

# REVISE

.wales

## 3.01 – Quadratic equations by formula

*Mark schemes for the 3.01 question pack*

*Spec 2.2.8 – Unit 3*

SOLUTIONS · 2025 SPECIFICATION

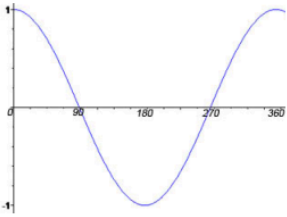
*Mark schemes for the 8 questions in the corresponding revise.wales question pack (36 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes. Pack layout © revise.wales.*

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<b>GCSE MATHEMATICS</b> <b>Unit 2 : Higher Tier</b> <b>Autumn 2016</b>	✓	Mark	Comment
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<p>12.</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div style="border: 1px solid black; padding: 2px;"><math>x^2 - 4 = 0</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x(2x + 3) = 0</math></div> <div style="border: 1px solid black; padding: 2px;"><math>(x - 1)(2x - 3) = 0</math></div> <div style="border: 1px solid black; padding: 2px;"><math>(2x - 3)(2x + 3) = 0</math></div> <div style="border: 1px solid black; padding: 2px;"><math>(4x + 9)^2 = 0</math></div> </div>	<div style="display: flex; flex-direction: column; gap: 5px;"> <div style="border: 1px solid black; padding: 2px;"><math>x = 1, x = -\frac{3}{2}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = 2, x = -2</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = 1, x = \frac{3}{2}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = \frac{4}{9}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = -1, x = -\frac{2}{9}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = -\frac{2}{3}, x = \frac{2}{9}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = \frac{3}{2}, x = -\frac{3}{2}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = 1, x = -\frac{2}{3}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = -\frac{9}{4}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = 0, x = \frac{1}{4}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = \frac{91}{16}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = 0, x = -\frac{9}{2}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = \frac{3}{2}</math></div> <div style="border: 1px solid black; padding: 2px;"><math>x = -\frac{9}{4}, x = 0</math></div> </div>	<div style="display: flex; flex-direction: column; gap: 20px;"> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;">B1</div> <div>3<sup>rd</sup> box</div> </div> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;">B1</div> <div>7<sup>th</sup> box</div> </div> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;">B1</div> <div>9<sup>th</sup> box</div> </div> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;">B1</div> <div>12<sup>th</sup> box</div> </div> </div>
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<p>11(a)(i). <math>\frac{x+1+x+2}{2} \times x (= 25)</math></p> <p><math>x^2 + x + x^2 + 2x = 50</math>  OR <math>x(2x + 3) = 50</math>  OR <math>\frac{2x^2+3x}{2} = 25</math>  OR <math>x^2 + 1.5x = 25</math></p> <p><math>2x^2 + 3x - 50 = 0</math></p>	<p>M1</p> <p>m1</p> <p>A1</p>	<p>Missing brackets in the expression <math>\frac{x(x+1+x+2)}{2}</math> may be implied later from correct working.</p> <p>Must be convincing.  If m1 awarded for <math>\frac{2x^2+3x}{2} = 25</math>, a further rearrangement, e.g. <math>2x^2 + 3x = 50</math>, must be seen before A1 is awarded.</p>
<p>11(a)(ii). <math>x = \frac{-(3) \pm \sqrt{(3)^2 - 4 \times 2 \times (-50)}}{2 \times 2}</math></p> <p><math>= \frac{-3 \pm \sqrt{409}}{4}</math></p> <p><math>x = 4.3(059 \dots)</math>, (<math>x = -5.8(059 \dots)</math>)  (AB=) 5.3(cm) AND (DC=) 6.3(cm)</p>	<p>M1</p> <p>A1</p> <p>A1</p> <p>B1</p>	<p>Maybe seen in a(i).  Allow one slip in substitution <b>for M1 only</b>, but must be correct formula.</p> <p>CAO.  Answers must be to 1 d.p.  FT 'their positive x' provided M1 awarded.</p>
<p>11.(b) <math>7^2 \times 36.8</math> OR <math>(7 \times \sqrt{36.8})^2</math>  <math>= 1803.2 \text{ (cm}^2\text{)}</math></p>	<p>M1</p> <p>A1</p>	<p>Allow 1803 (cm<sup>2</sup>)</p>

