GCSE
Mathematics

Paper 1 Higher Tier

Mark scheme

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Further copies of this mark scheme are available from aqa.org.uk

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.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

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.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
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.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq$ value $< b$
3.14…	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Question	Answer	Mark	Comments
1	10	B1	
2	8×10^8	B1	
3	$16a^{10}$	B1	
4	÷ 2	B1	

5(a)	$(x - 10)(x + 10)$	B1	either order ignore fw
	Additional Guidance		
	$(x + 10)(x + -10)$		B1
	Condone missing bracket at end only $(x - 10)(x + 10$ $(x - 10(x + 10)$		B1 B0
	$(x - 10)(x + 10)$ followed by attempt to solve, eg answer $x = 10$, $x = -10$		B1
	answer only $x = 10$, $x = -10$		B0

5(b)	$7x - 2x > 1 - 6$ or $5x > -5$ or $6 - 1 > 2x - 7x$ or $5 > -5x$ or $1 > -x$	M1	oe collecting terms
	$x > -1$ or $-1 < x$	A1	SC1 incorrect sign eg $x \geqslant -1$ or $x = -1$ or answer of –1
	Additional Guidance		
	Answer $x > \frac{-5}{5}$		M1A0
	Answer only $\frac{-5}{5}$		SC0
	$x > -1$ with –1 or 0, 1, 2 … as the answer		M1A0

Question	Answer	Mark	Comments
6	$((\sqrt{3})^2 =) 3$ and $((\sqrt{2})^2 =) 2$ or $(\sqrt{6})^2$ or $\sqrt{6^2}$ or $\sqrt{36}$ or $\sqrt{9} \times \sqrt{4}$ or $\sqrt{9 \times 4}$	M1	
	6	A1	
	Additional Guidance		
	$3 \times 2 = 6$ with answer eg $\sqrt{6}$ or 6^4		M0A0
	Condone $\sqrt{3} = 1.7$, $1.7^2 = 3$ and $\sqrt{2} = 1.4$, $1.4^2 = 2$, otherwise $\sqrt{3}$ or $\sqrt{2}$ or 3^2 or 2^2 incorrectly evaluated does not score, even if answer is 6		
	eg $\sqrt{3} = 1.5$, $1.5^2 = 3$		M0A0
	$\sqrt{2} = 1$, $1^2 = 2$, answer 6		M0A0
	$3^2 = 6$, $\sqrt{6} = 3$		M0
	$\left(\sqrt{6}\right)^4$		M0A0
	$\sqrt{2} = 1$		M0

Question	Answer	Mark	Comments
7	$\pi \times 6 \times 6$ or 36π or [113, 113.112] or $9 \times$ [3.14, 3.142] or [28.26, 28.3]	M1	oe accept [3.14, 3.142] for π
	9π or $9 \times \pi$ or $\pi 9$ or $\pi \times 9$	A1	
	Additional Guidance		
	36π followed by an incorrect method eg $36\pi \div 2 = 18\pi$ with answer 18π		M1A0
	Answer of 9π from $\pi \times 3^2$		M0A0
	9π and [28.26, 28.3] given on answer line		M1A0
	πr^2 stated but followed by 36 or 9		M0A0

Question	Answer	Mark	Comments
8	**Alternative method 1**		
	Three whole numbers that each are less than 80 and have units digit 4 or States that each number must have units digit 4	M1	
	82	A1	
	Alternative method 2		
	Correctly evaluated trial for three whole numbers, none of which are a multiple of 10, and that, when rounded, total 70	M1	eg 33 + 33 + 13 = 79
	82	A1	
	Additional Guidance		
	39 + 33 + 13 = 85 (40 + 30 + 10 = 80)		M0
	Beware 82 from incorrect values, eg 39 + 24 + 19 = 82		M0A0
	Ignore incorrectly evaluated trials that do not solely lead to the answer		
9	$n - 1$	B1	

