



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.

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 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 (cm²)	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 $452.6(\text{cm}^3)$ or $144\pi(\text{cm}^3)$	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.</i> <i>$2912 - 2800 = 112$, 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) Note to markers: Watch for answers that round to 4% from incorrect working, probably from a denominator of 58240, award finally M0, A0

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'										
<p>6(c) Sight of mid points 5, 15, 25, 35 (Total number of branches is) 150</p> $10 \times 5 + 30 \times 15 + 70 \times 25 + 40 \times 35$ $= 50 + 450 + 1750 + 1400 = 3650$ $\div 150$ <p>24(333.... mm)</p>	<p>B1 B1</p> <p>M1</p> <p>m1</p> <p>A1</p>	<p>Stated or implied. Accept embedded within incorrect working e.g. 150/4, or sight of 37.5</p> <p>FT provided their mid points are within or at the bounds of the intervals (<i>all upper bounds used gives 4400 ÷ 150, all lower bounds used gives 2900 ÷ 150</i>)</p> <p>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)</p> <p>CAO</p> <p><i>Luke selected, MR-1 then:</i></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 80%;">Mid points 5, 15, 25, 35</td> <td style="text-align: right;">B1</td> </tr> <tr> <td>Total number of branches 150</td> <td style="text-align: right;">B1</td> </tr> <tr> <td>$5 \times 30 + 15 \times 30 + 25 \times 70 + 35 \times 20$</td> <td style="text-align: right;">M1</td> </tr> <tr> <td style="text-align: right;">$\div 150$</td> <td style="text-align: right;">m1</td> </tr> <tr> <td style="text-align: right;">20(33... mm)</td> <td style="text-align: right;">A1</td> </tr> </table> <p>With appropriate FT</p>	Mid points 5, 15, 25, 35	B1	Total number of branches 150	B1	$5 \times 30 + 15 \times 30 + 25 \times 70 + 35 \times 20$	M1	$\div 150$	m1	20(33... mm)	A1
Mid points 5, 15, 25, 35	B1											
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$\div 150$	m1											
20(33... mm)	A1											
<p>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</p> <p>OR</p> <p>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'</p>	E1	<p>FT half 'their 150' (+0.5) provided this lies in the group 20mm to 30mm</p> <p>Allow '75(.5th) branch (is in the group 20mm to 30mm)', '75(.5th) value', '75(.5th) reading', '75 is halfway'</p> <p>Do not allow '75' without text</p> <p>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</p>										
7(a) 4 and 16	B2	B1 for either entry correct										
<p>7(b) Plots correct, allowing one error or the 2 omissions (x=-1 and x=2)</p> <p>All 6 points correct & joined with a curve</p>	<p>B1</p> <p>B1</p>	<p>FT from (a)</p> <p>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</p>										
<p>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 $y = 7$</p> <p>(x =) -1.47 and 1.14 (tolerance ½ one small square)</p>	<p>M1</p> <p>A1</p>	<p>FT their graph provided points are joined</p> <p>Unambiguous answer on the graph</p> <p>M1 may be awarded if only one point of intersection is given</p> <p>FT their graph but must be for 2 values</p> <p>Tolerance would be -1.4 to -1.5 and 1.1 to 1.2, but need to FT from their graph for 2 values</p> <p>Unsupported correct answers from their graph are awarded M1, A1</p>										

<p align="center">Summer 2016 Linear Paper 2 Higher Tier Summer</p>	<p align="center">Mark</p>	<p align="center">Comments</p>
<p>10(a) $(d^2 =) 4.8^2 + 4.4^2$ $d^2 = 42.4$ or $(d =) \sqrt{42.4}$ 6.5(... cm)</p>	<p>M1 A1 A1</p>	<p>ISW. Accept 7(cm) from correct working</p>
<p>10(b) $\sin e = \frac{4.2}{8.1}$ 31(.23....°)</p>	<p>M1 A2</p>	<p>A1 for $e = \sin^{-1}(4.2/8.1)$ (=sin⁻¹ 0. 518518....)</p>
<p>10(c) $f = \frac{12.4}{\cos 41^\circ}$ 16(.43...cm)</p>	<p>M2 A1</p>	<p>Or alternative full method M1 for $\cos 41^\circ = \frac{12.4}{f}$</p>
<p>11. $15a^7b^4$</p>	<p>B2</p>	<p>B1 for $15a^7b^4$ or $15a^7 \cdot b^4$ or $\dots a^7 b^4$ or $15 \times a^7 \times b^4$</p>
<p>12(a) $8a + 8b = 69.6$ or $a + b = 8.7$ or equivalent</p>	<p>B1</p>	<p>Accept unsimplified equations Mark final answer unless no other marks awarded in (b)</p>
<p>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)</p>	<p>M1 A1 m1 A1 B1</p>	<p>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 $b = -13$)</p>

