

GCSE

Applications of Mathematics (Linked Pair Pilot)

93702H

Unit 2: Higher Tier

Mark scheme

93702H

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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 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.

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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.
- M dep** A method mark dependent on a previous method mark being awarded.
- 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.
- 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 $\frac{1}{2}$
- [a, b]** Accept values between a and b inclusive.

A2 Higher Tier

Q	Answer	Mark	Comments
1	Alternative method 1		
	$150 \div 6$ or 25 (1 person)	M1	150×2 or 300 (12 people) or $\frac{150}{2}$ or 75 (3 people)
	their 25×15	M1dep	their 300 + their 75 or their 75×5
	375	A1	
	Alternative method 2		
	$15 \div 6$ or 2.5	M1	
	their 2.5×150	M1dep	
	375	A1	
	2	$2 \times \pi \times 9.15$ or 57.4 or 57.5(0)	M1
18.3π or [57.46, 57.5]		A1	Accept 57 if correct method seen

Q	Answer	Mark	Comments
3(a)	Any correct equation e.g.1 $2x + x + 96 + 96 = 360$ e.g.2 $3x + 192 = 360$ e.g.3 $x + \frac{1}{2}x + 96 = 180$	B1	
	Correct rearrangement of their equation to the form $ax = b$ or $\frac{360 - 96 - 96}{3}$	M1	$3x = 168$ or $\frac{3}{2}x = 84$ oe if B1 Follow through their equation of form $px + q = r$ a, b, p, q and r all non-zero
	56	A1ft	ft their $ax = b$ if M1 gained

Q	Answer	Mark	Comments
<p>3(b)</p>	<p>Fully correct explanation</p> <p>e.g.1 Labels large rectangle a and b or labels diagonals of kite a and b</p> <p>Area rectangle = $a \times b$</p> <p>Area kite = $\frac{1}{2} \times$ product of diagonals</p> $= \frac{1}{2} \times a \times b$ <p>e.g.2 Labels each part of top edge with w and the side parts with x and y</p> <p>Area rectangle = $2w(x + y)$</p> $= 2wx + 2wy$ <p>Area kite = $\frac{1}{2} wx + \frac{1}{2} wx + \frac{1}{2} wy$</p> $+ \frac{1}{2} wy$ $= wx + wy$ <p>e.g.3 Draws both diagonals of kite and indicates there are 4 pairs of equal areas</p> <p>e.g.4 Draws at least one diagonal of the kite and states that the area of a triangle is half the area of a rectangle</p> <p>e.g.5 Uses compatible numbers and correctly works out areas of kite and rectangle</p> <p>For example</p> <p>Labels each part of top edge with 4 and the side parts with 3 and 6</p> <p>Rectangle area = $8 \times 9 = 72$</p> <p>Kite area = $0.5 \times 8 \times 3 + 0.5 \times 8 \times 6$</p> $= 12 + 24 = 36$	<p>B2</p>	<p>B1 Partially correct statement or correct step towards correct explanation</p> <p>e.g.1 Labels large rectangle a and b or labels diagonals of kite a and b</p> <p>Area rectangle = $a \times b$</p> <p>Area kite = $\frac{1}{2} \times a \times b$</p> <p>e.g.2 Labels each part of top edge with w and the side parts with x and y</p> <p>Area rectangle = $2w(x + y)$</p> <p>Area kite = $\frac{1}{2} wx + \frac{1}{2} wx + \frac{1}{2} wy + \frac{1}{2} wy$</p> <p>e.g.3 Draws both diagonals of kite</p> <p>e.g.4 Uses compatible numbers and works out areas of kite and rectangle with correct method but makes arithmetic error(s)</p> <p>For example</p> <p>Labels each part of top edge with 4 and the side parts with 3 and 6</p> <p>Rectangle area = $8 \times 9 = 82$</p> <p>Kite area = $0.5 \times 8 \times 3 + 0.5 \times 8 \times 6$</p> $= 12 + 24 = 36$