Question	Answer	Mark	Comments
10(a)	$\frac{1}{2}(b + 2b)h$ or $3 \times \frac{1}{2}bh$	M1	oe
	1.5bh or $\frac{3}{2}bh$ or $\frac{3bh}{2}$ or $1\frac{1}{2}bh$	A1	accept hb for bh
	Additional Guidance		
	Correct expression with ×, ÷ or brackets		M1A0
	Condone units within expressions for M1 only		
	Condone the expression given within a formula eg A = 1.5hb		M1A1
	Condone correct expression stated and then equated to a value or with values substituted		M1A1
10(b)	$3b + 2s$ or $3b = 2s$ or $4s$	M1	oe
	$6b$	A1	oe eg $b + b + b + b + b + b$
	Additional Guidance		
	Condone the expression given within a formula eg P = 6b		M1A1

Question	Answer	Mark	Comments
11	**Alternative method 1**		
	$x + 2x + 2x + 10$ or $5x + 10$ or $x + 2x + 2x + 10 + 90$ or $5x + 100$	M1	oe
	$x + 2x + 2x + 10 = 360 - 90$ or $5x + 10 = 270$ or $x + 2x + 2x + 10 + 90 = 360$ or $5x + 100 = 360$ or $5x = 260$	M1dep	oe
	$(x =)$ 52 or $2x = 104$ or $2x + 10 = 114$	A1	May be on diagram
	$\frac{114}{360}$ or $\frac{57}{180}$ or $\frac{38}{120}$ or $\frac{19}{60}$ or 0.31(6..) or 0.317 or 0.32 or 31(.6…)% or 31.7% or 32%	B1ft	ft $\frac{2 \times \text{their } 52 + 10}{360}$ or $\frac{\text{their angle for C}}{360}$
	Alternative method 2		
	$\frac{90}{360} + \frac{x}{360} + \frac{2x}{360} + \text{P(C)} = 1$ or $\frac{90}{360} + \frac{x}{360} + \frac{2x}{360} + \frac{2x+10}{360}$ or $\frac{2x+10}{5x+100}$	M1	oe
	$\frac{90}{360} + \frac{x}{360} + \frac{2x}{360} + \frac{2x+10}{360} = 1$	M1dep	oe
	$(x =)$ 52 or $2x = 104$ or $2x + 10 = 114$	A1	May be on diagram
	$\frac{114}{360}$ or $\frac{57}{180}$ or $\frac{38}{120}$ or $\frac{19}{60}$ or 0.31(6..) or 0.317 or 0.32 or 31(.6…)% or 31.7% or 32%	B1ft	ft $\frac{2 \times \text{their } 52 + 10}{360}$ or $\frac{\text{their angle for C}}{360}$

11 cont	**Additional Guidance**	
	Ignore incorrect simplification or conversion after $\frac{114}{360}$ oe	M1M1A1B1
	$\frac{360-10-90}{5}$ oe	M1M1
	$x + 2x + 2x + 10$ followed by $6x + 10 = 270$	M1M0
	Do not accept decimal within fraction for final answer if correct fraction not seen	
	The follow through is not available if A1 awarded	

12	Any two of 0.5, 40 and 100	M1	1600 implies 40 10 implies 100
	$(40^2 =)$ 1600 or $(0.5 \times 40^2 =)$ 800 or $(\sqrt{100} =)$ 10	M1	
	80 with correct working	A1	
	Additional Guidance		
	$\frac{0.5\times1600}{\sqrt{100}}$ or $\frac{0.5\times40^2}{10}$ or $\frac{1\times1600}{10}$ or $\frac{800}{\sqrt{100}}$ or $\frac{800}{10}$		M1M1
	80 with no or incorrect working, eg attempt at actual calculation and then rounding to 80		M0M0A0
	Condone 0.50(0) for 0.5, 40.0(0) for 40 and 100.0(0) for 100 etc		
	Rounding 0.526 to 1, but otherwise correct, with answer 160		M1M1A0