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<p>13.</p> <p>$14 \text{ (million)} \times 1.017^3$ (=14.726 206 782 million)</p> <p>$\times 1.02^2$</p> <p>15 321 145(.54... tons) or 15.3(2... million tons)</p>	<p>M2</p> <p>M2</p> <p>A1</p>	<p><i>Penalise -1 incorrect place value for 14 million once only</i></p> <p>Or equivalent to attempt 1.7% on 3 different values</p> <p>M1 for $14 \text{ (million)} \times 1.017$ or $14 \text{ (million)} \times 1.7/100 + 14 \text{ (million)}$ or equivalent</p> <p>M1 only if additional years are included</p> <p>Or equivalent to attempt 2% on 2 different values</p> <p>FT from 'their 14.7... million' provided $> 14 \text{ (million)}$, i.e. an increased amount from the original</p> <p>M1 for '$\dots \times 1.02$' or '$\dots \times 2/100 + \dots$' or equivalent</p> <p>M1 only if additional years are included</p> <p>CAO <u>from correct working</u>, although accept answers rounding to 15 300 000</p> <p>Ignore any incorrect units given</p> <p><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(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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<p>14. 6.1×10^3</p>	<p>B2</p>	<p>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, $6(.0697\dots) \times 10^3$</p>																		
<p>15. $(x + 2)(x + 6)$</p> <p>$x = -2$</p>	<p>B2</p> <p>B1</p>	<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)</p> <p>Award B2 for a final answer of -2 without working</p> <p>An answer of $x = -2$ from clearly incorrect or spurious working is B1 only</p>																		
<p>16. (Area \Rightarrow) $\frac{1}{2} \times 11.6 \times 23.7 \times \sin 112^\circ$</p> <p>127(.45... cm²)</p>	<p>M1</p> <p>A1</p>	<p>ISW</p>																		
<p>17. (Linear scale factor) $6/4$ or 1.5 or equivalent seen</p> <p>$7.6 \times (6/4)^2$ or equivalent</p> <p>17(.1 cm²)</p>	<p>B1</p> <p>M1</p> <p>A1</p>	<p>Accept implied from sight of an answer of 11.4</p>																		
<p>18. $x = \{ -7 \pm \sqrt{(7^2 - 4 \times 4 \times -5)} \} / (2 \times 4)$</p> <p>$= \{ -7 \pm \sqrt{129} \} / 8$</p> <p>$x = 0.54$ and $x = -2.29$ (Answers to 2dp)</p>	<p>M1</p> <p>A1</p> <p>A1</p>	<p>Allow one error in sign or substitution, not in the formula</p> <p>CAO. Accept from sight of 0.5447... with -2.2947... CAO</p>																		

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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" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">x</td> <td style="text-align: center;">$\frac{1}{2}$</td> <td style="text-align: center;">3</td> </tr> <tr> <td style="text-align: center;">y</td> <td style="text-align: center;">1800</td> <td style="text-align: center;">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> <i>95 (people in up to 40 seconds) B1</i> <i>(100 \times) 95 \div 115 (0.826... or 82.6%) AND</i> <i>(Difference) 2.6...% of 115 B1</i> <i>(exceeded by serving) 3 (extra people) B1</i> <i>With equivalent FT, provided M1 awarded in (a), 'their 115'</i> <i>and 'their 115 – their 20',</i>						
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						