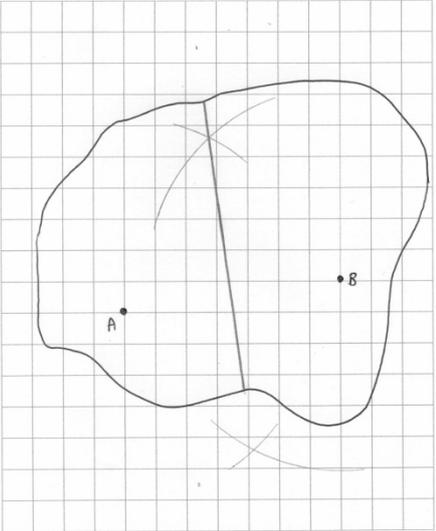
Q	Answer	Mark	Comments
4	Alternative method 1		
	(60mph) → 96 (km/h)	B1	288 (km) → 180 (miles)
	288 (km) ÷ their 96 (km/h) or 3(h)	M1	their 180 (miles) ÷ 60 (mph) or 3 (h)
	10.45 (am) + their 3(h) or 1.45 (pm) or 2 (pm) – their 3(h) or 11(.00 am) or 2 (pm) – 10.45 (am) or 3.25(h) or 3h 15min	M1	Condone 3.15(h)
	Yes and their 1.45 (pm) or Yes and their 11(.00 am) or Yes and their 3(h) and their 3.25(h) or Yes and their 15 minutes	A1ft	ft B0 M2 Only ft their 96 (km/h) or their 180 miles
	Alternative method 2		
	(60mph) → 96 (km/h)	B1	
	2 (pm) – 10.45 (am) or 3.25(h) or 3h 15min	M1	Condone 3.15(h)
	288 (km) ÷ their 3.25(h) or [88, 89] (km/h)	M1	
	Yes and their [88, 89] (km/h) and their 96 (km/h)	A1ft	ft B0 M2 Only ft their 96 (km/h)

Q	Answer	Mark	Comments
4	Alternative method 3		
	2 (pm) – 10.45 (am) or 3.25(h) or 3h 15min	M1	Condone 3.15(h)
	288 (km) ÷ their 3.25(h) or [88, 89] (km/h)	M1	
	[88, 89] (km/h) → [54, 56] (mph)	B1ft	ft their [88, 89] (km/h)
	Yes and [54, 56] (mph)	A1	
	Alternative method 4		
	2 (pm) – 10.45 or 3.25(h) or 3h 15min	M1	Condone 3.15(h)
	60 (miles) × their 3.25(h) or 195 (miles)	M1	
	195 (miles) → 312 (km)	B1ft	ft their 195 (miles)
	Yes and 312 (km)	A1	

Q	Answer	Mark	Comments
4	Alternative method 5		
	(60mph) → 96 (km/h)	B1	
	10.45 (am) + their 3(h) or 1.45 (pm) or 2 (pm) – their 3 (h) or 11(.00)(am) or 2 (pm) – 10.45 (am) or 3.25(h) or 3h 15min	M1	Condone 3.15(h)
	their 96 (km/h) × their 3.25(h) or 312 (km)	M1	
	Yes and their 312 (km)	A1ft	ft B0 M2 Only ft their 96 (km/h)
	Alternative method 6		
	288 (km) → 180 (miles)	B1	
	2 (pm) – 10.45 (am) or 3.25(h) or 3h 15min	M1	Condone 3.15(h)
	their 180 (miles) ÷ their 3.25 or [55, 56] or 60 (miles) × their 3.25(h) or 195 (miles)	M1	
	Yes and their [55, 56] or Yes and their 180 (miles) and 195 (miles)	A1ft	ft B0 M2 Only ft their 180 (miles)

Q	Answer	Mark	Comments
5(a)	64	B1	Any unambiguous indication
5(b)	064	Q1ft	Strand (i) Must have 0 as first digit ft their (a)
5(c)	angle $CBP =$ their 64 where P is a point due North of B or angle $ABQ =$ their 64 where Q is a point due South of B	M1	(angle $ABC =$) $180 - 2 \times$ their 64 or $116 -$ their 64 or 52 ft their 64 from (a)
	$360 -$ their 64	M1	$360 - 116 +$ their 52 or $180 +$ their 64 + their 52 or $270 + \frac{\text{their } 52}{2}$
	296	A1ft	Only ft their 64 from (a) and M2 scored
6(a)	$\frac{1}{2} \times (3.4 + 5) \times 3$ or 12.6	M1	oe Full correct method for one trapezium
	their 12.6 $\times 2$	M1dep	oe Full correct method for cross section $(3.4 + 5) \times 3$ with no further method is M2
	25.2	A1	SC1 50.4
6(b)	$360 \div$ their 25.2 or 14.2(85)	M1	
	[14.2857, 14.3] or 14.4	A1ft	ft their 25.2 Accept 14 if correct method seen

