



GCSE MARKING SCHEME

SUMMER 2016

**GCSE MATHEMATICS LINEAR PAPER 1
HIGHER TIER**

4370/05

INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCSE Mathematics - Linear Paper 1 Higher Tier
Summer 2016 Mark Scheme

Summer 2016 Linear Paper 1 Higher Tier	Marks	Comments															
1. 105(°)	B3	<p>Allow even if contradicted on the diagram</p> <p>B2 for sight of 75(°) (including as a final response or incorrectly placed on the diagram)</p> <p>B2 for sight of 105(°) in working not as an answer or contradicted as a final response in the answer space</p> <p>B2 for working: $38 + 67$ or $180 - 75$, or the intention of either calculation, allowing missing brackets $180 - (180 - 38 - 67) (= 38 + 67)$ or $180 - (180 - 38 - (180 - 113)) (= 180 - 75)$, or</p> <p>OR</p> <p>B1 for any further unambiguous correct angle indicated on the diagram: 113(°), 67(°), 38(°) or 142(°), or B1 for working: $180 - 38 - 67$ or $113 - 38$ or $180 - 38 - (180 - 113)$, or equivalent</p>															
<p>2. $400 \times 7 \div 10$ or $400 - 400 \times 3 \div 10$ or equivalent 280(cm)</p> <p>$280 \times \frac{3}{5}$ or $280 - 280 \times 2 \div 5$ or $280 - 112$ 168(cm)</p> <p>56 (cm)</p>	<p>M1 A1</p> <p>M1 A1</p> <p>B1</p>	<p>May be implied in further calculation Incorrect working leading to 280 is M0 A0, e.g. $3/10 \times 400 + 2/5 \times 400 = 120 + 160 = 280$</p> <p>FT 'their 280' provided < 400 May be implied in further calculation</p> <p>FT 'their 168' $\div 3$ correctly evaluated (rounded or truncated) provided either at least M1 previously awarded or 'their two stages of calculations' previously attempted (However if $3/10$ & $2/5$ used throughout SC marks may be awarded instead of possible B1 if a higher mark can be awarded)</p> <p>For consistent use of $3/10$ and $2/5$ award: SC3 for an answer of 16(cm from $400 \times 3/10 \times 2/5 \div 3$), or SC2 for workings equivalent to $400 \times 3/10 \times 2/5 \div 3$ (may be in stages), or SC1 for an answer of 48(cm from $400 \times 3/10 \times 2/5$)</p>															
3(a) Descriptions of no correlation, e.g. 'no relationship', 'no correlation', 'none', 'no connection'	B1	<p>Do not accept '(all) scattered (about)', or 'random', or 'neutral', 'no pattern'</p> <p>Allow if a correct response is given with one of the phrases listed above. Do not allow a correct response with an incorrect response, e.g. 'none but slightly positive'</p>															
<p>3(b)</p> <table border="1"> <thead> <tr> <th>Name</th><th>Height (cm)</th><th>Mark</th></tr> </thead> <tbody> <tr> <td>Dewi</td><td>145</td><td>80</td></tr> <tr> <td>Charlotte</td><td>163</td><td>80</td></tr> <tr> <td>Henri</td><td>176</td><td>92</td></tr> <tr> <td>Gareth</td><td>145</td><td>34</td></tr> </tbody> </table>	Name	Height (cm)	Mark	Dewi	145	80	Charlotte	163	80	Henri	176	92	Gareth	145	34	B3	<p>All entries correct Accept mark entries as a fraction of 100, or written as a percentage</p> <p>B2 for any 5, 6 or 7 entries correct, or if the correct entries in the table but they are in reversed columns, OR</p> <p>B1 for any 3 or 4 entries correct, or for any 5, 6 or 7 reversed entries in the table</p>
Name	Height (cm)	Mark															
Dewi	145	80															
Charlotte	163	80															
Henri	176	92															
Gareth	145	34															

