

INTERNATIONAL GCSE MATHEMATICS

9260/2E

Extension Tier Paper 2E

Mark scheme

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2 3 B Y 9 2 6 0 / 2 E / M S

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Key to mark types and abbreviations

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 $a \leq \text{value} < b$
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.

Q	Answer	Mark	Comments
1	$-\frac{1}{2}$	B1	oe eg -0.5
	Additional Guidance		
	Accept $\frac{-1}{2}$ or $\frac{1}{-2}$		B1

Q	Answer	Mark	Comments
2(a)	7350	B1	

Q	Answer	Mark	Comments
2(b)	7449	B1	

Q	Answer	Mark	Comments
3(a)	Yes and two correct comparable values eg 800 000 and 750 000 or 0.8 million and 0.75 million or $(8 \times 10^5$ and) $7.5(0) \times 10^5$ or 0.8×10^6 and 0.75×10^6 or Yes, it is 50 000 oe bigger	B2	B1 800 000 or 0.8 million or 0.8×10^6 or 750 000 or $7.5(0) \times 10^5$ or 0.75 million or 0.75×10^6
	Additional Guidance		
	Yes can be implied eg 800 000 seen and 750 000 is less		B2

Q	Answer	Mark	Comments
3(b)	1.8×10^{-1}	B2	B1 18×10^{-2} or 0.18 oe or 0.09
	Additional Guidance		
	Correct answer in working with 0.18 on answer line		B1

Q	Answer	Mark	Comments
4	Alternative method 1		
	$\frac{x}{2} = 25 - 1$ or $\frac{x}{2} = 24$ or $x + 2 = 50$	M1	box A
	24×2 or $50 - 2$ or 48	M1dep	box A
	3(their 48 – 30) or 3×18 or 54 and their 48 + 5 or 53	M1	oe substitution in boxes B and C ft their 48 which must be > 30
	54 and 53 and No	A1	
	Alternative method 2		
	$3x - 90 = x + 5$ or $3x - x = 90 + 5$ or $2x = 95$	M1	assuming boxes B and C are equal
	their $95 \div 2$ or 47.5	M1dep	oe
	their $47.5 \div 2 + 1$ or $23.75 + 1$ or 24.75	M1	oe substitution in box A ft their 47.5
	24.75 (and 25) and No	A1	
	Alternative method 3		
	$\frac{x}{2} = 25 - 1$ or $\frac{x}{2} = 24$	M1	box A
	$3x - 90 = x + 5$ or $3x - x = 90 + 5$ or $2x = 95$	M1	assuming boxes B and C are equal
	their 24×2 or 48 or their $95 \div 2$ or 47.5	M1dep	oe dep on either M1
	48 and 47.5 and No	A1	
	Additional Guidance		
	Choose the scheme that favours the student		
	No can be implied eg box B is heavier than box C		

Q	Answer	Mark	Comments
5	$\begin{pmatrix} 5 \\ 0 \end{pmatrix}$	B1	ignore fraction line
	$x = 6$	B1	
	180 and (6, 4)	B1	

Q	Answer	Mark	Comments
6	$\frac{4 \times x}{2}$ or $2x$ or 11×2.5 or 27.5	M1	oe
	$\frac{3}{5} \times 11 \times 2.5$ or $\frac{33}{2}$ or 16.5 or $\frac{4 \times x}{2} \div \frac{3}{5}$ or $\frac{10x}{3}$	M1	oe
	$\frac{4 \times x}{2} = \frac{3}{5} \times 11 \times 2.5$ or $2x = 16.5$	M1dep	oe equation dep on M1M1 $\frac{3}{5} \times 11 \times 2.5 \div 4 \times 2$ oe implies M3
	8.25	A1	

Q	Answer	Mark	Comments
7(a)	0.21×2 or 0.42	M1	oe may be in table
	$1 - 0.21 - 0.15 - \text{their } 0.42$	M1	oe their 0.42 must be < 0.64 implied by four values in table totalling 1
	0.22	A1	may be in table

