

OXFORD

INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL GCSE MATHEMATICS CORE 9260/2C

Paper 2C

Mark scheme

November 2019

Version: 1.0 Final



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 Examiner.

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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	24	B1										
2	$\frac{x}{2} - 10$	B1										
3	$\frac{20}{36}$	B1										
4	$x = a - 3$	B1										
5	$x + 61 + 80 + 90 = 360$ or $360 - (61 + 80 + 92)$ or $360 - 233$	M1	oe									
	127	A1										
	Additional Guidance											
6	<table><tr><td>6</td><td>1</td><td>8</td></tr><tr><td>7</td><td>5</td><td>3</td></tr><tr><td>2</td><td>9</td><td>4</td></tr></table>	6	1	8	7	5	3	2	9	4	B2	B1 6 or 2 correct
	6	1	8									
	7	5	3									
2	9	4										
Additional Guidance												

Q	Answer	Mark	Comments
7	True	B1	
	False	B1	
	False	B1	
	Additional Guidance		
	Allow a cross if it is the only answer in that row		
	If a combination of a tick and a cross are used in a row then mark the tick		
8(a)	1.5×1000 or 1500 or $800 \div 1000$ or 0.8 or 2300	M1	
	2.3	A1	
	Additional Guidance		
	801.5		MOA0

Q	Answer	Mark	Comments
8(b)	Alternative method 1		
	4 min 30 s $\times$ 2 or 8 min 60 s or 9	M1	oe eg 4.5×2 condone 4.3(0) used for 4 min 30 s
	4 min 30 s $\times$ 2 + 4 min 30 s or 12 min 90 s or 13 min 30 s	M1dep	oe eg $9 + 4.5$ or 13.5 4 min 30 s $\times$ 3 or 4.5×3 scores M2
	13 min 30 s and Yes	A1	oe eg 13.5 and Yes
	Alternative method 2		
	14 min – 4 min 30 s or 9 min 30 s	M1	oe eg $14 - 4.5$ or 9.5 condone 4.3(0) used for 4 min 30 s
	$\frac{\text{their 9 min 30 s}}{2}$ or 4 min 45 s	M1dep	oe eg $9.5 \div 2$ or 4.75
	4 min 45 s and Yes	A1	oe eg 4.75 and 4.5 and Yes
	Alternative method 3		
	14 min – 4 min 30 s or 9 min 30 s	M1	oe eg $14 - 4.5$ or 9.5 condone 4.3(0) used for 4 min 30 s
	4 min 30 s $\times$ 2 or 8 min 60 s or 9	M1	oe eg 4.5×2
	9 min 30 s and 9 min and Yes	A1	oe eg 9.5 and 9 and Yes
	Additional Guidance		
	Allow working in seconds but in alt 1 to award the final mark, if 810 s is not converted to 13 min 30 s it will be necessary to convert 14 min to 840 s		
	Yes may be implied by a written statement including 'less than 14 min'		
	4.3(0) used for 4 min 30 s is a maximum of M1M0A0 unless recovered		
	$4.3(0) \times 2 = 9$ $9 + 4.3(0) = 13.3(0) = 13 \text{ min } 30 \text{ s}$		M1M1
	$4.3(0) \times 2 = 9$ $9 + 4.3(0) (= 13.3(0) (\text{min}))$		M1M0

Q	Answer	Mark	Comments
9	Always true Sometimes true Always true Never true	B4	B1 for each row
	Additional Guidance		
		Always true	Sometimes true
		Never true	
	$5x$ is negative	☒	☐
	$x + 4$ is positive	☐	☒
	x^2 is positive	☒	☐
	$2 - x$ is negative	☐	☒
Allow a cross if it is the only answer in that row			
If a combination of a tick and a cross are used in a row then mark the tick			