Summer 2016 Linear Paper 1 Higher Tie	Marks	Comments
4(a) Correct reflection	B2	B1 for the sight of the line $x = 1$, or a reflection in any vertical line or in the line $y = 1$ B0 if more than one triangle drawn, unless all are reflections in a vertical line
4(b) Correct enlargement Correct position	B2 B1	B1 for any 2 adjacent lines or any 3 points correct in appropriate positions Intention of correct placement, i.e. with appropriate rays seen, or correct positioning of at least two vertices Penalise consistent incorrect scale factor -1
5(a)(i) $6n + 9$	B2	Condone change of variable, letter and/or case, for B2 or B1 B1 for sight of $6n$
5(a)(ii) $-4n + 34$ or $34 - 4n$	B2	Condone change of variable, letter and/or case, for B2 or B1 B1 for sight of $-4n$ or $+34$
5(a)(iii) $n^2 - 2$	B2	Condone change of variable, letter and/or case, for B2 or B1 B1 for sight of n^2 (that is $1n^2$) or showing second difference of 2 at least twice
5(b) 103	B3	Look at the answer space first for the candidate's response Only award B3 if the candidate is indicating 103 as their response Accept ' $n = 22$ gives a <u>value</u> of 103' in the answer space, or in working and not contradicted in the answer space B2 for $n > 85/4$, or response ($n =$) 22 (sight of 103 is not required), or for trial $n=21$ with 99 seen, or for trial $n=23$ with 107 seen. Trial or selection of ($n=$) 22 and 103 in working, without stating 103 as the answer (e.g. in the answer space), is awarded B2 OR B1 for sight of $4n + 15 > 100$, or for sight of ($n =$) 21.25 or ($n=$) $85/4$, or for at least 2 trials of $n \geq 10$ with terms calculated correctly, or for any 2 of the values 59, 63, 67, 71, 75, 79, 83, 87, 91, 95, 99 seen within a sequence
6. Accurate perpendicular bisector constructed with all necessary arcs Accurate bisection with evidence of all necessary arcs and an angle $45^\circ (\pm 2^\circ)$	B1 B2	No marks if no arcs or spurious arcs Accept 1 pair of arcs with a correct midpoint Accept a construction of 90° with arcs from a measured midpoint Tolerance is $\pm 2\text{mm}$ and $\pm 2^\circ$ B1 for pair of arcs on appropriate lines with an attempt at the next step, but some inaccuracy

Summer 2016 Linear Paper 1 Higher Tie	Marks	Comments
7. (% of daily calories 25% of 1920 =) 480 (calories)	B1	
(Number of bags needed) 480÷160	M1	FT 'their 480' provided attempt at $1920 \div 25 \div 100$ or $1920 \div 4$ or equivalent is seen or implied
(=) 3	A1	May be implied in later working
(Number of almonds eaten 3×20) ×20	m1	
60 (almonds)	A1	FT 'their 3'×20 evaluated provided attempt to find 25% of 1920 and M1, m1 previously awarded
		<u>Alternatives</u>
		(% of daily calories 25% of 1920 =) 480 (calories) B1
		160÷20 M1
		= 8 (calories per almond) A1
		(May be implied in later working)
		(Number of almonds) 480÷8 m1
		(FT 'their 25% of 1920'÷ 'their 160÷20')
		60 (almonds) A1
		(FT provided attempt to find 25% of 1920 and M1, m1 previously awarded)
		<u>or</u>
		(Number of bags in a full daily allowance is)
		1920÷160 M1
		= 12 (bags) A1
		(May be implied in later working)
		(Number of bags 25% of allowance is $\frac{1}{4} \times 12 =$) 3 (bags) B1
		(FT 'their $\frac{1}{4} \times 1920 \div 160$ provided M1 previously awarded)
		(Number of almonds eaten) 3 × 20 m1
		(FT 'their $\frac{1}{4} \times 1920 \div 160$ '×20 provided M1 previously awarded)
		(Previous B1 & m1 calculations may be seen in either order)
		60 (almonds) A1
		(FT provided attempt to find 25% of $1920 \div 160$ and M1, m1 previously awarded)
		<u>or</u>
		20 (almonds) with 160 (calories) used as a ratio M1
		e.g. sight of 40 almonds is 320 calories or similar
		Use of ratio or multiples that lead to 1920 (calories) m1
		240 (almonds is 1920 calories) A1
		(Number of almonds is) $\frac{1}{4} \times 240$ M1
		(FT provided M1, m1 previously awarded)
		60 (almonds) A1
		(FT provided M1, m1 previously awarded AND attempt to find the number of almonds in 1920 calories)
		<u>If no marks, and no incorrect logic seen, then award SC2 for an answer of 60 almonds</u>