Q	Answer	Mark	Comments
7(a)	Valid explanation e.g.1 3 or 3.4 labelled in correct place on the x -axis and marking on graph corresponding to $V = 50$ e.g.2 3 labelled in correct place on the x -axis and markings on graph corresponding to $x = 3$ and $x = 4$	B2	oe B1 Partial explanation e.g.1 Marking on graph corresponding to $V = 50$ e.g.2 Markings on graph corresponding to $x = 3$ and $x = 4$ SC1 Marking on graph corresponding to $40 < V < 80$ (not 50) with 3 or value between 3 and 4 labelled in correct place on the x -axis
7(b)	Two correct trials [3.25, 3.35] which bracket 50 and 3.3 as the answer	B3	B2 Two correct trials [3.25, 3.35] which bracket 50 and 3.3 not the answer or Two correct trials [3.3, 3.4] which bracket 50 and 3.3 as the answer B1 One correct trial $3 < x < 4$
8(a)	70 – 22 – 22 or 26 seen	M1	26 may be seen on the diagram
	572	A1	
8(b)	Smooth curve passing through (0, 0), (5, 300), (10, 500), (15, 600), (17.5, 612.5), (20, 600), (25, 500), (30, 300) and (35, 0)	B2	B1 Any six points plotted correctly from (0, 0), (5, 300), (10, 500), (15, 600), (17.5, 612.5), (20, 600), (25, 500), (30, 300) and (35, 0) All points within half a square Points can be implied by a graph
8(c)	area \div 0.75	M1	$0 < \text{area} \leq 650$
	[816, 817]	A1	
	816	B1ft	ft value or calculation seen rounded down to nearest integer SC1 612.5 seen

Q	Answer	Mark	Comments
9	Two pairs of intersecting arcs with equal radii from centres <i>A</i> and <i>B</i>	M1	
	Straight line between the intersecting arcs (may go outside the island and/or not be all the way across the island)	A1	
	Line goes all the way across the island but no further	Q1ft	

Q	Answer	Mark	Comments
10	4 packs of bread rolls and 25 packs of sausages	B3	<p>B2 $4n$ packs of bread rolls and $25n$ packs of sausages where n is an integer > 2 e.g. 8 packs of bread rolls and 50 packs of sausages</p> <p>B1 Works out a common multiple of 8 and 25 e.g.1 8, 80, 160, 200 and 25, 50, 100, 200, 250 e.g.2 $8 \times 25 = 200$ e.g.3 $2^3 \times 5^2 = 200$ or Indicates a valid number of bread rolls and sausages i.e. $100m$ bread rolls and $200m$ sausages where m is an integer > 0</p> <p>SC2 25 packs of bread rolls and 4 packs of sausages</p>

Q	Answer	Mark	Comments
11	Any two correct expressions from $7x - 42$ $5x - 6$ $2x + 48$ (allow $2x + 42 + 6$)	B2	Any one correct expression from $7x - 42$ $5x - 6$ $2x + 48$ (allow $2x + 42 + 6$)
	Forms a correct equation using at least one of their expressions e.g.1 $7x - 42 = 5x - 6$ e.g.2 $5x - 42 = 2x + 48$ e.g.3 $7x - 42 + 5x - 6 = 2(2x + 48)$	M1	their expressions must be of the form $ax + b$ a and b both non-zero Award B2 M1 for any of the following $3(7x - 42) = 14x$ or $3(5x - 6) = 14x$ or $3(2x + 48) = 14x$ Award B2 M0 for $7x - 42 + 5x - 6 + 2x + 48 = 14x$
	Collects terms correctly for their equation e.g.1 $7x - 5x = -6 + 42$ e.g.2 $5x - 2x = 48 + 42$ e.g.3 $21x - 14x = 126$ e.g.4 $7x + 5x - 4x = 96 + 42 + 6$	M1	oe
	18	A1	

