



GCSE MATHEMATICS

2023 PRACTICE PAPER SET 2 Higher Tier Paper 3
Mark Scheme

8300/3H

Version 1.0

Principal Examiners have prepared these mark schemes for specimen papers. These mark schemes have not, therefore, been through the normal process of standardising that would take place for live papers.

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 within the scheme 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 <i>a</i> and <i>b</i> inclusive.
3.14 ...	Allow 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.

Q	Answer	Mark	Comments
1(a)	x^6	B1	
1(b)	y^6	B1	
2	360°	B1	
3	$\frac{25x}{4}$	B2	B1 $\frac{ax}{b}$ or sight of 4 and 25
4	$10.35 \leq t < 10.45$	B2	B1 1 correct bound
	Additional Guidance		
	Accept correct use of recurring decimals for 10.45		
5(a)	$\frac{5}{8}$	B1	oe
5(b)	Alternative method 1		
	$20 \div 5$ or 4 or $5 \div 20$ or $\frac{1}{4}$ or $8 \div 5$ or $\frac{8}{5}$ or $5 \div 8$ or $\frac{5}{8}$	M1	oe
	32	A1	
	Alternative method 2		
	$\frac{20}{y} = \text{their } \frac{5}{8}$	M1	oe
	32	A1ft	ft their $\cos x$ from (a)
	Alternative method 3		
	$\cos^{-1}(\text{their } \frac{5}{8})$ or [51.3, 51.4]	M1	This could be on the diagram or seen in part (a)
	32	A1ft	ft their $\cos x$ from (a)

Q	Answer	Mark	Comments
6	3×21 or 63	M1	
	4×22 or 88	M1	
	their 88 – their 63	M1dep	dependent on M2
	25	A1	
7(a)	0	B1	
7(b)	4×4 or 16	M1	May be implied from a diagram or as the denominator of a fractional answer
	7 (and 7) and 8 or 3	M1	May be shown by exactly 3 outcomes above 6 in a list, grid or table or as the numerator of a fractional answer
	$\frac{3}{16}$ or 0.1875 or 18.75%	A1	oe fraction, decimal or percentage
	Additional Guidance		
	For M1, their (sample space) diagram or table may be blank		
	A 4×4 grid with correct values for at least the 3 numbers over 6 seen or implied. This may be ticks or other indication in the right position on a (sample space) diagram		M1M1
8	Alternative method 1 – Eliminating c		
	$3a - a = 46 - 24$ or $2a = 22$	M1	oe elimination of one variable
	$a = 11$	A1	oe
	$c = 6.50$	A1	oe (condone 6.5 as answer)

Q	Answer	Mark	Comments
8 cont	Alternative method 2 – Eliminating a		
	$6c - 2c = 39 - 13$ or $4c = 26$	M1	oe elimination of one variable
	$c = 6.50$	A1	oe (condone 6.5 as answer)
	$a = 11$	A1	oe
	Alternative method 3 - Substitution		
	$3 \times (24 - 2c) + 2c = 46$ or $72 - 4c = 46$ or $4c = 26$	M1	oe substitution of one variable
	$c = 6.50$	A1	oe (condone 6.5 as answer)
	$a = 11$	A1	oe
	Additional Guidance		
	$a = 11$ and $c = 6.50$	M1A1A1	
	One correct value with one incorrect value (or no second value) and no working eg $a = 11$ and $c = 3.20$ or eg $a = 11$	M1A1A0	
	Embedded, correct values in both equations eg $3 \times 11 + 2 \times 6.5 = 46$ and $11 + 2 \times 6.5 = 24$	M1A1A0	
	Embedded, correct values in one equation only eg $3 \times 11 + 2 \times 6.5 = 46$	M1M0A0	