Q	Answer	Mark	Comments
7(b)	0.21×600 or 126 or 0.15×600 or 90 or $0.21 + 0.15 (\times 600)$ or $0.36 (\times 600)$	M1	oe
	216	A1	
	Additional Guidance		
	Answer $\frac{216}{600}$		M1A0
	Answer 216 out of 600		M1A1

Q	Answer	Mark	Comments
8(a)	Alternative method 1		
	Arc, centre <i>A</i> , radius [7.8, 8.2] cm or arc, centre <i>B</i> , radius [7.8, 8.2] cm	M1	
	Pair of intersecting arcs, radius [7.8, 8.2] cm, centres <i>A</i> and <i>B</i> and <i>AC</i> and <i>BC</i> drawn	A1	
	Alternative method 2		
	Two pairs of intersecting arcs, equal radii > half <i>AB</i>	M1	±2 mm
	Uses the intersecting arcs to draw the perpendicular bisector of <i>AB</i> and Locates correct position of <i>C</i> on the perpendicular bisector and <i>AC</i> and <i>BC</i> drawn	A1	
	Additional Guidance		
	Ignore redundant or incorrect lines/arcs		

Q	Answer	Mark	Comments
8(b)	Alternative method 1		
	Pair of arcs, same radius, centre E , intersecting ED and EF	M1	± 2 mm
	M1 awarded and pair of intersecting arcs, same radius, centred on intersections of original arcs with ED and EF and angle bisector drawn	A1	± 2 mm
	Alternative method 2		
	Arc, centre E , radius ED , intersecting EF	M1	± 2 mm
	M1 awarded and pair of intersecting arcs, same radius, centred on D and the original arc on EF and angle bisector drawn	A1	± 2 mm
	Alternative method 3		
	Pair of arcs, same radius, centre E , intersecting ED and EF	M1	± 2 mm
	M1 awarded and second pair of arcs, same radius, centre E , intersecting ED and EF and two intersecting lines joining arcs on ED and EF and angle bisector drawn	A1	± 2 mm
	Additional Guidance		
	Ignore redundant or incorrect lines/arcs		

Q	Answer	Mark	Comments
9(a)	At least two of 2^3 , 5^2 , 7 selected with 3 not selected eg $2^3 \times 5^2 \times 7$ or 2 2 2 5 5 7 or $2^3 \times 5^2$ or 200 or $5^2 \cdot 7$ or 175 or $2^3 \cdot 7$ or 56	M1	allow 2^3 to be $2 \times 2 \times 2$ or 8 allow 5^2 to be 5×5 or 25 allow 7 to be 7^1 selection is implied by inclusion in intersection of overlapping circles
	1400	A1	
	Additional Guidance		
	For M1 condone selection written as a sum eg $2^3 + 5^2 + 7$		M1
	For M1 allow incorrect power on one of 2, 5 or 7 eg $2^3 \times 5^2 \times 7^2$ or 2 2 5 5 7 or $2^3 + 5 + 7$ or 8, 25, 49 or $4 + 25 + 7$		M1
	Intersecting circles with eg only 25 and 7 in the intersection		M1
	Allow inclusion of 1 for M1 eg $1 \times 2^3 \times 5^2 \times 7$		M1
	Inclusion of 3 in selection eg $2^3 \times 3 \times 5^2 \times 7$		M0
	M1 seen with answer 235 200 (LCM)		M1A0

Q	Answer	Mark	Comments
9(b)	(LCM =) $2 \times p^3$ or $p^3 = 4913$ or $\sqrt[3]{4913}$ or $2 (\times) 17 (\times) 17 (\times) 17$	M1	oe
	17	A1	

Q	Answer	Mark	Comments
10	Alternative method 1		
	42×75 or 3150 or $42 \div 100$ or 0.42	M1	oe implied by 31.5(m)
	$453.6 \div (42 \times 75 \div 100)$ or $453.6 \div (3150 \div 100)$ or $453.6 \div (0.42 \times 75)$ or $453.6 \div 31.5$ or 14.4	M1dep	actual width oe
	their $14.4 \div 75$ or 0.192 or their 14.4×100 or 1440	M1dep	oe
	19.2	A1	oe
	Alternative method 2		
	$453.6 \div 75^2$ or 0.08064 or 453.6×100^2 or 4 536 000	M1	oe
	$453.6 \div 75^2 \times 100^2$ or 0.08064×100^2 or $4 536 000 \div 75^2$ or 806.4	M1dep	drawing area (cm ²) oe
	their $806.4 \div 42$	M1dep	
	19.2	A1	oe