<p>16. Use of 7175 AND (1)·2345 or (1)23·45(÷100) 7175 × 1·2345</p> <p style="text-align: right;">= (£)8858</p>	<p>B1 M1  A1</p>	<p>Or equivalent complete method. FT for 'their 7175' provided <math>7170 \leq x &lt; 7180</math> and 'their 1·2345' provided <math>1·234 \leq y &lt; 1·235</math> Sight of (£)8857·53(75) or (£)8857·54 implies B1M1. CAO.</p>
<p>17.(a) General cosine <u>curve</u> with appropriate orientation and position.</p> <p>Correct sketch with curve passing through <math>(0^\circ, 1)</math>, <math>(90^\circ, 0)</math> and <math>(270^\circ, 0)</math> and approximately <math>(180^\circ, -1)</math> and <math>(360^\circ, 1)</math> AND <math>90^\circ</math>, <math>180^\circ</math>, <math>270^\circ</math>, <math>360^\circ</math> indicated on the x-axis AND -1 and 1 indicated on the y-axis.</p> 	<p>M1  A1</p>	<p>Ignore curve shown for values <math>x &lt; 0^\circ</math> or <math>x &gt; 360^\circ</math>.</p> <p>Accept <math>180^\circ</math> as mid-way between <math>0^\circ</math> and <math>360^\circ</math> if unlabelled. Accept <math>360^\circ</math> as unlabelled provided the sketch does not exceed <math>360^\circ</math>.</p>
<p>17.(b) <math>46^\circ</math> AND <math>314^\circ</math> OR <math>45·6^\circ</math> AND <math>314·4^\circ</math> OR <math>45·57(29\dots)^\circ</math> AND <math>314·4(27\dots)^\circ</math>.</p>	<p>B2</p>	<p>B1 for sight of one correct angle. Allow embedded answers. If more than two answers offered award B1 for sight of one correct angle.</p> <p>If no marks, awarded SC1 for truncated answers <math>45^\circ</math> AND <math>315^\circ</math> OR <math>45·5^\circ</math> AND <math>314·5^\circ</math>.</p>
<p>18. <math>0·7 \times 0·2 \times 0·1 \times 6</math></p> <p style="text-align: right;">= 0·084 or equivalent</p>	<p>M2  A1</p>	<p>M1 for sight of <math>0·7 \times 0·2 \times 0·1</math> OR <math>0·014</math> OR <math>7/500</math> or equivalent. A1 Fractional answer: <math>21/250</math> or equivalent. (ISW)</p>
<p>19. Sight of <math>25x^2 + 15x - 15x - 9</math> <math>25x^2 - 19x - 9 = 0</math></p> $x = \frac{-(-19) \pm \sqrt{(-19)^2 - 4 \times 25 \times (-9)}}{2 \times 25}$ $x = \frac{19 \pm \sqrt{1261}}{50}$ <p><math>x = 1·09</math> with <math>x = -0·33</math> (answers to 2dp)</p>	<p>B1 B1  M1  A1  A1</p>	<p>Or equivalent. '= 0' required, but may be implied by an attempt to use the quadratic formula or if <math>a = 25</math>, <math>b = -19</math>, <math>c = -9</math> used in the quadratic formula.</p> <p><b>This substitution into the formula must be seen for M1, otherwise award M0A0A0.</b> FT 'their derived quadratic equation' of equivalent difficulty (<math>a</math>, <math>b</math> and <math>c</math> must be non-zero). Allow one slip in substitution <b>for M1 only</b>, but must be correct formula.</p> <p>Can be implied from at least one correct value of <math>x</math> evaluated, provided M1 awarded.</p> <p>CAO for their quadratic equation.</p>