Q	Answer	Mark	Comments																																																	
10(a)	<table><tr><td>×</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>1</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>2</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td></tr><tr><td>3</td><td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td></tr><tr><td>4</td><td>4</td><td>8</td><td>12</td><td>16</td><td>20</td><td>24</td></tr><tr><td>5</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td><td>30</td></tr><tr><td>6</td><td>6</td><td>12</td><td>18</td><td>24</td><td>30</td><td>36</td></tr></table>	×	1	2	3	4	5	6	1	1	2	3	4	5	6	2	2	4	6	8	10	12	3	3	6	9	12	15	18	4	4	8	12	16	20	24	5	5	10	15	20	25	30	6	6	12	18	24	30	36	B2	B1 at least 6 correct
	×	1	2	3	4	5	6																																													
	1	1	2	3	4	5	6																																													
	2	2	4	6	8	10	12																																													
3	3	6	9	12	15	18																																														
4	4	8	12	16	20	24																																														
5	5	10	15	20	25	30																																														
6	6	12	18	24	30	36																																														
Additional Guidance																																																				
10(b)	8 and 6 and Yes or $\frac{8}{36}$ and $\frac{6}{36}$ and Yes	B2ft	oe B1ft 8 or 6 or $\frac{8}{36}$ or $\frac{6}{36}$ ft their completed table for B2 or B1																																																	
	Additional Guidance																																																			
	8 or $\frac{8}{36}$ must not be for the prime numbers 6 or $\frac{6}{36}$ must not be for the square numbers																																																			
	8 and 6 or associated probabillities must not be from clearly incorrect lists of square numbers and prime numbers																																																			
11(a)	Alternative method 1																																																			
	0.35 × 2040 or 714	M1	oe																																																	
	2040 – their 714	M1dep																																																		
	1326	A1																																																		
	Alternative method 2																																																			
	1 – 0.35 or 0.65	M1	oe																																																	
	2040 × their 0.65	M1dep	oe																																																	
	1326	A1																																																		
	Additional Guidance																																																			
	1326 in working but 714 on answer line		M1M1A0																																																	

Q	Answer	Mark	Comments
11(b)	Alternative method 1		
	$400 - 172$ or 228	M1	
	their $228 \div 38$ or 6	M1dep	
	7	A1	
	Alternative method 2		
	Any correct trial for more than two days	M1	implied by a correct answer
	$172 + (6 \times 38) = 400$	M1dep	oe
	7	A1	
	Additional Guidance		
	Answer 7 with no incorrect working	M1M1A1	
	Answer 6 with no incorrect working	M1M1A0	
	$172 + (6 \times 38) = 400$ with no other working	M1M1	
	Examples of trials $172 + (2 \times 38) = 248$ $172 + (7 \times 38) = 438$ $172 + (3 \times 38) = 286$ $172 + (8 \times 38) = 476$ $172 + (4 \times 38) = 324$ $172 + (9 \times 38) = 514$ $172 + (5 \times 38) = 362$ $172 + (10 \times 38) = 552$ $172 + (6 \times 38) = 400$		

Q	Answer	Mark	Comments
12	Alternative method 1		
	$180 - 38$ or 142	M1	oe
	their $142 \div 2$ or 71	M1dep	oe
	109	A1	
	Alternative method 2		
	$180 + 38$ or 218	M1	oe
	their $218 \div 2$	M1dep	oe
	109	A1	
	Alternative method 3		
	$x + x + 38 = 180$ or $y + y - 38 = 180$	M1	oe equation in one unknown
	$(x =) \frac{180 - 38}{2}$ or $\frac{142}{2}$ or 71 or $(y =) \frac{180 + 38}{2}$ or $\frac{218}{2}$	M1dep	oe
	109	A1	
	Additional Guidance		
	Answer 109	M1M1A1	
	In an algebraic method condone use of incorrect letter for method marks eg $y + y + 38 = 180$ leading to $(y =) 71$	M1M1	