Question	Answer	Mark	Comments
13	**Alternative method 1**		
	88 ÷ (7 + 4) or 88 ÷ 11 or 8	M1	oe 11 × 8 = 88
	their 8 × 7 and their 8 × 4 or their 8 × 7 and 88 – their value or their 8 × 4 and 88 – their value or 56 and 32 or their 8 × (7 – 4) or their 8 × 3	M1dep	oe eg 8 × 7 = 63 and 88 – 63 eg 8 × 4 = 30 and 88 – 30
	24	A1	
	Alternative method 2		
	One correctly evaluated trial for two numbers, other than 7 and 4, in the ratio 7 : 4	M1	eg 70 + 40 = 110
	56 and 32	M1dep	eg 56 + 32 = 88
	24	A1	
	Alternative method 3 using $x : y = 7 : 4$ (correct)		
	$4x = 7y$ and $4x + 4y = 352$ / $4x = 7y$ and $7x + 7y = 616$	M1	oe forming equation from ratio and equating coefficients
	$11y = 352$ or $y = 32$ / $11x = 616$ or $x = 56$	M1dep	oe equation in one variable
	24	A1	
	Alternative method 4 using $x : y = 4 : 7$ (incorrect)		
	$7x = 4y$ and $4x + 4y = 352$ / $7x = 4y$ and $7x + 7y = 616$	M1	oe forming equation from ratio and equating coefficients
	$11x = 352$ or $x = 32$ / $11y = 616$ or $y = 56$	M1dep	oe equation in one variable
	their answer	A0	

13 cont	**Alternative method 5** using $x : y = 7 : 4$ (correct)		
	$x = \frac{7}{4}y$ or $y = \frac{4}{7}x$ or $x = 88 - y$ or $y = 88 - x$	M1	oe making one variable the subject
	$\frac{7y}{4} + y = 88$ or $\frac{11}{4}y = 88$ or $x + \frac{4}{7}x = 88$ or $\frac{11}{7}x = 88$	M1dep	oe equation in one variable
	24	A1	
	Alternative method 6 using $x : y = 4 : 7$ (incorrect)		
	$y = \frac{7}{4}x$ or $x = \frac{4}{7}y$ or $x = 88 - y$ or $y = 88 - x$	M1	oe making one variable the subject
	$\frac{7x}{4} + x = 88$ or $\frac{11}{4}x = 88$ or $y + \frac{4}{7}y = 88$ or $\frac{11}{7}y = 88$	M1dep	oe equation in one variable
	their answer	A0	
	Additional Guidance		
	–24 with no incorrect working implies 56 and 32		M1M1A0
	$x = 32$ and $y = 56$		M1M1A0

Question	Answer	Mark	Comments
14	**Alternative method 1**		
	60 ÷ 2 or 30	M1	exterior angle may be on diagram
	360 ÷ their 30	M1dep	
	12	A1	
	Alternative method 2		
	$\frac{360-60}{2}$ or $\frac{300}{2}$ or 150	M1	interior angle may be on diagram
	360 ÷ (180 – their 150) or 360 ÷ 30	M1dep	
	12	A1	
	Alternative method 3		
	$\frac{360-60}{2}$ or $\frac{300}{2}$ or 150	M1	interior angle may be on diagram
	180 × (n – 2) = their 150 × n or 180n – their 150n = 360 or 30n = 360	M1dep	oe equation
	12	A1	

Question	Answer	Mark	Comments
15(a)	$7 \times 5 \times 3$	M1	oe 35×3
	105	A1	
	Additional Guidance		
	105 given with further work		M1A0
15(b)	**Alternative method 1**		
	$\frac{2}{7} \times \frac{3}{5}$ or $\frac{2 \times 3}{7 \times 5}$	M1	oe
	$\frac{6}{35}$	A1	oe
	Alternative method 2		
	$\frac{2 \times 3 \times 3}{\text{their } 105}$	M1	their 105 from (a)
	$\frac{18}{\text{their } 105}$ or $\frac{6}{35}$	A1ft	oe ft their 105 from (a) if 0 < probability < 1
	Additional Guidance		
	Ignore incorrect simplification or conversion after a correct fraction		M1A1
	$\frac{2}{7} \times \frac{3}{5}$ or $\frac{6}{35}$ with further work other than simplification or conversion		M1A0
	$\frac{2}{7} + \frac{3}{5}$		M0A0
16	15 litres	B1	