Alternative methods 3 and 4 and Additional Guidance on the next page

Q	Answer	Mark	Comments
10 cont	Alternative method 3		
	$453.6 \div 75^2$ or 0.08064	M1	drawing area (m ²) oe
	$42 \div 100$ or 0.42	M1	drawing length (m) oe
	their 0.08064 $\div$ their 0.42 or 0.192	M1dep	drawing width (m) oe dep on M2
	19.2	A1	oe
	Alternative method 4		
	453.6×100^2 or 4 536 000	M1	actual area (cm ²) oe
	42×75 or 3150	M1	actual length (cm) oe implied by 31.5(m)
	their 4 536 000 $\div$ their 3150 or 1440	M1dep	actual width (cm) oe dep on M2
	19.2	A1	oe
	Additional Guidance		
	Use of a linear scale factor on an area or an area scale factor on a linear value needs to be recovered eg1 $453.6 \div 75 \times 100 = 604.8$ eg1 $453.6 \div 75 \times 100 = 604.8$, $604.8 \div 42$ or 14.4		M0 M1M1

Q	Answer	Mark	Comments
11(a)	$3x - ax = 2 - y$ or $y - 2 = ax - 3x$	M1	
	$x(3 - a) = 2 - y$ or $y - 2 = x(a - 3)$ or $\frac{2 - y}{3 - a}$ or $\frac{y - 2}{a - 3}$	M1dep	oe single fraction
	$x = \frac{2 - y}{3 - a}$ or $x = \frac{y - 2}{a - 3}$	A1	oe single fraction with $x =$
	Additional Guidance		
	$x = \frac{2 - y}{3 - a}$ in working with $\frac{2 - y}{3 - a}$ on answer line		M1M1A1
	$x = \frac{2 - y}{3 - a}$ followed by incorrect further work		M1M1A0

Q	Answer	Mark	Comments
11(b)	$(2a + 10)(2a - 10)$ or $4(a^2 - 25)$	M1	oe partial factorisation eg $2(a + 5)(2a - 10)$ or $(4a + 20)(a - 5)$ brackets in either order
	$4(a + 5)(a - 5)$	A1	brackets in either order
	Additional Guidance		
	Allow multiplication signs throughout eg $4 \times (a + 5) \times (a - 5)$		M1A1
	Condone missing final bracket throughout eg $4(a^2 - 25$		M1

Q	Answer	Mark	Comments
12	$45.1 \div 10 \times 6$ or 27.06	M1	oe
	21.5×0.2 or 4.3	M1	oe
	31.36	A1	

Q	Answer	Mark	Comments
13(a)	-5	B1	

Q	Answer	Mark	Comments
13(b)	$w^{2r+\frac{1}{3}}$	M1	
	$2r + \frac{1}{3} = \frac{1}{2}$ or $\frac{1}{2} - \frac{1}{3}$ or $\frac{1}{6}$	M1dep	oe
	$\frac{1}{12}$	A1	
	Additional Guidance		
	Condone 0.33(3...) for $\frac{1}{3}$, and 0.16(6...) or 0.17 for $\frac{1}{6}$		
	Ignore conversion attempt after correct fraction seen		

Q	Answer	Mark	Comments
13(c)	$y^{\frac{3n}{5}}$ or $y^{\frac{5}{3}(n-3)}$	M1	oe eg $y^{0.6n}$
	$\frac{3}{5}n = n - 3$	M1dep	oe equation eg $n = \frac{5}{3}(n-3)$
	$3n = 5n - 15$ or $n - \frac{3}{5}n = 3$	M1dep	oe equation with elimination of fractions or collection of terms
	$\frac{15}{2}$ or $7\frac{1}{2}$ or 7.5	A1	