<p>11.</p> $\frac{63 \cdot 5^2}{8 \cdot 65}$ <p>= 466(·156...) or 466·16 or 466·2</p>	<p>M2</p> <p>A1</p>	<p>If many attempts are offered without a method/answer being identified, then mark the final attempt.</p> <p>If M2 not gained, award M1 for correct use of values <math>63 \leq d &lt; 64</math> AND <math>8 \cdot 6 &lt; e \leq 8 \cdot 7</math></p> <p>Mark final answer. M2 required for A1.</p> <p>Fractional equivalent <math>466(\cdot 156 \dots) = 80645/173</math></p> <p>Allow this A1 for an answer of 470 only from correct unambiguous working seen.</p> <p>If no marks gained, award SC1 for sight of 63·5 and 8·65 used within the same calculation.</p>
<p>12. Use of cosine rule followed by sine rule</p> <p>(EG = ) <math>\sqrt{2 \cdot 7^2 + 3 \cdot 2^2 - 2 \times 2 \cdot 7 \times 3 \cdot 2 \times \cos 79^\circ}</math></p> <p>(EG = ) 3·77.... (cm)</p> <p><math>\sin EFG = EG \times \sin 65^\circ / 6 \cdot 4</math> OR <math>EFG = \sin^{-1}(EG \times \sin 65^\circ / 6 \cdot 4)</math></p> <p>F = 32(·29.....°)</p>	<p>S1</p> <p>M2</p> <p>A1</p> <p>M2</p> <p>A1</p>	<p>M1 for <math>(EG^2 = ) 2 \cdot 7^2 + 3 \cdot 2^2 - 2 \times 2 \cdot 7 \times 3 \cdot 2 \times \cos 79^\circ</math> or for <math>(EG^2 = ) 14 \cdot 2(3 \dots)</math></p> <p>Accept 3·8 cm</p> <p>Allow <math>\sqrt{14 \cdot 2(3 \dots)}</math> if used in this form in subsequent work, provided not evaluated as a decimal (at any stage)</p> <p>F.T. 'their derived EG' (not 2·7, 3·2, 6·4 or spurious EG).</p> <p>Award M1 for <math>\sin EFG / EG = \sin 65^\circ / 6 \cdot 4</math> OR <math>EG / \sin EFG = 6 \cdot 4 / \sin 65^\circ</math></p> <p>Dependent on previous M2.</p>
<p>13. (Numerator) Sight of <math>3x(2x - 3)</math> (Denominator) Sight of <math>(2x - 3)(2x + 3)</math></p> $\frac{3x}{2x + 3}$	<p>B1</p> <p>B2</p> <p>B1</p>	<p>B1 for <math>(2x \dots 3)(2x \dots 3)</math></p> <p>Mark final answer.</p> <p>F.T. provided at least one previous B1 awarded AND provided simplification required.</p>
<p>14. (a) <math>\frac{1}{2} \times (x - 1) \times (2x + 3) \times \sin 30^\circ [= 6]</math> OR <math>\frac{1}{2} \times (2x^2 + 3x - 2x - 3) \times \sin 30^\circ [= 6]</math></p> <p><math>2x^2 + x - 3 (= 6 \times 2 \times 2)</math></p> <p><math>2x^2 + x - 27 = 0</math></p>	<p>B1</p> <p>B1</p> <p>B1</p>	<p>Use of 'Area = <math>\frac{1}{2} ab \sin C</math>'.</p> <p>Correct expansion of brackets and correct collection of x terms. May be implied within equation.</p> <p>Must be convincing.</p>
<p>14. (b) <math>(x =) \frac{-1 \pm \sqrt{[1]^2 - 4(2)(-27)}}{2(2)}</math></p> <p><math>(x =) \frac{-1 \pm \sqrt{217}}{4}</math></p> <p>(x =) -3·93 AND 3·43</p>	<p>M1</p> <p>A1</p> <p>A1</p>	<p><b>This substitution into the formula must be seen for M1, otherwise award M0A0A0.</b></p> <p>Allow one slip in substitution <b>for M1 only</b>, but must be correct formula.</p> <p>Can be implied from at least one correct value of x evaluated, provided M1 awarded.</p> <p>Both solutions required.</p> <p><i>Using trial and improvement</i> Award B3 for a method leading to <u>both</u> solutions, namely <math>x = -3 \cdot 93</math> AND <math>x = 3 \cdot 43</math>, otherwise B0.</p> <p>An unsupported answer gains zero marks.</p>
<p>14. (c) (AC = ) 2·43 (cm)</p> <p>Length cannot be negative / must be positive.</p>	<p>B1</p> <p>E1</p>	<p>F.T. 'their derived x' provided one positive and one negative solution.</p> <p>Accept any valid explanation, e.g. <math>x - 1 &gt; 0</math>, so <math>x &gt; 1</math>, <math>x</math> cannot be negative (as <math>x - 1</math> must be <math>&gt; 0</math>)</p>
<p>15. (a) <math>y = f(x) - 3</math></p>	<p>B1</p>	
<p>15. (b) <math>y = -f(x)</math></p>	<p>B1</p>	
<p>15. (c) <math>y = f(x - 10)</math></p>	<p>B1</p>	

15.