Question	Answer	Mark	Comments
17	Ticks No and gives correct reason or ticks No and gives numerical counter-example for any solid	B1	eg1 (volume of) A is 8 times bigger eg2 (volume) sf = 2^3 eg3 if A and B are cubes and l = 3, volume of A = 27 volume of B = 216 216 is not 27 × 2
	Additional Guidance		
	Condone $8l^3$		B1
	No, as the height/width is (also) doubled/different		B1
	No, as the length/volume is cubed		B0
	No, volume is l^3		B0
	No, as the height could be different		B0
	No, it would be 3 times as big		B0
	Doubling the length doesn't double the volume		B0
18	$-\frac{3}{2}$ and $\frac{2}{5}$	B1	
19	a + 65 + 115 + c = 360 or b + c = 180	M1	oe oe
	a + c = 180 and b + c = 180 and a = b	A1	oe eg c = 180 – a b = 180 – (180 – a) = a
	angles at a point and (co)interior angles	A1	
	Additional Guidance		
	Accept angles round a point for angles at a point		
	Accept allied angles for interior angles		

Question	Answer	Mark	Comments
20	Median ticked and a valid reason for not using mode (eg there is no mode) and a valid reason for not using mean (eg 82 will affect the mean disproportionately)	B2	B1 median ticked or valid reason to reject mean or valid reason to reject mode with any box or no box ticked
	Additional Guidance		
	Accept any indication in place of a tick		
	Ignore non-contradictory statements alongside a correct reason		
	Median ticked with reasons “There is no mode” and “82 would skew the mean”		B2
	No box or mode ticked with reason “Not mean, because of the 82”		B1
	No box or mean ticked with reason “Not mode, all the numbers are different”		B1
	No box or mode ticked with statement that 82 is very large		B0
	Condone “one number” oe for “82” in reason for mean if intention is clear, eg “One of the numbers is far bigger than the others”		
	Do not accept reasons for the mean indicating that 12.7 is too high unless 82 is also mentioned		
	Do not accept reasons given with the wrong measure eg “It cannot be the mean as they’re all different”		
	Do not accept a reason which simply defines mean and mode		
	Giving reasons for mode and mean does not imply a selection of median – the box must be ticked to achieve both marks		
	Median ticked with two valid reasons which are not attributed to median and mode eg median ticked and “There is not a repeated number” and “82 is far too high to calculate the average”		B2
	Otherwise, reasons must be attributed		

Question	Answer	Mark	Comments
21	Set of 3 points that give area 28 and *A* on positive *y*-axis and *B* on negative *y*-axis and *C* on positive *x*-axis	B2	eg1 *A*(0, 10) *B*(0, –4) *C*(4, 0) eg2 *A*(0, 18) *B*(0, –10) *C*(2, 0) B1 diagram labelled with numbers that give area 28 eg *A* labelled 20, *B* labelled –8, C labelled 2 or calculation of form $\frac{b \times h}{2}$ seen that equals 28 or $b \times h$ that equals 2 × 28 eg $\frac{8 \times 7}{2}$ (= 28) or 8 × 7 (= 56)

22(a)	(6) 22 50 60	B1	cumulative frequency values may be implied by points plotted (± 0.5 square)
	Points plotted with upper class boundaries and cf values (± 0.5 square)	B1ft	ft their cumulative frequencies must be increasing
	Smooth curve or polygon (± 0.5 square)	B1ft	ft their cumulative frequencies must be increasing and not a single straight line
	Additional Guidance		
	Graphs may start from their first plotted point or from (40, 0) If the points are plotted at mid-points, with a point at (45, 6), the graph may start at (35, 0) (± 0.5 square) If the points are plotted at the lower bounds, with a point at (40, 6), the graph may start at (0, 0)		
	Graph starting at (0, 0), but otherwise correct		B1B1B0
	Graph plotted at mid-points or lower class boundaries, but otherwise correct		B1B0B1
	Graph ascends or descends after x = 80		B0 for 3rd mark
	Bars drawn as well as correct graph		B1B1B0
	Bars drawn without correct graph		max B1