Q	Answer	Mark	Comments
13	$8ab$	B2	B1 ($2 \times a \times b =$) $2ab$ or ($6a \times b =$) $6ab$ or (answer =) $8 \times a \times b$ or (answer =) $8a \times b$ or (answer =) $a \times 8b$ or (answer =) $8 \times ab$
	Additional Guidance		
	$8ab$ followed by further incorrect work eg $8ab = 8 + ab$		B1
	B1 response for one correct term followed by further incorrect work for that term scores B0 eg $2ab + 6b = 2b + 6b$		B0
14	Alternative method 1		
	9.5×0.88 or 8.36	M1	oe eg in cents 9.5×88 or 836
	$14.99 -$ their 8.36 or 6.63	M1dep	oe 1499 – their 836 or 663
	their $6.63 \div (25 - 9.5)$ or 0.42(7...) or 0.428 or 0.42 or 0.43	M1dep	oe their 663 $\div (25 - 9.5)$ or 42.(7...) or 42.8 or 42
	43	A1	
	Alternative method 2		
	25×0.88 or 22	M1	oe eg in cents 25×88 or 2200
	their $22 - 14.99$ or 7.01	M1dep	oe their 2200 – 1499 or 701
	$0.88 -$ (their $7.01 \div (25 - 9.5)$) or $0.88 - 0.45(2...)$ or 0.42(7...) or 0.428 or 0.42 or 0.43	M1dep	oe $88 -$ (their $701 \div (25 - 9.5)$) or $88 - 45.(2...)$ or 42.(7...) or 42.8 or 42
	43	A1	
	Additional Guidance		
	43 with no incorrect working		M1M1M1A1
	9.5×0.88 even if not subsequently used		M1
	$25 \div 9.5 \times 0.88$ with no other relevant working		M0
	$14.99 \div 25$ with no other relevant working		M0

Q	Answer	Mark	Comments
15(a)	55	B1	
	Additional Guidance		
15(b)	55×2 or 110 or $55 + 360 - 125$ or 290	M1	ft their 55 from part (a)
	70	A1ft	ft their 55 from part (a) provided the answer is positive
	Additional Guidance		
	Allow calculations using particular values for a and b provided they sum to their 55 eg $a = 30$ $b = 25$ giving $30 \times 2 + 25 \times 2$ (could go on to score M1A1)		M1

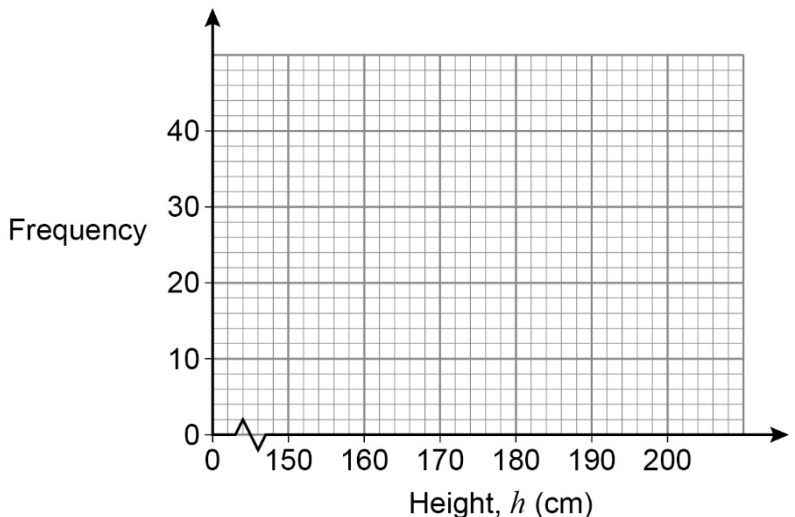
Q	Answer	Mark	Comments
16	Alternative method 1		
	$\frac{135}{360} \times 1800$ or 675	M1	oe
	$1800 - \text{their } 675$ or 1125	M1dep	
	375	A1	
	Alternative method 2		
	$360 - 135$ or 225	M1	
	their $225 \div 3$ or 75 or $\frac{\text{their } 225}{360} \times 1800$ or 1125	M1dep	oe
	375	A1	
	Alternative method 3		
	$1 - \frac{135}{360}$ or $\frac{225}{360}$	M1	oe fraction, decimal or percentage
	their $\frac{225}{360} \div 3$ or $\frac{75}{360}$ or $\frac{\text{their } 225}{360} \times 1800$ or 1125	M1dep	oe fraction, decimal or percentage
	375	A1	
	Additional Guidance		
	Values may be seen in an equation eg $3x = 360 - 135$ (M1) $y + 2y = 1125$ (M1M1)		