Q	Answer	Mark	Comments
12	$2.5^2 - 2^2$ or $2.5^2 = BD^2 + 2^2$	M1	oe e.g. working in metres
	2.25 or 1.5	A1	oe
	$3.4^2 +$ their 2.25 or $3.4^2 +$ their 1.5^2 or 13.81	M1	oe
	$\sqrt{3.4^2 + \text{their } 2.25}$	M1	oe Condone $\sqrt{3.4^2 \pm \text{their } 2.25^2}$ or $\sqrt{3.4^2 - \text{their } 1.5^2}$
	[3.7, 3.72]	A1	Allow as further work [3.7, 3.72] + 2 + 2.5 + 3.4 = [11.6, 11.62]
13	$\pi \times 11 \times 18$	M1	Allow this mark if they add on $\pi \times 11^2$
	[621.7, 622.12] or 198π	A1	
	620 or 200π	B1ft	ft value or calculation or expression seen > 2sf
14	14 (metres) and 7 (metres) seen	B1	Check the diagram
	their $14 \times$ their 7×1.5 or 147	M1	147 implies B1 M1
	$0.5 \times \pi \times$ their $7^2 \times 2.8$ or 68.6π or [215.4, 216]	M1	
	their 147 + their [215.4, 216]	M1	Must add two volumes with at least one of previous M marks gained
	[362.4, 363] or $147 + 68.6\pi$	A1	Accept 362 with correct method seen

Q	Answer	Mark	Comments
15(a)	$0.5 \times 20 \times 5$ or 50 or 5×50 or 250 or $0.5 \times 40 \times 5$ or 100 or $0.5 \times 5 \times (110 + 50)$	M1	oe Working may be on the diagram e.g.1 Trapezium rule e.g.2 Attempt to count squares and convert to a distance For example $0.5 \times 2 \times 5 = 5$ and their 5×10
	$0.5 \times 20 \times 5 + 5 \times 50 + 0.5 \times 40 \times 5 = 400$ or $50 + 250 + 100 = 400$ or $0.5 \times 5 \times (110 + 50) = 400$	A1	oe

Q	Answer	Mark	Comments
15(b)	Alternative method 1		
	$0.5 \times 60 \times 6$ or 180	M1	oe Distance for first 60 seconds
	$0.5 \times 60 \times 6 + 50 \times 6$ or 480	M1	oe Distance for first 110 seconds This mark implies the first M1 $0.5 \times (110 + 50) \times 6$ is M2
	480 and Yes	A1	
	Alternative method 2		
	$0.5 \times 60 \times 6$ or 180	M1	oe Distance for first 60 seconds
	$(400 - \text{their } 180) \div 6$ or [36, 37] or $(400 - \text{their } 180) \div 50$ or 4.4 or Correctly builds up to a distance ≥ 400	M1	Remaining distance \div speed \rightarrow time or Remaining distance \div time \rightarrow speed
	[96, 97] and Yes or 4.4 and Yes or Correct time for their build up and Yes	A1	

Q	Answer	Mark	Comments
16	Alternative method 1		
	$\tan 20 = 38.3 \div BD$ or $\tan 70 = BD \div 38.3$	M1	
	$(BD =) 38.3 \div \tan 20$ or $38.3 \times \tan 70$ or [105.2, 105.3]	M1	This mark implies the first M1
	$\tan 12 = 38.3 \div AD$ or $\tan 78 = AD \div 38.3$	M1	
	$(AD =) 38.3 \div \tan 12$ or $38.3 \times \tan 78$ or [180.1, 180.2]	M1	This mark implies the third M1
	[74.9, 74.96]	A1	Only accept 75(.0) on the answer line if [74.9, 74.96] seen in working
	Alternative method 2		
	$\sin 20 = 38.3 \div BC$ or $\cos 70 = 38.3 \div BC$	M1	oe
	$(BC =) 38.3 \div \sin 20$ or $38.3 \div \cos 70$ or [111.9, 112]	M1	oe This mark implies the first M1
	$\frac{d}{\sin 8} = \frac{\text{their 112}}{\sin 12}$	M1	oe
	$\frac{\text{their 112}}{\sin 12} \times \sin 8$	M1dep	dep on third M1 This mark implies the third M1
	[74.9, 74.96]	A1	Only accept 75(.0) on the answer line if [74.9, 74.96] seen in working