Question	Answer	Mark	Comments
22(b)	One correct mpg reading for their graph from cf of 15(.25) or 45(.75) or horizontal lines from 15(.25) and 45(.75) only to their graph or 15(.25) and 45(.75) indicated as the cf values for the quartiles	M1	± 0.5 square ft their increasing graph may be on table
	Correct value for their increasing graph	A1ft	
23	(–3, 5)	B1	
24	**Alternative method 1**		
	180 ÷ (5 + 7) or 180 ÷ 12 or 15	M1	oe
	5 × their 15 or 180 – 7 × their 15 or 75	M1dep	oe
	180 – their 75 – 20 or 180 – 95	M1dep	oe
	85	A1	
	Alternative method 2		
	$x + \frac{7x}{5} = 180$ or $\frac{5y}{7} + y = 180$ or $y = 105$	M1	oe correct elimination of a variable from equations $x + y = 180$ and $7x = 5y$
	$(x =)\ 180 \times \frac{5}{12}$ or $(x =)\ 75$	M1dep	oe
	180 – their 75 – 20 or 180 – 95	M1dep	oe
	85	A1	

Question	Answer	Mark	Comments
25	**Alternative method 1**		
	15 × 8 or 120 or 3 × 6 or 18	M1	oe total number of hours needed oe total number of hours worked by the 3 machines
	15 × 8 – 3 × 6 or 102	M1dep	oe total number of hours worked by the other 12 machines
	8.5	A1	
	Alternative method 2		
	3 × (8 – 6) or 3 × 2 or 6	M1	oe total number of hours not worked by the three machines
	their 6 ÷ 12 or 0.5	M1dep	oe that number divided by the other 12 machines
	8.5	A1	
	Alternative method 3		
	15 × 8 or 120 or 15 × 6 or 90	M1	oe total number of hours needed oe total number of hours worked in the first 6 hours
	$\frac{15\times8-15\times6}{12}$ or 2.5	M1dep	oe number of remaining hours divided by the other 12 machines
	8.5	A1	
	Additional Guidance		
	Note that 15 ÷ 6 is not a correct method to get 2.5 (unless simplified from 30 ÷ 12), so does not score		

Question	Answer	Mark	Comments
26(a)	$0.\dot{7} \div 10 = 0.0\dot{7}$ and $\frac{7}{9} \div 10 = \frac{7}{90}$ or $0.0\dot{7} \times 10 = 0.\dot{7}$ and $\frac{7}{90} \times 10 = \frac{7}{9}$ or $0.\dot{7} \div 10 = 0.0\dot{7}$ and $\frac{7}{90} \times 10 = \frac{7}{9}$ or because the decimal is divided by 10 the 9 has to be multiplied by 10	B1	oe
	Additional Guidance		
	Algebraic methods		B0
	Division of 7 by 90		B0

Question	Answer	Mark	Comments
26(b)	**Alternative method 1**		
	$0.2 + 0.0\dot{7}$ or $\frac{2}{10} + \frac{7}{90}$	M1	
	$\frac{18}{90} + \frac{7}{90}$ or $\frac{25}{90}$	M1dep	
	$\frac{5}{18}$	A1	
	Alternative method 2		
	$10x = 2.777...$ or $100x = 27.777...$	M1	Any letter
	$10x - x = 2.777... - 0.277...$ or $9x = 2.5$ or $\frac{2.5}{9}$ or $100x - x = 27.777... - 0.277...$ or $99x = 27.5$ or $\frac{27.5}{99}$ or $100x - 10x = 27.777... - 2.777...$ or $90x = 25$ or $\frac{25}{90}$	M1dep	oe
	$\frac{5}{18}$	A1	

Question	Answer	Mark	Comments
27	**Alternative method 1**		
	(B, B) $\frac{8}{11}$ and $\frac{7}{10}$ or (R, R) $\frac{3}{11}$ and $\frac{2}{10}$	M1	oe may be seen on tree diagram
	(B, B) $\frac{8}{11} \times \frac{7}{10}$ or $\frac{56}{110}$ or (R, R) $\frac{3}{11} \times \frac{2}{10}$ or $\frac{6}{110}$	M1dep	oe may be seen on tree diagram
	$\frac{8}{11} \times \frac{7}{10} + \frac{3}{11} \times \frac{2}{10}$	M1dep	$\frac{56}{110} + \frac{6}{110}$
	$\frac{62}{110}$ or $\frac{31}{55}$	A1	oe fraction accept 0.56(…) or 56.(…)%
	Alternative method 2		
	(B, R) $\frac{8}{11}$ and $\frac{3}{10}$ or (R, B) $\frac{3}{11}$ and $\frac{8}{10}$	M1	oe may be seen on tree diagram
	(B, R) $\frac{8}{11} \times \frac{3}{10}$ or (R, B) $\frac{3}{11} \times \frac{8}{10}$ or $\frac{24}{110}$	M1dep	oe may be seen on tree diagram
	$1 - \frac{8}{11} \times \frac{3}{10} - \frac{3}{11} \times \frac{8}{10}$	M1dep	$1 - \frac{24}{110} - \frac{24}{110}$
	$\frac{62}{110}$ or $\frac{31}{55}$	A1	oe fraction accept 0.56(…) or 56.(…)%
	Additional Guidance		
	Ignore incorrect simplification or conversion after a correct fraction		M3A1
	$\frac{6820}{12100}$		M3A1