Q	Answer	Mark	Comments
14	Alternative method 1		
	30×8 or 240 or 15×12 or 180	M1	oe eg $240x$ or $180y$
	$15 \times 12 : 30 \times 8$ or $30 \times 8 : 15 \times 12$ or $4 : 3$ or $\frac{4}{3} : 1$ or $1 : \frac{3}{4}$	M1dep	oe eg $240x = 180y$ or $x = \frac{180y}{240}$ or $4x = 3y$ allow as fractions eg $\frac{240}{180}$
	$3 : 4$ or $1 : \frac{4}{3}$ or $\frac{3}{4} : 1$	A1	
	Alternative method 2		
	$\frac{30}{15}$ or $\frac{15}{30}$ or $\frac{8}{12}$ or $\frac{12}{8}$	M1	oe
	$\frac{30}{15} \times \frac{8}{12}$ or $\frac{240}{180}$ or $\frac{4}{3}$ or $\frac{15}{30} \times \frac{12}{8}$ or $\frac{180}{240}$ or $\frac{3}{4}$	M1dep	oe
	$3 : 4$ or $1 : \frac{4}{3}$ or $\frac{3}{4} : 1$	A1	
	Additional Guidance		
	Alt 1 For first M1 only unless recovered condone the same letter used for both heights eg $240x$ $180x$		M1

Q	Answer	Mark	Comments
15(a)	$-12 \leq f(x) \leq 4$	B1	

Q	Answer	Mark	Comments
15(b)	$y = 2$ drawn or marks on the x -axis at $[0.5, 0.7]$ and $[3.3, 3.5]$ or $[0.5, 0.7]$ or $[3.3, 3.5]$	M1	implied by marks on the curve where $y = 2$
	$[0.5, 0.7]$ and $[3.3, 3.5]$	A1	
	Additional Guidance		
	$([0.5, 0.7], 2)$ and $([3.3, 3.5], 2)$		M1A0

Q	Answer	Mark	Comments
16	At least 2 correct frequency densities $\frac{19}{10}$ or 1.9 $\frac{27}{5}$ or 5.4 $\frac{30}{5}$ or 6(.0) $\frac{24}{20}$ or 1.2	M1	may be implied by heights of bars
	Fully correct histogram with linear vertical scale labelled or correct key shown.	A2	$\pm \frac{1}{2}$ square A1 at least 3 bars correct or no labels on vertical axis but bars in correct proportions
	Additional Guidance		
	Non-linear vertical scale		max M1

Q	Answer	Mark	Comments
17	180 – 80 – 56 or 44	M1	
	$\frac{x}{\sin 80} = \frac{7}{\sin(\text{their } 44)}$	M1	oe equation in x their 44 cannot be 80 and must be from 180 – 80 – 56 or be marked in the correct position on the diagram eg $x^2 = 7^2 + \left(\frac{7\sin 56}{\sin 44}\right)^2 - 2 \times 7 \times \frac{7\sin 56}{\sin 44} \times \cos 80$
	$\frac{7\sin 80}{\sin(\text{their } 44)}$	M1dep	oe eg $\sqrt{7^2 + \left(\frac{7\sin 56}{\sin 44}\right)^2 - 2 \times 7 \times \frac{7\sin 56}{\sin 44} \times \cos 80}$
	[9.9, 9.924]	A1	accept 10 with M2 awarded
	Additional Guidance		
	Answer 10 from a value not in the range [9.9, 9.924] is A0		

Q	Answer	Mark	Comments
18	$\frac{2-5}{18-6}$ or $\frac{5-2}{6-18}$ or $-\frac{3}{12}$ or $-\frac{1}{4}$	M1	oe method to find gradient of ST eg $5 = 6m + c$ and $2 = 18m + c$ with correct method to solve the equations and m evaluated implied by $y = -\frac{1}{4}x...$
	$\frac{-1}{\text{their } -1/4}$ or 4	M1	ft their non-zero gradient of ST implied by $y = 4x...$
	$5 = \text{their } 4 \times 6 + c$ or $c = -19$ or $y - 5 = \text{their } 4 \times (x - 6)$	M1dep	oe dep on second M1 ft their perpendicular gradient
	$y = 4x - 19$	A1	
	Additional Guidance		
	If $y = mx + c$ and simultaneous equations are used to find the gradient of ST , ignore c if m evaluated correctly		
	$m = 4$ and $c = -19$		M1M1M1A1