Summer 2016 Linear Paper 1 Higher Tie	Marks	Comments
<p>QWC2: Candidates will be expected to</p> <ul style="list-style-type: none"> present work clearly, with words explaining process or steps <p>AND</p> <ul style="list-style-type: none"> make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer <p>QWC1: Candidates will be expected to</p> <ul style="list-style-type: none"> present work clearly, with words explaining process or steps <p>OR</p> <ul style="list-style-type: none"> make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer 	QWC 2	<p>QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar.</p> <p>QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar</p> <p>OR</p> <p>evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar.</p> <p>QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.</p>
<p>8(a) $5x - 3x = 65 - 17$ $2x = 48$ $x = 24$</p>	B1 B1 B1	<p>FT until 2nd error, then stop marking</p> <p>Must be simplified if possible for this final B1 mark</p>
<p>8(b) $x/4 = 28 - 12$ or $x/4 = 16$ or $x + 12 \times 4 = 28 \times 4$ $x = 64$</p>	M1 A1	<p>Mark final answer</p> <p>Accept embedded answer, e.g. $64/4 + 12 = 28$</p>
<p>8(c) $y^2 + 8y$</p>	B2	<p>$y \times y$ must be written as y^2 & $8 \times y$ as $8y$ for B2</p> <p>B1 for $y \times y + 8 \times y$, or</p> <p>B1 for 1 correct term, e.g.</p> <p>$2y + 8y = 10y$ or $y + 8y = 9y$</p> <p>BUT do not accept from incorrect working, e.g.</p> <p>B0 for '$y + 8 = 8y$'</p> <p>Mark final answer, e.g. B1 only for '$y^2 + 8y = 8y^3$'</p>
<p>8(d) $y(3y - 1)$</p>	B1	<p>Mark final answer</p>
<p>8(e) $10x < 34$ or $10x < 42 - 8$ $x < 34/10$ or $x < 3.4$ or $x < 3^4/10$ or $x < 3^2/5$ or equivalent</p>	B1 B1	<p>Do not accept '='</p> <p>FT from 1 error only. ISW</p> <p><i>If '=' used but replaced by '<' to give final correct answer, allow B2</i></p> <p>Note: $10x < 42 + 8$ must lead to $x < 5$ to be awarded B0,B1</p>
<p>9(a) Method with at least 2 correct prime factors Sight of correct factors (2, 2, 3, 3, 11) $2^2 \times 3^2 \times 11$ or $2^2 \cdot 3^2 \cdot 11$</p>	M1 A1 B1	<p>2 correct primes before 2nd error</p> <p>Ignore 1s seen</p> <p>FT their factors (with at least one index >1 used).</p> <p>Do not ignore 1s.</p>
<p>9(b) $(y =) 66$</p>	B2	<p>FT from (a), provided equivalent difficulty</p> <p>B1 for $2 \times 3 \times 11$ or for 4356 or for 11 in the box or answer space</p>
<p>10(a) $1/8$</p>	B1	
<p>10(b) 3.6×10^5</p>	B1	
<p>10(c) 0.0054</p>	B1	

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11(a) $5w = h - t$ $w = \frac{h-t}{5}$ or equivalent	B1 B1	FT from $5w = h + t$ or similar 1 error made Award B1, B0 for an answer of $w = h - t \div 5$
11(b) $aw + 3 = 4bw + 20$ $aw - 4bw = 20 - 3$ OR $3 - 20 = 4bw - aw$ $w(a - 4b) = 17$ OR $-17 = w(4b - a)$ $w = \frac{17}{a - 4b}$ OR $\frac{-17}{4b - a} = w$	B1 B1 B1 B1	Includes correct expansion FT until 2 nd error Mark final answer. Do not accept a numerator $20 - 3$
12(a)(i) Using $0.7 \times \dots = 0.63$ or sight of $0.63 \div 0.7$ or $0.63/0.7$ $P(\text{necklace}) = 0.9$ or equivalent	M1 A1	
12(a)(ii) Tree completed correctly (0.3, 0.9, 0.1, 0.9, 0.1 on appropriate branches)	B2	FT their '0.9', this could be 0.63 and 0.37 on second pairs of branches B1 for 0.3 with at least one other pair of branches total of 1
12(b) 0.3×0.1 $= 0.03$	M1 A1	FT attempt to multiply appropriate probabilities, provided no probability > 1 FT for correct evaluation, provided not > 1
13(a) 225 (people)	B1	Allow 224 (people)
13(b) $(100 \times) 50 \div 400$ or equivalent $12\frac{1}{2}(\%)$ or $12.5(\%)$	M1 A1	If no marks allow SC1 for an answer of 87.5(%), i.e. percentage less than 15 seconds
13(c) (Median) Answers in the range 9.4 to 9.5 (seconds) (Interquartile range) 13.25 to 13.35 - 6.75 to 6.8 6.45 to 6.6 (seconds)	B1 M1 A1	Check working, do not assume correct calculation from sight of an answer in the given range
14. Sight of $x(x - 6) = -5$ $x^2 - 6x + 5 = 0$ $(x - 1)(x - 5) (= 0)$ $x = 1$ AND $x = 5$ or equivalent	B2 B1 M2 A1	Allow choice of a variable other than x Accept intention of brackets (invisible but used later) B1 for sight of $x(x - 6)$ or $x^2 - 6x$ Implies previous B2. Must be an equation Accept as an expression. See* below. M1 for $(x \dots 1)(x \dots 5)$ FT from their pair of brackets, equivalent level of difficulty Do not FT from incorrect working that leads to $(x - 1)(x - 5)$ If M0 A0, allow SC1 for answers 1 and 5 from trial & improvement or inspection If formula used, then M1 for correct substitution (allowing 1 slip in substitution), M1 for <i>simplification of 'b²-4ac' to 16</i> , finally A1 for correct solutions simplified but surds not required *For final M2 & A1, FT from their quadratic equation (or expression) provided equivalent difficulty and has been <i>derived from '... = -5'</i> .