Question	Answer	Mark	Comments
28(a)	$(0^2 +) 6^2 = 36$ or (*OA* =) radius = 6 or $\sqrt{36} = 6$	B1	oe
	Additional Guidance		
	0 + 36 = 36		B0
28(b)	(6, 0)	B1	
28(c)	**Alternative method 1**		
	$\frac{6 - \text{their } 0}{0 - \text{their } 6}$ or $\frac{\text{their } 0 - 6}{\text{their } 6 - 0}$ or $\frac{6}{-6}$ or $\frac{-6}{6}$ or –1	M1	gradient *AB*
	gradient *OM* × gradient *AB* = –1 and gradient *OM* = 1 (and $y = x$)	A1	must see correct working for M1
	Alternative method 2		
	$\left(\frac{6+0}{2}, \frac{0+6}{2}\right)$ or (3, 3)	M1	coordinates of *M*
	gradient *OM* = 1 (and $y = x$) or (0, 0) and (3, 3) (and $y = x$)	A1	must see correct working for M1

Question	Answer	Mark	Comments
28(d)	$x^2 + x^2 = 36$ or $2x^2 = 36$ or $y^2 + y^2 = 36$ or $2y^2 = 36$ or (–)6 cos 45° or (–)6 sin 45°	M1	oe equation
	(–)$\sqrt{\frac{36}{2}}$ or (–)$\sqrt{18}$ or (–)$3\sqrt{2}$ or (–)$\frac{6\sqrt{2}}{2}$ or (–)$\frac{6}{\sqrt{2}}$	M1	
	$(-\sqrt{18}, -\sqrt{18})$ or $(-3\sqrt{2}, -3\sqrt{2})$ or $(-\frac{6\sqrt{2}}{2}, -\frac{6\sqrt{2}}{2})$ or $(-\frac{6}{\sqrt{2}}, -\frac{6}{\sqrt{2}})$	A1	oe surd form

29(a)	(180, 0)	B1	
	Additional Guidance		
	Condone degrees symbol on 180		
	Condone (π, 0)		B1

29(b)	(–270, 1)	B1	
	Additional Guidance		
	Condone degrees symbol on 270		
	Condone ($\frac{-3\pi}{2}$, 1)		B1

Question	Answer	Mark	Comments
30(a)	$\frac{1}{81^{\frac{1}{4}}}$ or $\frac{1}{\sqrt[4]{81}}$ or $\sqrt[4]{\frac{1}{81}}$ or 3^{-1} or $9^{-\frac{1}{2}}$ or $81^{\frac{1}{4}} = 3$ or $\sqrt[4]{81} = 3$ or $3^4 = 81$	M1	
	$\frac{1}{3}$	A1	
	Additional Guidance		
	3 without $81^{\frac{1}{4}}$ or $\sqrt[4]{81}$		M0A0
30(b)	**Alternative method 1**		
	(16 =) 2^4 or $(2^3)^{2x}$ or 2^{6x}	M1	oe with consistent base 2
	(16 =) 2^4 and $(2^3)^{2x}$ or 2^{6x}	M1dep	
	2^{4+6x} or $2^{2(2+3x)}$	A1	
	Alternative method 2		
	$((4 \times 8^x)^2 =)$ $(2^2 \times 2^{3x})^2$	M1	
	$(2^{2+3x})^2$	M1dep	
	2^{4+6x} or $2^{2(2+3x)}$	A1	oe index