Q	Answer	Mark	Comments
19	Alternative method 1 – considers values above and below 3		
	Correctly substitutes an x -value < 3 into $x^2 - 9$ or correctly substitutes an x -value > 3 into their $x^2 - 9$ or $x^2 - 9 < 0$ for x (slightly) < 3 or $x^2 - 9 > 0$ for $x > 3$	M1	eg $2^2 - 9$ or $4^2 - 9$
	$x^2 - 9$ correctly evaluated for their x -value < 3 and $x^2 - 9$ correctly evaluated for their x -value > 3 and Minimum point or $x^2 - 9 < 0$ for x (slightly) < 3 and $x^2 - 9 > 0$ for $x > 3$ and Minimum point	A1	eg ($x = 2$ gives) -5 and ($x = 4$ gives) 7 and Minimum point
	Alternative method 2 – works out the 2nd derivative		
	$2x$	M1	
	6 and Minimum point	A1	
	Additional Guidance		
	When substituting in decimal values for x allow $\frac{dy}{dx}$ values to be rounded or truncated to any degree of accuracy		

Q	Answer	Mark	Comments
20	17 and 18	B3	B2 17 or 18 or $(2m =) 10, 12, 14, 16$ (and $5 \leq m < \frac{1}{2}a$) or $(m =) 5, 6, 7, 8$ (and $5 \leq m < \frac{1}{2}a$) or $a > 16$ or $a \geq 17$ B1 $5 \leq m < \frac{1}{2}a$ or $5 \leq m \dots$ and $(m =) 5, 6, 7, 8$ or $5 \leq m \dots$ and $(2m =) 10, 12, 14, 16$

Q	Answer	Mark	Comments
21(a)	Alternative method 1		
	$(3^3)^{16}$ or 3^{48}	M1	
	1 with M1 seen	A1	
	Alternative method 2		
	Last digit pattern of 7, 9, 3, and 1	M1	last digit pattern for 27^m or 7^m
	1 with M1 seen	A1	
	Additional Guidance		
	In alt 2 the pattern could be consecutive powers of 7 or 27 eg 1 7 49 343 2401 eg 2 27 729 19683 531441 14348907 387420489		M1

Q	Answer	Mark	Comments
21(b)	(Last digit of $3^{31} =$) 7 or (last digit of $3^{30} =$) 9 or $3^{30} \times (3 - 1)$ or $3^{30} \times 2$ or 9×2 or 18 or $17 - 9$	M1	
	8	A1	
	Additional Guidance		
	7 – 9 scores M1		
	9 – 7 is M0 unless evidence of M1 seen		

Q	Answer	Mark	Comments
22	Alternative method 1		
	$10x = 0.38(38\dots)$ or $100x = 3.83(83\dots)$ or $1000x = 38.38(38\dots)$	M1	oe multiplication by a power of 10 any letter
	$1000x - 10x = 38.38(38\dots) - 0.38(38\dots)$ or $990x = 38$ with $1000x = 38.38(38\dots)$ and $10x = 0.38(38\dots)$ seen or $100x - x = 3.83(83\dots) - 0.03(83\dots)$ or $99x = 3.8$ with $100x = 3.83(83\dots)$ seen	M1dep	oe subtraction to eliminate recurring digits
	$\frac{38}{990} = \frac{19}{495}$ or $\frac{3.8}{99} = \frac{19}{495}$	A1	with M2 awarded
	Alternative method 2		
	$0.\overline{38} = \frac{38}{99}$	M1	
	$\frac{38}{99} \div 10 = \frac{38}{990}$	M1dep	
	$\frac{38}{990} = \frac{19}{495}$	A1	with M2 awarded
	Additional Guidance		
	Use of x may be implied eg $100 \times 0.038(38\dots) = 3.83(83\dots)$ $99 \times 0.03(83\dots) = 3.8$	M1 M1	

