, 0.7, 0.3, 0.7	B1	
19(b)	Chooses VV, VC and CV	M1	0.09, 0.21, 0.21
	0.09 + 0.21 + 0.21	M1ft	ft from their tree diagram even if probabilities do not add to 1 on each branch
	0.51	A1ft	ft from their tree diagram. Sc1. Two relevant products added (ft their diagram)
19 (b) Alt	1 − (no vowels)	M1	
	$1 - (0.7)^2$ or $1 - 0.49$	M1ft	ft from their tree diagram even if probabilities do not add to 1 on each branch
	0.51	A1ft	ft from their tree diagram.
19 (b) Alt 2	Chooses VV, VC and CV from a without replacement tree diagram (0.7, $\frac{2}{9}$, $\frac{7}{9}$, $\frac{7}{9}$, $\frac{3}{9}$, $\frac{6}{9}$)	M1	$\frac{6}{90}, \frac{21}{90}, \frac{21}{90}$
	$\frac{6}{90} + \frac{21}{90} + \frac{21}{90}$	M1	$1 - \frac{42}{90}$
	$\frac{48}{90} = \frac{24}{45}$	A1	0.53333…
20 (a) (i)	Angle at centre twice angle at circumference	B1	oe allow ‘edge’ or ‘outside’ for circumference Allow middle for centre
20 (a) (ii)	Opposite angles in cyclic quadrilateral (add up to 180°)	B1	Must mention cyclic quadrilateral or quadrilateral in a circle
20 (b)	*SOQ* = 100 **and** *SRQ* = 130	B1	Check diagram for angles
	opposite angles not equal	B1Dep	

Q	Answers	Mark	Comment
21	fds 0.8, 2.2, 2.6, 1.9, 0.6	B1	Allow one error. Accept equivalent scaled values.
	Correct plot, heights and widths	B1Dep	ft their values
	Axis labelled frequency density oe	B1Dep	One error lose one mark
22	$y(2x + 5) = 3x - 1$	M1	
	$2xy - 3x = -1 - 5y$	A1	Allow one expansion or rearrangement error
	$x(2y - 3) = -1 - 5y$	M1	
	$x = \frac{-1-5y}{2y-3}$	A1	Must have $x =$, $x = \frac{1+5y}{3-2y}$
23	$\frac{\sin c}{14} = \frac{\sin 52}{15}$	M1	
	$\sin c = \frac{14 \times \sin 52}{15} = 0.73547$	M1	
	47(.347…)	A1	
	$\frac{1}{2} \times 15 \times 14 \times \sin 80.7$ (81)	M1Dep	Dependent on both Ms
	103.5 to 104	A1	
23 Alt	$AX = 14 \times \sin 52$	M1	
	$AX = 11.03…$	A1	
	$BC = 18.78$	M1	They will need *BC* which involves the method above and a further use of the sine rule or cosine rule. (good luck to them)
	$0.5 \times 11.03 \times 18.78$	M1Dep	Dependent on both Ms
	103.5 to 104	A1	

Q	Answers	Mark	Comment
24 (a)	Part (i) Curve passes through (1, 5) and asymptotes to $x = 0$. It can touch the axis at $y = 8$ or above but must **not** cross the axis.	B2	B2 if all three parts correct. B1 if 2 out of 3 parts correct.
	Part (ii) Passes through (1, 5) and (5, 1). Curve must be at least half a unit from $x + y = 6$		
	Part (iii). Curve passes through (5, 1) and asymptotes to $y = 0$. It can touch the axis at $x = 8$ or above but must **not** cross the axis.		
24 (b)	$\frac{5}{x} = x$ or $x^2 = 5$	M1	
	$(\sqrt{5}, \sqrt{5})$ or (2.23.. , 2.23..) or (2.24, 2.24)	A1	Allow 2.2 to 2.25 range for either coordinate.
25	$2(2x + 1) - 3(3x - 1)$ (× 5)	M1	$4x + 2 - 9x \pm 3$ (= $-5x + 5$)
	$2 \times (3x - 1)(2x + 1)$	M1	$\frac{2}{5} \times (3x - 1)(2x + 1)$
	$-25x + 25 = 12x^2 + 2x - 2$	A1	Allow one error
	$12x^2 + 27x - 27 = 0$ $(4x^2 + 9x - 9)$	M1	Allow one error in collection of terms
	$(x + 3)(4x - 3) = 0$	A1	
	-3 and $\frac{3}{4}$	A1	
26	$\pi \times (2y)^2 \times x = \frac{4}{3} \times \pi \times (2y)^3$	M1	Allow missing brackets.
	Cancelling to give $x = \frac{8}{3}y$	A1	oe Missing brackets $\Rightarrow x = \frac{4}{3}y$
	$\frac{1}{3} \times \pi \times (3y)^2 \times h = \frac{4}{3} \frac{4}{3} \times \pi \times (3y)^3$	M1	Allow missing brackets
	Cancelling to give $h = 12y$	A1	oe Missing brackets $\Rightarrow h = 4y$
	$h = \frac{9}{2}x$	A1	oe Missing brackets $\Rightarrow h = 3x$