Summer 2016 Linear Paper 1 Higher Tie	Marks	Comments
<p>15. $\hat{DAB} = 180(^{\circ}) - w(^{\circ})$, stated or indicated on the diagram Cyclic quadrilateral (opposite angles sum is 180°)</p> <p>$\hat{XAY} = \hat{DAB} = 180(^{\circ}) - w(^{\circ})$, stated or indicated, OR a statement 'vertically opposite angles' or 'equal angles with intersecting lines'</p> <p>$\hat{XOY} = 2(180(^{\circ}) - w(^{\circ}))$ or $\hat{XOY} = 360(^{\circ}) - 2w(^{\circ})$</p> <p>Angle at centre is twice angle at circumference</p>	<p>B1</p> <p>E1</p> <p>B1</p> <p>B1</p> <p>E1</p>	<p>Allow $w(^{\circ}) = 180(^{\circ}) - \hat{DAB}$</p> <p>Depends on previous B1</p> <p>Accept indication by arcs, or both angles indicated by the same 'value' or expression.</p> <p>Implies award of previous B1 ISW working towards reflex \hat{XOY} Do not accept $2 \times 180(^{\circ}) - w(^{\circ})$ (with missing brackets) or equivalent FT 'their angle at the centre' being indicated as twice 'their angle at the circumference' provided equivalent level of difficulty, i.e. at least 2 terms multiplied by 2 involved with any brackets required shown</p> <p>Only accept 'reflex $\hat{XOY} = 2w(^{\circ})$' if stated as reflex without contradiction on the diagram, or $2w(^{\circ})$ indicated as reflex \hat{XOY} on the diagram</p> <p>Allow FT from a response of $2 \times 180(^{\circ}) - w(^{\circ})$ (missing brackets) or where FT has been similar giving B0, or correct rearrangement of the correct response, otherwise depends on previous B1</p> <p>Award B3 for a correct unambiguous \hat{XOY} without working, or from correct working.</p>
<p>16(a) $4(x+6) + 8(2x-3)$ as a <u>numerator</u> $(2x-3)(x+6)$ as a <u>denominator</u> $20x / (2x-3)(x+6)$</p>	<p>M1</p> <p>M1</p> <p>A1</p>	<p>CAO, mark final answer If $(2x-3)(x+6)$ expanded, must be correct (Note: $(2x-3)(x+6) = 2x^2 + 9x - 18$)</p> <p>If no marks then award SC1 for sight of $4(x+6) + 8(2x-3) = 20x$ in working</p>
<p>16(b) $(3x + 5)(3x - 5)$ $2(3x + 5)$ $(3x - 5)/2$</p>	<p>B2</p> <p>B1</p> <p>B1</p>	<p>B1 for $(3x \dots 5)(3x \dots 5)$ including being written as either $(3x - 5)^2$ or $(3x + 5)^2$</p> <p>FT provided no more than 1 previous error and provided simplification required. Mark final answer. Accept $1.5x - 2.5$</p> <p>Award B4 for sight of a correct answer</p>
<p>17. $(\sqrt{2 \times 25} - 3\sqrt{2})^2$ or $(\sqrt{2 \times 5 \times 5} - 3\sqrt{2})^2$ or sight of $\sqrt{50} = 5\sqrt{2}$ in working</p> <p>$(5\sqrt{2} - 3\sqrt{2})^2 = (2\sqrt{2})^2$</p> <p>8</p>	<p>M1</p> <p>m1</p> <p>A1</p>	<p>OR M1 $50 - 3\sqrt{50}\sqrt{2} - 3\sqrt{50}\sqrt{2} + 18$ any 3 terms correct (accept as terms given in table)</p> <p>m1 $50 - 30 - 30 + 18$ any 3 terms correct or $50 - 60 + 18$ with -60 correct and 1 other term (accept as terms given in table)</p> <p>CAO A1 8</p>