Q	Answer	Mark	Comments
23(a)	$1 - 0.45$ or 0.55	M1	oe
	their 0.55×0.64	M1	oe their 0.55 must be > 0 and < 1
	$0.35(2)$	A1	oe fraction, decimal or percentage
	Additional Guidance		
	0.45×0.64 or 0.288		M0M1

Q	Answer	Mark	Comments
23(b)	0.64×0.62 or 0.3968 or $0.4(0)$ or $(1 - 0.64) \times 0.81$ or 0.36×0.81 or $0.29(16)$ or 0.292	M1	oe
	$0.64 \times 0.62 + (1 - 0.64) \times 0.81$ or $0.3968 + 0.2916$ or $0.4(0) + 0.29$	M1dep	oe
	$0.688(4)$ or 0.69	A1	oe fraction, decimal or percentage

Q	Answer	Mark	Comments
24	$12x + x(20 + x)$ or $20x + x(12 + x)$ or $12x + 20x + x^2$ or $(x + 12)(x + 20) - 240$	M1	oe
	$x^2 + 32x \leq 50$ or $x^2 + 32x - 50 = 0$	M1dep	oe inequality or equation with brackets expanded and terms collected
	$(x + 16)^2 - 256 (\leq 50)$ or $x + 16 \leq \pm\sqrt{306}$ or $\frac{-32 \pm \sqrt{32^2 - 4(\times 1) \times -50}}{2(\times 1)}$ or $\frac{-32 \pm \sqrt{1224}}{2}$ or 1.4928... (and -33.4928...)	M1	method must be using their 3-term quadratic condone positive root only
	1.49	A1	

Q	Answer	Mark	Comments
25	$x^4 - 5$	M1	
	$4x^3$ or $2x$	M1	oe eg $2 \times x$
	$4x^3 + 2x$ or $x(4x^2 + 2)$ or $2x(2x^2 + 1)$	A1	oe
	Additional Guidance		
	Accept correct use of product or quotient rule		
	$4x^3 - 5 + 2x$ with no previous working		M0M1A0
	$x^4 - 5 + x^2$ followed by $4x^3 - 5 + 2x$		M1M1A0
	$5x^4 - 5 + 2x$		M0M1A0

Q	Answer	Mark	Comments
26	$10^2 + 10^2$ or 200 or $\sqrt{10^2 + 10^2}$ or $\sqrt{200}$ or $10\sqrt{2}$ or 14.1(4...) or $5^2 + 5^2$ or 50	M1	oe eg $10 \div \cos 45$
	$0.5 \times \sqrt{10^2 + 10^2}$ or $\sqrt{5^2 + 5^2}$ or $\sqrt{50}$ or $5\sqrt{2}$ or 7.07... or 7.1	M1dep	oe eg $5 \div \cos 45$ or $10 \times \cos 45$
	$\tan x = \frac{16}{\text{their } 7.07...}$ or $90 - \tan^{-1} \frac{\text{their } 7.07...}{16}$	M1dep	oe eg $\sin x = \frac{16 \times \sin 90}{\sqrt{\sqrt{5^2 + 5^2}^2 + 16^2}}$ allow any letter for x
	[66, 66.2]	A1	

Q	Answer	Mark	Comments
27	$316\,000 \times k = 316\,000 + 27\,000$ or $316\,000 \times k = 343\,000$ or $\frac{343\,000}{316\,000}$ or 1.0854...	M1	oe equation or calculation eg $316\,000 \times c^3 = 316\,000 + 27\,000$ or $1 + \frac{27\,000}{316\,000}$ any letter for k or c
	$\sqrt[3]{\frac{343\,000}{316\,000}}$ or [1.0276, 1.02771]	M1dep	oe
	2.8(%)	A1	
	Additional Guidance		
	$\frac{316\,000}{343\,000}$ or 0.921... is M0 unless recovered eg $\frac{1}{0.921...}$ scores M1		
	T & I scores 3 or zero		