Q	Answer	Mark	Comments
17(a)	$30 \times 24 \times 60$ or 43 200 or $24 \times 60 \div 92$ or [15.6, 15.7]	M1	oe eg $24 \div (92 \div 60)$ or $24 \div 1.53(3\dots)$
	their $43\,200 \div 92$ or their $[15.6, 15.7] \times 30$ or 469.5(...) or 469.6	M1dep	oe
	469	A1	
	Additional Guidance		
	1.32 (h) used for 92 min can score a maximum of M1M0A0		
	$24 \times 60 \div 92 = 15$ and 15×30		M1M1
	$30 \times 24 \div 1.53(3\dots)$ full calculation		M1M1
	$30 \times 24 \div 1.32$ full calculation but using 1.32 h for 92 min		M1M0
	$24 \div 1.32$ (using 1.32 h for 92 min)		M1M0
	15 orbits (per day) stated with no working or 15 orbits (per day) from a build-up method (to 23 h)		M0
17(b)	$2.76 \times 10^4 \times 24 \times 7$	M1	oe
	4 636 800 or 4 637 000 or 4.6368×10^6	A1	oe eg 46.368×10^5
	4 640 000 or 4.64×10^6	B1ft	oe eg 464×10^4 ft any answer seen with more than 4 sf correctly rounded to 3 sf
	Additional Guidance		
	$(2.76 \times 10^4 \times 24 \times 7 =) 4\,640\,000$ (oe)		M1A1B1
	$2.76 \times 10^4 \times 7 = 193\,200$ Answer 193 000		M0A0B1ft

Q	Answer	Mark	Comments
18	Reflect(ion) in AC or reflect(ion) in $x = 4$	B2	B1 reflect(ion) or triangle correctly reflected on diagram or B reflected to $(6, 6)$ on diagram or $(6, 6)$ given as the coordinates of the reflection of B
	Additional Guidance		
	The image of B may be referred to as B' or with another letter eg D		
	$(6, 6)$ and other coordinates given for B		B0

19(a)	$[111, 113]$ or $[72, 76]$	M1	correct conversion of either value
	$[111, 113]$ and Thailand or $[72, 76]$ and Thailand	A1	accept 120 for Thailand
	Additional Guidance		
	$[111, 113]$ or $[72, 76]$ may be written on the graph		
	Points marked on the line at $(70, \dots)$ or $(\dots, 120)$ with no indication of $[111, 113]$ or $[72, 76]$ on the graph or in the working is M0 unless there is a descriptive interpretation of the points		
	Allow approximate values to be given eg 70 mph is around 110 km/h		M1

Q	Answer	Mark	Comments
19(b)	Alternative method 1 Using UK or Thailand values from (a)		
	$\frac{120}{\text{their } [72, 76]}$ or $\frac{\text{their } [111, 113]}{70}$	M1	ft their value in (a)
	[1.5, 1.7]	A1ft	oe simplified fraction or mixed number ft their value in (a)
	Alternative method 2 Using gradient of graph		
	Attempt at gradient	M1	triangle drawn on graph and their $\frac{\text{vertical}}{\text{horizontal}}$ both values $\pm \frac{1}{2}$ small square
	[1.5, 1.7]	A1	oe simplified fraction or mixed number
	Alternative method 3 Using a point from the graph		
	Reads a point from the graph and <u>their y value</u> their x value	M1	$\pm \frac{1}{2}$ small square
	[1.5, 1.7]	A1	oe simplified fraction or mixed number
	Additional Guidance		
	Allow an equation eg $y = 1.6x$	M1A1	
	Readings from the graph must be within tolerance eg $150 \div 90 = 1.66$ (190 is not in tolerance)	M0A0	

Q	Answer	Mark	Comments
20(a)	grouped and continuous	B1	
20(b)	3 or 4 correct plots	M1	(155, 10), (165, 34), (175, 32), (185, 11) within $\pm \frac{1}{2}$ small square condone plots consistently positioned incorrectly at or between the class boundaries eg all at upper bounds
	4 correct plots joined with straight lines to form a frequency polygon	A1	within $\pm \frac{1}{2}$ small square must be at midpoints
	Additional Guidance		
			M1A1
	Mark intention for straight lines		
	Ignore (155, 10) joined to (0, 0) or to (150, 0) and ignore (185, 11) joined to (195, 0) or to (190, 0) but any other extra lines score A0		
	For M1 extra points may be ignored if not used to make the polygon		
	Two points plotted and joined with a vertical line eg (170, 30) joined to (170, 34)		M0A0
	Histogram		M0A0