Summer 2016 Linear Paper 1 Higher Tie	Marks	Comments
18(a) Correct sketch in 4 quadrants with -9 on the y-axis AND 3 & -3 on the x-axis	B3	<p>B2 for an appropriate sketch in 4 quadrants with <u>either</u> -9 indicated (allow shown between -8 & -10) on the y-axis <u>OR</u> 3 & -3 indicated on the x-axis (ignore additional incorrect points indicated), or</p> <p>B2 for sketch only in 2 quadrants with -9 indicated on the y-axis AND -3 or 3 indicated on the x-axis</p> <p>OR</p> <p>B1 for an appropriate sketch in 4 quadrants without points indicated or with incorrect points indicated, or</p> <p>B1 for sketch only in 1 quadrant with -9 indicated (allow shown between -8 & -10) on the y-axis AND -3 or 3 indicated on the x-axis , or</p> <p>B1 for sketch only in 2 quadrants with -9 indicated on the y-axis</p> <p>Penalise -1 if 'points' are joined with straight lines</p>
18(b) Move horizontal (Translate) to the left 2	B2	<p>Alone, with no other movements</p> <p>Allow descriptions such as 'move to the left 2', or 'move left along x-axis 2', 'shift -2 horizontally'</p> <p>B1 for move (translate) horizontally (left or right), allow use of descriptions such as 'sideways' or 'along x-axis'</p> <p>Allow B1 translation shown graphically, provided it is not derived from plotted points with -5 and 1 indicated on the x-axis</p>
19. 225(°) or 315(°)	B1	<p>Allow an answer in the range 224(°) to 225(°) or 315(°) to 316(°) inclusive. (Answers are actually 224.4(°) or 315.6(°) but, for a non calculator paper, such accuracy would be suspicious)</p>
The other angle, with no other values	B1	<p>FT 540 – first answer, however only FT for reflex angles and be a unique second angle</p> <p>Accept embedded answers</p>



GCSE MARKING SCHEME

SUMMER 2016

**GCSE MATHEMATICS - LINEAR PAPER 2
HIGHER TIER**

4370/06

INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

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**GCSE Mathematics - Linear Paper 2 Higher Tier
Summer 2016 Mark Scheme**

Summer 2016 Linear Paper 2 Higher Tier Summer	Mark	Comments
1(a) 1	B2	B1 for sight of $(9 - 7 =) 2$ or $(45 - 35 =) 10$
1(b) 2744	B2	B1 for evidence of 14^3 or $2 \times 7 \times 2 \times 7 \times 2 \times 7$ or equivalent that should lead to a correct answer
2. $4 \times 1400 \div 5$ (£)1120	M1 A1	
3(a) 3.1	B2	B1 for evidence of $228 \div 74$ or $3.08(1\dots)$ or 3 or 3.10
3(b) 125 (kg) and 137 (kg)	B2	B1 for 125.4 and 136.8, or 125 or 137
4(a) $\frac{1}{2} \times (6 + 8) \times 5$ or equivalent 35 (cm ²)	M1 A1	
4(b) $360(^{\circ}) \div 30(^{\circ})$ 12 (sides)	M1 A1	Or equivalent full method Mark final answer. Do not ignore further working.
4(c) $\pi \times 4^2 \times 9$ Answers in the range 452 to 452.6(cm ³) or 144π (cm ³)	M1 A1	
5(a) 870 (hundredweight)	B1	
5(b) (USA 28 tons) $28 \times 20 \times 100$ (= 56 000 pounds) <u>OR</u> (UK 26 tons) $26 \times 20 \times 112$ (= 58 240 pounds) <u>OR</u> (for sight of) $26 \times 112 - 28 \times 100 = 112$ (Difference in pounds 20×112 or $58240 - 56000 =$) 2240 (Percentage difference, compared with USA) $(100 \times) \frac{2240}{56000}$ or $(100 \times) \frac{58240}{56000} - 1 (\times 100)$ 4(%) or equivalent	M1 A1 M1 A1	<i>Appropriate working leading to 112 must be seen, e.g. $2912 - 2800 = 112$, not for sight of the '112' given in the question</i> CAO. Must be seen (Note: $58240 \div 56000 - 1 = 1.04 - 1 = 0.04$) FT their difference '58240-56000' correctly evaluated provided at least M1 previously awarded Allow M1 for $(100 \times) 112/2800$ (also FT for A1) CAO, including FT from $100 \times 112/2800 = 4(\%)$ Award M1, A0, M1, A1 for an unsupported 4% (not from 3.9 rounded to 4, the later marks are M0, A0) <i>Note to markers: Watch for answers that round to 4% from incorrect working, probably from a denominator of 58240, award finally M0, A0</i>