$$3x - 7 + x - 2 = (x - 2)(3x - 7) \text{ oe}$$

Sight of  $3x^2 - 7x - 6x + 14$ 

$$3x^2 - 17x + 23 = 0 \text{ OR } -3x^2 + 17x - 23 = 0$$

$$x = \frac{-(-17) \pm \sqrt{(-17)^2 - 4 \times 3 \times 23}}{2 \times 3}$$

$$x = \frac{17 \pm \sqrt{13}}{6}$$

$$x = 3.43 \text{ with } x = 2.23$$

*A correct common denominator may be shown throughout for first 3 marks.  
Also, look out for alternative, correct methods leading to the same quadratic equated to zero.*

- B1 For multiplying throughout the numerator of all terms by the common denominator.
- B1 Or equivalent. May be seen in the denominator.
- B1 '= 0' required, but may be implied by an attempt to use the quadratic formula or if  $a = 3, b = -17, c = 23$  used in the quadratic formula.  
FT from B1B0 from one error only.
- M1 **This substitution into the formula must be seen for M1, otherwise award M0A0A0.**  
FT 'their derived quadratic equation equated to 0', (but not  $3x^2 - 13x + 14 = 0$ ), provided of equivalent difficulty ( $a, b$  and  $c$  must be non-zero).  
Allow one slip in substitution **for M1 only**, but must be correct formula.
- A1 Can be implied from at least one correct value of  $x$  evaluated.
- A1 CAO for their quadratic equation.  
Answers must be given to 2 decimal places.

<p>19. <math>x + 3 + 5x = 7x^2</math> OR <math>x + 3 = x(7x - 5)</math> OR  <math>x + 3 = 7x^2 - 5x</math></p> <p><math>7x^2 - 6x - 3 = 0</math></p> $x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4 \times (7) \times (-3)}}{2 \times (7)}$ $= \frac{3 \pm \sqrt{30}}{7} \left( \frac{6 \pm \sqrt{120}}{14} \right)$ <p><math>x = 1.21(\dots)</math> AND <math>-0.35(\dots)</math></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>Clearing the denominator of <math>x</math>.                  May be seen in stages, e.g. first writing <math>\frac{x+3}{x}</math> as <math>1 + \frac{3}{x}</math>,                  etc</p> <p>CAO                  '= 0' required, but may be implied by an attempt to use the quadratic formula or if <math>a = 7, b = -6, c = -3</math> used in the quadratic formula.</p> <p><b>This substitution into the formula must be seen for M1, otherwise award M0A0A0.</b>                  FT 'their derived quadratic equation equated to zero' provided of equivalent difficulty (<math>a, b</math> and <math>c</math> must be non-zero).                  Allow one slip in substitution <b>for M1 only</b>, but must be correct formula.                  This can be awarded as a single attempt which may be seen anywhere in the solution for solving their quadratic equation equated to zero.</p> <p>Can be implied from at least one correct value of <math>x</math> evaluated, provided M1 awarded.</p> <p>CAO for their quadratic equation.                  Both solutions required.                  Accept 1.2 and -0.4.</p>
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<p>15. <math>11x^2 - 23x - 19 = 0</math> or  <math>0 = -11x^2 + 23x + 19</math></p> $x = \frac{-(-23) \pm \sqrt{(-23)^2 - 4 \times 11 \times -19}}{2 \times 11}$ <p>OR</p> $x = \frac{-23 \pm \sqrt{(23)^2 - 4 \times -11 \times 19}}{2 \times -11}$  $x = \frac{23 \pm \sqrt{1365}}{22}$	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>'= 0' required unless <math>a = 11, b = -23, c = -19</math> OR <math>a = -11, b = 23, c = 19</math> is used in the quadratic formula.</p> <p>FT only if the rearrangement set to '=0' is seen unless <math>a = 11, b = -23, c = -19</math> OR <math>a = -11, b = 23, c = 19</math> is used in the quadratic formula.  <b>This substitution into the formula must be seen for M1, otherwise award M0A0A0.</b>  FT 'their derived quadratic equation equated to zero' provided of equivalent difficulty (<math>a, b</math> and <math>c</math> must be non-zero).  Allow one slip in substitution <b>for M1 only</b>, but must be correct formula.  This can be awarded as a single attempt which may be seen anywhere in the solution for solving their quadratic equation equated to zero.</p> <p>Can be implied from at least one correct value of <math>x</math> evaluated (not necessarily rounded to 2dp), provided M1 awarded.</p> <p>CAO for their quadratic equation</p>
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End of solutions