Q	Answer	Mark	Comments
9	Alternative method 1		
	$\frac{\pi \times 3.6 \times 1.2}{4}$ or [3.39, 3.4]	M1	
	$\frac{\text{their [3.39, 3.4]}}{1.2 \times 3.6} (\times 100)$ or [0.785, 0.787] or 0.79	M1dep	
	[78.5, 78.7] or 79	A1	
	Alternative method 2		
	$\frac{\pi \times 3.6 \times 1.2}{4}$ or [3.39, 3.4]	M1	
	$\frac{1.2 \times 3.6 - \text{their [3.39, 3.4]}}{12 \times 3.6} (\times 100)$ or [21.3, 21.6] or 21	M1dep	
	[78.5, 78.7] or 79	A1	
	Additional Guidance		
	[0.784, 0.785) or [78.4, 78.5) implies M2 – the value may be outside the limits for A1 due to premature rounding		
	Clear statement or intention to convert $\pi/4$ to a percentage implies M2		

Q	Answer	Mark	Comments
10	Alternative method 1		
	32 + 368 or 400	M1	
	$\frac{32}{\text{their } 400}$ or 0.08	M1	oe eg 8%
	8% and the (company)A is correct or Two correct comparable values and (company) A is correct	A1	eg 0.08 and 0.04 $\frac{32}{400}$ and $\frac{16}{400}$ 32 : 400 and 16 : 400
	Alternative method 2		
	32 + 368 or 400	M1	
	$\frac{\text{their } 400}{32}$ or 12.5	M1	
	Two correct comparable values and (company) A is correct	A1	eg 12.5 and 25 $\frac{400}{32}$ and $\frac{400}{16}$ 300 : 32 and 300 : 16
	Alternative method 3		
	32 + 368 or 400	M1	
	$0.04 \times \text{their } 400$	M1dep	
	16 from correct method and 32 and (company) A is correct	A1	
	Additional Guidance		
	In alt 2, 12.5% and 25% instead of 12.5 and 25 cannot get the accuracy mark		M1M1A0
	32/368 and 8.7% and A is correct		M0M1A1

Q	Answer	Mark	Comments
11(a)	Explanation that in $A \times 10^b$ the value of A must be range $1 \leq A < 10$	B1	eg the first part should be 2.0976 Accept the correct conversion to 2.0976×10^5
	Additional Guidance		
	Ignore errors in inequalities given if the written answer shows clear understanding. eg in $a \times b^n$, a must be less than 10, $0 < a > 10$		B1
11(b)	Explanation that the power should be positive	B1	eg the power should be 4, not -4 this gives 0.00020976 Accept the correct conversion to 2.0976×10^5 unless awarded in 1(1a)
	Additional Guidance		
	Allow an incorrect conversion with a correct statement		B1
12	15 : 9 (:4) or (5 :) 3 : $\frac{4}{3}$	M1	Any correct three-part ratio scaled up or down to be comparable eg 45:27:12
	their 15 + their 9 + their 4 or 28	M1dep	Could be multiples of these numbers
	$15 \div 28 = 0.53...$ or 0.54 or 54...% or 15 and (half of 28 is) 14	A1	oe

Q	Answer	Mark	Comments
13	$x = \frac{-7 \pm \sqrt{7^2 - 4 \times 4 \times (-3)}}{2 \times 4}$ or $\left(x + \frac{7}{8}\right)^2 = \frac{97}{64}$	M1	Allow one error Condone missing brackets
	$\frac{-7 \pm \sqrt{7^2 - 4 \times 4 \times (-3)}}{2 \times 4}$ or $\frac{-7 \pm \sqrt{97}}{8}$ or -2.1061.... and 0.3561... or -2.11 or 0.36	A1	oe Fully correct Condone missing brackets 0.3561072252
	-2.11 and 0.36	A1	