Summer 2016 Linear Paper 2 Higher Tier Summer	Mark	Comments
6(a) 100	B1	Do not accept $30 + 70$ as a final answer
6(b) Bryn, with a reason, e.g. 'Bryn has cut more (branches with diameters) between 30mm and 40mm', 'Bryn because he cut 40 of the thicker branches', 'Bryn because Luke only cut 20 of the thicker branches', 'Bryn because he cut 40 between 30mm and 40mm', 'Bryn because he cut 40, Luke only cut 20 (of the branches with diameter 30mm to 40mm)'	E1	Allow 'Bryn because more at 40(mm)', or 'Bryn because more at 30(mm)', 'Bryn because more at 35(mm)', Bryn with a taller bar at the end of the graph'
6(c) Sight of mid points 5, 15, 25, 35 (Total number of branches is) 150 $10 \times 5 + 30 \times 15 + 70 \times 25 + 40 \times 35$ $(=50+450+1750+1400 = 3650)$ $\div 150$ $24(.333 \dots \text{ mm})$	B1 B1 M1 m1 A1	Stated or implied. Accept embedded within incorrect working e.g. $150/4$, or sight of 37.5 FT provided their mid points are within or at the bounds of the intervals (<i>all upper bounds used gives $4400 \div 150$, all lower bounds used gives $2900 \div 150$</i>) Intention to divide their Σfx by 'their 150' provided 'their 150' $\neq 4$ ('their 150' from attempt $10+30+70+40$, i.e. similar order) CAO <i>Luke selected, MR-1 then:</i> <i>Mid points 5, 15, 25, 35</i> B1 <i>Total number of branches 150</i> B1 $5 \times 30 + 15 \times 30 + 25 \times 70 + 35 \times 20$ M1 $\div 150$ m1 $20(.33 \dots \text{ mm})$ A1 <i>With appropriate FT</i>
6(d) Explanation that there is a need to find which group contains the 75(.5) th branch, they must mention or imply looking at the 75(.5) th branch OR Explanation such as 'less than half of the branches had diameters less than 20mm and less than half had diameters greater than 30mm, (so the median is between 20mm and 30mm)', 'there is equal area either side of 25mm'	E1	FT half 'their 150' (+0.5) provided this lies in the group 20mm to 30mm Allow '75(.5 th) branch (is in the group 20mm to 30mm)', '75(.5 th) value', '75(.5 th) reading', '75 is halfway' Do not allow '75' without text Do not accept 'more branches are cut between 20mm and 30mm', or definition of the median without reference to the frequency diagram, or an answer of 25mm without relevant explanation or reason
7(a) 4 and 16	B2	B1 for either entry correct
7(b) Plots correct, allowing one error or the 2 omissions ($x=-1$ and $x=2$) All 6 points correct & joined with a curve	B1 B1	FT from (a) FT from (a). Need to have all 6 plots no omissions. If a point is clearly not on 'their curve' then accept 'their curve' without passing through this point
7(c) Sight of $y = 7$ including the intersection, or marking the intersection of $y = 7$ with a point, or a vertical line to a point of intersection with $y = 7$ $(x =) -1.47$ and 1.14 (tolerance $\frac{1}{2}$ one small square)	M1 A1	FT their graph provided points are joined Unambiguous answer on the graph M1 may be awarded if only one point of intersection is given FT their graph but must be for 2 values Tolerance would be -1.4 to -1.5 and 1.1 to 1.2, but need to FT from their graph for 2 values Unsupported correct answers from their graph are awarded M1, A1

Summer 2016 Linear Paper 2 Higher Tier Summer	Mark	Comments
8. (2010: £3400 to BRL) 2.86×3400 9724 (BRL) (2014: 9724 BRL to £) $9724 \div 3.71$ 		