Q	Answer	Mark	Comments
16	Alternative method 3		
	$\sin 12 = 38.3 \div AC$ or $\cos 78 = 38.3 \div AC$	M1	oe
	$(AC =) 38.3 \div \sin 12$ or $38.3 \div \cos 78$ or [184.2, 184.213]	M1	oe This mark implies the first M1
	$\frac{d}{\sin 8} = \frac{\text{their [184.2, 184.213]}}{\sin 160}$	M1	oe
	$\frac{\text{their [184.2, 184.213]}}{\sin 160} \times \sin 8$	M1dep	dep on third M1 This mark implies the third M1
	[74.9, 74.96]	A1	Only accept 75(.0) on the answer line if [74.9, 74.96] seen in working
	Alternative method 4		
	$\sin 20 = 38.3 \div BC$ or $\cos 70 = 38.3 \div BC$	M1	oe $\sin 12 = 38.3 \div AC$ or $\cos 78 = 38.3 \div AC$
	$(BC =) 38.3 \div \sin 20$ or $38.3 \div \cos 70$ or [111.9, 112]	M1	oe $(AC =) 38.3 \div \sin 12$ or $38.3 \div \cos 78$ or [184.2, 184.213]
	their $BC^2 + \text{their } AC^2 -$ $2 \times \text{their } BC \times \text{their } AC \times \cos 8$ or [5618.8, 5619]	M1	
	$\sqrt{\text{their [5618.8, 5619]}}$	M1dep	dep on third M1
	[74.9, 74.96]	A1	Only accept 75(.0) on the answer line if [74.9, 74.96] seen in working

Q	Answer	Mark	Comments
17(a)	[6, 6.5]	B1	
17(b)	Tangent drawn at $m = 3$	B1	
	vertical change \div horizontal change	M1	For their tangent
	[1.8, 2.4]	A1ft	ft B0 M1 ft their tangent

Q	Answer	Mark	Comments
18(a)	Alternative method 1		
	20 ÷ 32 or 0.625	M1	32 ÷ 20 or 1.6
	their 0.625 × 24.8	M1dep	24.8 ÷ their 1.6
	15.5	A1	
	Alternative method 2		
	24.8 ÷ 32 or 0.775	M1	32 ÷ 24.8 or [1.29, 1.3]
	their 0.775 × 20	M1dep	20 ÷ their [1.29, 1.3]
	15.5	A1	
18(b)	Alternative method 1		
	$\left(\frac{37}{32}\right)^3$ or 1.15625^3 or $\frac{V_1}{37^3} = \frac{V_2}{32^3}$	M1	oe
	[1.54, 1.55] or [154(%), 155(%)]	A1	
[1.54, 1.55] and [54(%), 55(%)] and decision or [154(%), 155(%)] and decision or [1.54, 1.55] and 1.5(0) and decision	Q1ft	Strand (iii) ft their [1.54, 1.55] or their [154(%), 155(%)] if M1 gained SC1 $37^3 : 32^3$	

Q	Answer	Mark	Comments
18(b)	Alternative method 2		
	$\left(\frac{32}{37}\right)^3$ or $(0.86486\dots)^3$	M1	oe
	[0.64, 0.65]	A1	
	[0.64, 0.65] and [66(%), 67(%)] and decision or [0.64, 0.65] and [0.66, 0.67] and decision	Q1ft	Strand (iii) ft their [0.64, 0.65] if M1 gained SC1 $37^3 : 32^3$
	Alternative method 3		
	32 ³ × 1.5 or 49 152 and 37 ³ or 50 653 or 32 ³ or 32 768 and 37 ³ ÷ 1.5 or [33768, 33 769]	M1	oe
	49 152 and 37 ³ or 50 653 or [33768, 33 769] and 32 ³ or 32 768	A1	
	49 152 and 50 653 and decision or [33768, 33 769] and 32 768 and decision	Q1ft	Strand (iii) ft their 49 152 and their 50 653 if M1 gained or ft their [33768, 33 769] and their 32 768 if M1 gained SC1 $37^3 : 32^3$

Q	Answer	Mark	Comments
18(b)	Alternative method 4		
	$\frac{37^3 - 32^3}{32^3}$ or $\frac{50\,653 - 32\,768}{32\,768}$	M1	oe
	[0.54, 0.55] or [54(%), 55(%)]	A1	
	[0.54, 0.55] and [54(%), 55(%)] and decision or [54(%), 55(%) and decision or [0.54, 0.55] and 0.5 and decision	Q1ft	Strand (iii) ft their [0.54, 0.55] or [54(%), 55(%) if M1 gained SC1 $37^3 : 32^3$
	Alternative method 5		
	$\sqrt[3]{1.5}$ or 1.14471... and $\frac{37}{32}$ or 1.15625	M1	
	1.14471... and 1.15625	A1	
	1.14471... and 1.15625 and decision	Q1ft	Strand (iii) ft their 1.14471... and their 1.15625 if M1 gained SC1 $37^3 : 32^3$