Q	Answer	Mark	Comments
14	Alternative method 1		
	[3.1415, 3.14153334]	B1	
	their $3.14153 \div 3.14159 \times 100$ or 99.997... or 99.998...	M1	
	100 – their 99.99...	M1dep	
	[0.0018..., 0.003...]%	A1	
	Alternative method 2		
	[3.1415, 3.14153334]	B1	
	3.14159 – their 3.14153 or [0.00005666, 0.00009]	M1	
	their $0.00005667 \div 3.14159 \times 100$	M1dep	
	[0.0018..., 0.003...]%	A1	
	Alternative method 3		
	[3.1415, 3.14153334]	B1	
	3.14159×0.9999 or 3.1412758... or 3.14159×1.0001 or 3.14190...	M1	
	3.14159×0.9999 or 3.1412758... and [3.1415, 3.14153334]	M1	
	3.14159×0.9999 or 3.1412758... and [3.1415, 3.14153334] and states that value is between lower bound and given value	A1	
	Additional Guidance		
	Numbers in the correct range can come from finding a percentage of their value, which can only gain the B mark.		

Q	Answer	Mark	Comments
15	$e(6 - f) = f + 7$	M1	
	$6e - ef = f + 7$	M1dep	
	$6e - 7 = f + ef$ or $6e - 7 = f(1 + e)$	M1dep	
	$f = \frac{6e - 7}{1 + e}$	A1	oe $d = \frac{-6e + 7}{-1 - e}$
16	Draws the line $y = 3$ as a dashed line	B1	at least from $x = -2$ to $x = 2.5$
	Draws the line $x + y = 1$ as a solid line	B1	at least from $x = -2$ to $x = 1$
	Draws the line $y = 2x - 2$ as a solid line	B1	at least from $x = 1$ to $x = 2.5$
	Correctly labels or shades the region satisfying all three inequalities	B1ft	ft their three lines
	Additional Guidance		
	Only withhold a mark for an incorrect line style on the first occasion With only one or two or with four or more lines drawn it is impossible to score the last B1		
17(a)	Square numbers cannot be prime	B1	oe
	Additional Guidance		
	Accept any correct explanation why square numbers cannot be prime, eg prime numbers have exactly two factors and square numbers have an odd number of factors		
	An incorrect statement, even with a correct statement, scores B0, eg prime numbers cannot be square numbers as prime numbers have no factors		B0
17(b)	51	B1	

Q	Answer	Mark	Comments
18	Alternative method 1		
	$(a =) b - 5$ and $(c =) b + 5$	M1	Allow $(b =) a + 5$ and $(b =) c - 5$
	$(b - 5)(b + 5) + 25$ or $ac \vee (b - 5)(b + 5)$ and $ac = b^2 - 25$	M1	
	$= b^2 - 25 + 25$ and $b^2 - 25 + 25 = b^2$	A1	All steps must be seen SC1 correct numerical example with all steps shown
	Alternative method 2		
	$(b =) a + 5$ and $(c =) a + 10$	M1	Allow $(a =) b - 5$ and $(a =) c - 10$
	$(a)(a + 10) + 25$	M1	
	$= a^2 + 10a + 25$ and $a^2 + 10a + 25 = (a + 5)^2$ and $(a + 5)^2 = b^2$	A1	All steps must be seen SC1 correct numerical example with all steps shown
	Alternative method 3		
	$(b =) c - 5$ and $(a =) c - 10$	M1	Allow $(c =) b + 5$ and $(c =) a + 10$
	$(c)(c - 10) + 25$	M1	
	$= c^2 - 10c + 25$ and $c^2 - 10c + 25 = (c - 5)^2$ and $(c - 5)^2 = b^2$	A1	All steps must be seen SC1 correct numerical example with all steps shown
	Additional Guidance		
	$b = 7, a = 2, c = 12$ and $2 \times 12 + 25 = 49$		0
	$b = 7, a = 2, c = 12$ and $2 \times 12 + 25 = 49$ and $49 = 7^2$		SC1
	$2 \times 12 + 25 = 49$ and $49 = 7^2$		0