Summer 2016 Linear Paper 2 Higher Tier Summer	Mark	Comments
10(a) $(d^2 =) 4.8^2 + 4.4^2$ $d^2 = 42.4$ or $(d =) \sqrt{42.4}$ 6.5(... cm)	M1 A1 A1	ISW. Accept 7(cm) from correct working
10(b) $\sin e = \frac{4.2}{8.1}$ 31(.23....°)	M1 A2	A1 for $e = \sin^{-1}(4.2/8.1)$ ($=\sin^{-1} 0.518518....$)
10(c) $f = \frac{12.4}{\cos 41^\circ}$ 16(.43...cm)	M2 A1	Or alternative full method M1 for $\cos 41^\circ = \frac{12.4}{f}$
11. $15a^7b^4$	B2	B1 for $15a^7b^{\dots}$ or $15a^{\dots}b^4$ or $\dots a^7b^4$ or $15 \times a^7 \times b^4$
12(a) $8a + 8b = 69.6$ or $a + b = 8.7$ or equivalent	B1	Accept unsimplified equations Mark final answer unless no other marks awarded in (b)
12(b) Method to equate coefficients (allow 1 slip) with attempt to subtract First variable Method to find second variable Second variable (Length of rectangle H is) 23.1 (cm) AND (Width of rectangle H is) 11.7 (cm)	M1 A1 m1 A1 B1	OR alternative algebraic method (not trial & improvement), e.g. $a = 8.7 - b$ or $b = 8.7 - a$ substituted into $10a + 16b = 96$ FT for their equations in a similar format $a = 7.2$ $b = 1.5$ Accept length and width in either order FT provided both answers are positive and only provided M1, m1 awarded ($3a + b$ and $a + 3b$ correctly evaluated) (FT use of $4a + 4b = 69.6$ leads to $a = 30.4$ and $b = -13$)

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13. $14 \text{ (million)} \times 1.017^3$ (=14.726 206 782 million) $\times 1.02^2$ 15 321 145(.54... tons) or 15.3(2... million tons)	M2 M2 A1	<p><i>Penalise -1 incorrect place value for 14 million once only</i> Or equivalent to attempt 1.7% on 3 different values M1 for $14 \text{ (million)} \times 1.017$ or $14 \text{ (million)} \times 1.7/100 + 14 \text{ (million)}$ or equivalent M1 only if additional years are included</p> <p>Or equivalent to attempt 2% on 2 different values FT from 'their 14.7... million' provided $> 14 \text{ (million)}$, i.e. an increased amount from the original M1 for '$\dots \times 1.02$' or '$\dots \times 2/100 + \dots$' or equivalent M1 only if additional years are included</p> <p>CAO <u>from correct working</u>, although accept answers rounding to 15 300 000 Ignore any incorrect units given <i>An unsupported correct answer is awarded all 5 marks</i></p> <p><i>Simple 'compound' working may be awarded both M1 marks (simple 'compound' answer is 15 302 560 tons), maximum mark possible is M1, M1, A0. Allow embedded working, e.g. '$14 \text{ (million)} \times 1.051$' or equivalent for M1 and '$\dots \times 1.04$' or equivalent for M1.</i></p> <p><i>Use of 1.17 and 1.2 is not a misread, however award SC1 for an answer of 32 288 518(.08 tons) or 32 000 000</i></p> <p><i>Note:</i></p> <table border="1"> <thead> <tr> <th>Year</th><th>Millions of tons</th><th>Tons</th></tr> </thead> <tbody> <tr> <td>2013</td><td>14.238</td><td>14 238 000</td></tr> <tr> <td>2014</td><td>14.480046</td><td>14 480 046</td></tr> <tr> <td>2015</td><td>14.7262068</td><td>14 726 206.8</td></tr> <tr> <td>2016</td><td>15.0207309</td><td>15 020 730.9</td></tr> <tr> <td>2017</td><td>15.3211455</td><td>15 321 145.5</td></tr> </tbody> </table>	Year	Millions of tons	Tons	2013	14.238	14 238 000	2014	14.480046	14 480 046	2015	14.7262068	14 726 206.8	2016	15.0207309	15 020 730.9	2017	15.3211455	15 321 145.5
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14. 6.1×10^3	B2	B1 for the actual answer, or as given correct to 2 s.f. or as given in standard form, e.g. 6069.70..., 6069.(...), 6070, 6100, 61×10^2 , 0.61×10^4 , $6(.0697\dots) \times 10^3$																		
15. $(x + 2)(x + 6)$ $x = -2$	B2 B1	<p>B1 for $(x \dots)(x + 6)$, or (substituting $x = -6$ to find) $b = 8$, or sight of $x^2 + 8x + 12 = 0$</p> <p>Award B3 for a final answer of -2 with correct reasoning, e.g. sight of $12 \div -6 = -2$ (i.e. use product of the 2 solutions = constant term) Award B2 for a final answer of -2 without working An answer of $x = -2$ from clearly incorrect or spurious working is B1 only</p>																		
16. (Area =) $\frac{1}{2} \times 11.6 \times 23.7 \times \sin 112^\circ$ 127(.45... cm ²)	M1 A1	ISW																		
17. (Linear scale factor) $6/4$ or 1.5 or equivalent seen $7.6 \times (6/4)^2$ or equivalent 17(.1 cm ²)	B1 M1 A1	Accept implied from sight of an answer of 11.4																		
18. $x = \{ -7 \pm \sqrt{7^2 - 4 \times 4 \times -5} \} / (2 \times 4)$ $= \{ -7 \pm \sqrt{129} \} / 8$ $x = 0.54$ and $x = -2.29$ (Answers to 2dp)	M1 A1 A1	Allow one error in sign or substitution, not in the formula CAO. Accept from sight of 0.5447... with -2.2947... CAO																		