Q	Answer	Mark	Comments
21	250%	B1	
22	5	B1	
23	12^2 and 5^2 seen or 144 and 25 seen or 119	M1	
	$\sqrt{12^2 - 5^2}$ or $\sqrt{\text{their } 144 - \text{their } 25}$ or $\sqrt{119}$	M1dep	oe
	[10.9, 10.91]	A1	
	Additional Guidance		
	12 cm ² is not 12^2 unless recovered		
	$12^2 = 24$ and $5^2 = 10$, $\sqrt{24 - 10}$		M1M1A0
	$\sqrt{12^2 + 5^2}$ or $\sqrt{144 + 25}$ or $12^2 + 5^2$ or $144 + 25$		M1M0A0
	Only $\sqrt{169}$ or only 169 or only 13		M0
	Using trigonometry		M0
	Using scale drawing		M0
24(a)	2, 3, 4, 5, 6 in any order	B2	B1 4 correct and 1 missing eg 2, 3, 4, 5 or 5 correct and 1 incorrect eg 1, 2, 3, 4, 5, 6 or $1 < x \leq 6$ oe inequality (x any letter)
	Additional Guidance		
	$2 \leq x \leq 6$		B1
	2 errors eg 1, 2, 3, 4, 5		B0

Q	Answer	Mark	Comments
24(b)	-64	B1	
	Additional Guidance		
25	$\frac{1}{5} \times 80$ or 16 or 28 in $(B \cup D)'$	M1	oe eg 16 seen in $B \cap D$
	their 16 + 28 or 44	M1dep	their 16 must be from a correct method may be implied by $80 - 16 - 28$
	$2x + \text{their } 44 = 80$ or $\frac{80 - \text{their } 44}{2}$ or $\frac{36}{2}$ or 18	M1dep	oe eg 18 seen in $B \cap D'$ or 18 seen in $D \cap B'$
	34	A1	
	Additional Guidance		
	A fully correct Venn diagram will scored at least M3		
	16 (with no method shown) seen anywhere in Venn diagram implies M1		
	36 without working is not enough to imply the 44		
	34 on answer line (even if 16, 18 and 28 in Venn diagram are in incorrect places)		M1M1M1A1
	34 on answer line with incorrect numbers in Venn diagram		M1M1M1A1
	18 seen in both $B \cap D'$ and $D \cap B'$ in Venn diagram (even if 16 and 28 are incorrectly placed) and answer line not 34		M1M1M1A0
	18 with no incorrect working		M1M1M1
	44 with no incorrect working		M1M1
	16 + 28 + 22 without seeing 44		M1M0

Q	Answer	Mark	Comments
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26(a)	$(3 - x)(3 + x)$	B1	oe fully factorised expression
	Additional Guidance		

26(b)	Alternative method 1		
	$\frac{1}{10} \times (10 + 10)$ or $\frac{1}{10} \times 20$ or $\frac{1}{10} \times 10 + 1$ or $1 + 1$	M1	oe correct expression using $\frac{1}{1/10} = 10$
	2	A1	
	Alternative method 2		
	$10x + 1$	M1	
	2	A1	
	Additional Guidance		

26(c)	$12x^3y + 3xy^3$	B2	B1 one term correct
	Additional Guidance		
	Condone $12 \times x^3 \times y + 3 \times x \times y^3$ for B1 only		B1
	Further work following a B2 answer		B1
	Further work following a B1 answer		B1

Q	Answer	Mark	Comments
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27(a)	$\frac{7}{25}$	B1	
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27(b)	Valid reason	B1	eg C was the biggest sample
	Additional Guidance		
	More men in C		B1
	The sample size of C is large		B1
	More trials in C		B1
	More men completed in C		B0
	More men in C and more completed the program		B0
	It's more accurate		B0
	It has the lowest probability		B0

27(c)	'Women' ticked and valid comparison	B1	eg 0.24 or 0.24(6...) or 0.247 or 0.25 or (0.38 × 200 =) 76
	Additional Guidance		
	The comparison must be using sample C or a combination of samples that includes sample C		
	If the comparison is based on relative frequencies, they must be in comparable form, eg 24% and 38%		
	'Women' ticked and 0.38 is more than 0.3 and 0.28 and 0.24		B1
	Calculations must be correct eg $0.38 \times 200 = 76$		B0
	'Women' ticked and 0.38 is more than 0.3		B0
	'Women' ticked and 0.38 is more than 0.28		B0