Q	Answer	Mark	Comments
19(a)	$x = \frac{4}{\sin 35}$	M1	
	($x =$) 6.97(4...)	A1	
19(b)	$\frac{4}{\sin 35} = \frac{x}{\sin 80}$	M1	oe both fractions inverted or x made subject
	6.86(7...)	A1	
	6.97 and 6.86 and suitable comment	A1	eg they are the same to the nearest cm they are different to one decimal place his answer will give a (slightly) larger length
20	$h = kT^2$	M1	
	$80 = k \times 4^2$ or $80 = k \times 16$	M1	
	$k = \frac{80}{4^2}$ or $k = \frac{80}{16}$ or $k = 5$ or $h = 5T^2$	M1	oe
	($h =$) their 5×7.5^2 or ($T =$) their 5×56.25	M1dep	dependent on first two method marks
	281.25	A1ft	ft their 5 if M1M1M0M1 scored

Q	Answer	Mark	Comments
21	(C has coordinates) (3, 6)	B1	
	(Gradient =) -2	B1	Implied by $y = -2x \dots$
	$\frac{-1}{\text{their gradient}}$ or (Gradient =) $\frac{1}{2}$	M1	Implied by $y = \frac{1}{2}x \dots$
	their 6 = their $\frac{1}{2} \times$ their 3 + c or $c = 4.5$	M1	oe
	$y = \frac{1}{2}x + 4.5$	A1ft	oe $y = \frac{1}{2}(x + 9)$ ft their coordinates of C and their initial gradient if M1M1 scored
	Additional Guidance		
	(Gradient =) $\frac{1}{2}$ or $y = \frac{1}{2}x \dots$ implies the second B mark and the first M mark.		
22(a)	4b	B1	
22(b)	$\vec{ED} = \frac{1}{3}(\mathbf{a} + 3\mathbf{b})$ or $\vec{ED} = \frac{1}{3}\mathbf{a} + \mathbf{b}$	B1	
	$\vec{EC} = \text{their } (\frac{1}{3}\mathbf{a} + \mathbf{b}) - \frac{1}{3}\mathbf{a}$ or $\vec{EC} = \mathbf{b}$	M1	
	Valid justification	A1	eg $\vec{ED} = \frac{1}{3}\mathbf{a} + \mathbf{b}$ and $\vec{EC} = \mathbf{b}$ and $\vec{AB} = 4\vec{EC}$ (so $\vec{AB}$ is a multiple of $\vec{EC}$)
23	$y = x^2 - 2$	B1	

Q	Answer	Mark	Comments
24	$7f(x) = 9x + 4$ or $7f(x) - 4 = 9x$ or $7y = 9x + 4$ or $7y - 4 = 9x$ or $7x = 9y + 4$ or $7x - 4 = 9y$	M1	accept any letter used for y
	$\frac{7f(x)-4}{9} (=x)$ Or $\frac{7y-4}{9} (=x)$	M1	
	$\frac{7x-4}{9}$	A1	Condone $y =$ (or any other letter)
25	Alternative method 1		
	$\frac{1}{2} \times 8 \times 9$ or 36 and 6×9 or 54 or $\frac{1}{2} \times (14 + 6) \times 9$ or 90	M1	oe
	$\frac{1}{2} \times (9 + 6) \times (t - 14)$	M1	oe
	their $36 +$ their $54 + 7.5t - 105 = 7.2t$	M1	oe
	$0.3t = 15$	M1	
	50	A1	

Q	Answer	Mark	Comments
25 cont	Alternative method 2		
	$\frac{1}{2} \times 8 \times 9$ or 36 and 6×9 or 54 or $\frac{1}{2} \times (14 + 6) \times 9$ or 90	M1	oe
	$\frac{1}{2} \times (9 + 6) \times x$ or $7.5x$	M1	oe any letter using x to denote $t - 14$
	their $36 +$ their $54 + 7.5x$ $= 7.2(14 + x)$ or $0.3x = 10.8$ or $x = 36$	M1	oe
	their $36 + 14$	M1	
	50	A1	

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