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19(a) $y \propto 1/x^2$ OR $y = k/x^2$ $50 = k/3^2$ or $k = 50 \times 3^2$ or $k = 450$ $y = 450/x^2$ or $y = 450 \div x^2$	M1 M1 A1	Allow incorrect notation, e.g. $y \propto k/x^2$ FT non linear only Do not accept $y \propto 450/x^2$ Maybe stated in part (b)						
19(b) <table border="1"> <tr> <td>x</td><td>$\frac{1}{2}$</td><td>3</td></tr> <tr> <td>y</td><td>1800</td><td>50</td></tr> </table>	x	$\frac{1}{2}$	3	y	1800	50	B1	FT their non linear expression
x	$\frac{1}{2}$	3						
y	1800	50						
20(a) Strategy, finding area $0.5 \times 10 + 2 \times 10 + 4 \times 10 + 3 \times 10 + 1 \times 20$ or equivalent 115 (people)	M1 M1 A1	Any single area is sufficient Must show intention to add. Allow for 4 of the 5 terms correct (Note for markers: $5+20+40+30+20$ or the final 20 as $10+10$) CAO						
20(b) $0.5 \times 10 + \frac{1}{4} \times 2 \times 10$ or equivalent 10 (people)	M1 A1	FT 'their 5' + $\frac{1}{4}$ of 'their 20' provided area is being considered, with M1 awarded in (a)						
20(c) (80% of 115 people is) 92 (people) 95 (people in up to 40 seconds) (Exceeded by serving) 3 (extra people)	B1 B1 B1	FT 'their 115' provided area has been considered, with M1 awarded in (a) FT 'their 115' – 'their 20', with M1 awarded in (a) CAO Allow B3 for an unsupported answer of 3 <i>Alternative:</i> 95 (people in up to 40 seconds) B1 $(100 \times) 95 \div 115$ (0.826... or 82.6%) AND (Difference) 2.6...% of 115 B1 (exceeded by serving) 3 (extra people) B1 With equivalent FT, provided M1 awarded in (a), 'their 115' and 'their 115 – their 20',						
21. $\cos x = \frac{7.8^2 + 8.6^2 - 4.2^2}{2 \times 7.8 \times 8.6}$ (=0.8732856.....) $x = 29.157...(^{\circ})$ rounded or truncated Value for calculated angle $x \div 2$ with an attempt at the sine rule $y = \frac{7.8 \times \sin 14.578...^{\circ}}{\sin 49^{\circ}}$ Answers in the range $y = 2.58(\text{cm})$ to $2.61(\text{cm})$	M2 A1 S1 M2 A1	M1 for $4.2^2 = 7.8^2 + 8.6^2 - 2 \times 7.8 \times 8.6 \times \cos x$ Accept $29(^{\circ})$, $29.1(^{\circ})$, $29.15(^{\circ})$, $29.2(^{\circ})$ FT 'their derived angle $x/2$ ', i.e. must come from some previous working FT 'their angle for $x/2$ ' M1 for $\frac{y}{\sin 14.578...^{\circ}} = \frac{7.8}{\sin 49^{\circ}}$ CAO						