

School Name
Mathematics Test 2017

Year 10A *Non Linear Equations*

Calculator Allowed

- Solve simple quadratic equations using a range of strategies (ACMNA241)
- 10 A Solve simple exponential equations (ACMNA270)
- 10A Factorise monic and nonmonic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts (ACMNA269)

Name _____

Section 1 Short Answer Section

Write all working and answers in the spaces provided on this test paper.

1. Solve the equation $p^2 = 49$.

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2. Find the values of x for which $2x^2 = 128$.

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3. For what values of k is $k^2 - 36 = 0$?

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4. For what values of b is $\frac{b^2}{3} = 27$?

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5. Solve for e : $2e^2 + 5 = 23$.

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6. Write down the solutions to $(m - 5)(m - 9) = 0$.

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7. Solve : $s(2s + 5) = 0$

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8. Solve the equation: $m^2 - 14m + 48 = 0$.

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9. Solve: $y^2 + 12y + 20 = 0$.

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10. Solve: $t^2 + 7t - 44 = 0$.

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11. Solve: $w^2 - w - 72 = 0$.

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12. Solve $2x^2 + 17x + 21 = 0$.

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13. Solve $3d^2 - 17d - 56 = 0$.

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14. Give the exact values for which $2r^2 + 9r + 5 = 0$.

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15. Complete the square on the equation $m^2 - 16m = 5$, to find the solutions in surd form.

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16. Find the solutions to $3z^2 - 11z + 4 = 0$, correct to two decimal places.

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17. Determine how many solutions (if any) there are to the equation $3x^2 + 5x + 9 = 0$.
Give reasons for your answer.

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18. Make w the subject of $P = \frac{rw - q}{4a}$.

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Section 2 Multiple Choice Section

Mark all your answers on the accompanying multiple choice answer sheet, not on this test paper. You may do any working out on this test paper. Calculators are allowed for this section.

1. The solutions to $(g - 7)(g + 4) = 0$ are:
- A. $g = -7$ or $g = -4$ B. $g = -7$ or $g = 4$
C. $g = 7$ or $g = -4$ D. $g = 7$ or $g = 4$

2. Solve $(x - 8)(x - 3) = 0$.
- A. $x = -8$ or $x = -3$ B. $x = -8$ or $x = 3$
C. $x = 8$ or $x = -3$ D. $x = 8$ or $x = 3$

3. For what values of x is $(4x - 3)(2x + 7) = 0$?
- A. $x = -\frac{3}{4}$ or $x = \frac{7}{2}$. B. $x = \frac{3}{4}$ or $x = -\frac{7}{2}$.
C. $x = -\frac{4}{3}$ or $x = \frac{2}{7}$. D. $x = \frac{4}{3}$ or $x = -\frac{2}{7}$.

4. The solutions to $36x^2 - 25 = 0$ are:
- A. $x = -\frac{6}{5}$ or $x = \frac{6}{5}$. B. $x = -\frac{5}{6}$ or $x = \frac{5}{6}$.
C. $x = -\frac{6}{5}$ only. D. $x = \frac{5}{6}$ only.

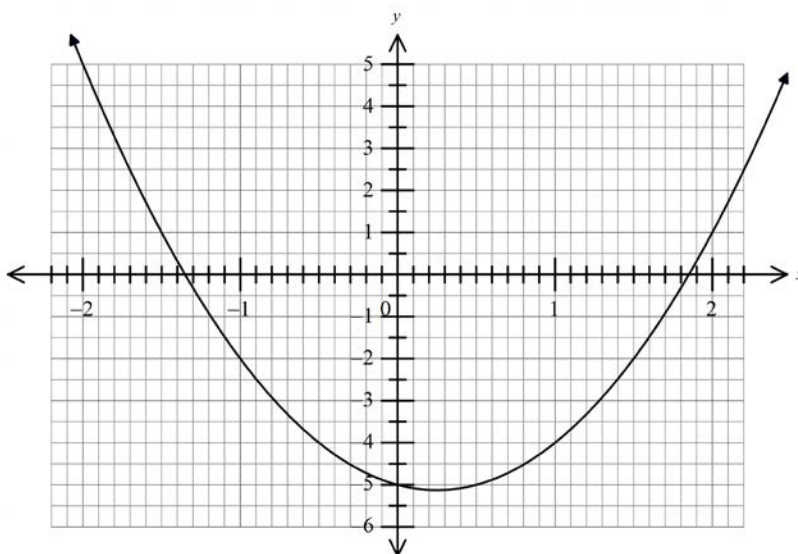
5.	What are the solutions to $w^2 - 12w + 36 = 0$?
	A. $w = -6$ only. B. $w = -6$ or $w = 6$ C. $w = -9$ or $w = 4$ D. $w = 6$ only
6.	The solutions to $s^2 + 2s - 48 = 0$ are:
	A. $s = -8$ or $s = 6$ B. $s = -12$ or $s = 4$ C. $s = 4$ or $s = -12$. D. $s = -6$ or $s = 8$.
7.	Solve $p^2 - 17p + 72 = 0$.
	A. $p = -9$ or $p = -8$ B. $p = -3$ or $p = 24$ C. $p = 9$ or $p = 8$ D. $p = 6$ or $p = 12$
8.	Solve $2w^2 - 15w + 18 = 0$
	A. $w = -\frac{3}{2}$ or $w = -6$ B. $w = -\frac{9}{2}$ or $w = -2$ C. $w = \frac{3}{2}$ or $w = 6$ D. $w = \frac{9}{2}$ or $w = 2$
9.	Solve $5u^2 + 21u - 20 = 0$.
	A. $u = -5$ or $u = \frac{4}{5}$ B. $u = -10$ or $u = \frac{2}{5}$ C. $u = -\frac{4}{5}$ or $u = 5$ D. $u = -\frac{2}{5}$ or $u = 10$

10. The graph of $y = 2x^2 - x - 5$ is shown.

Estimate the solution to

$$2x^2 - x - 5 = 0$$

- A. $x = -5.05$ or $x = 1.85$
B. $x = -5.05$ or $x = -1.35$
C. $x = -1.35$ or $x = 1.85$
D. $x = -1.85$ or $x = 1.35$



11. Find all the solutions to $6x^2 - 13x = 2x^2 - 10$.

- A. $x = -\frac{5}{2}$ or $x = 1$.
B. $x = \frac{5}{4}$ or $x = 2$
C. $x = -1$ or $x = \frac{5}{2}$
D. $x = -2$ or $x = \frac{5}{4}$

12. The solutions to $2d^2 - 7d + 2 = 0$ are:

- A. $d = \frac{-7 \pm \sqrt{65}}{4}$
B. $d = \frac{-7 \pm \sqrt{33}}{4}$
C. $d = \frac{7 \pm \sqrt{65}}{4}$
D. $d = \frac{7 \pm \sqrt{33}}{4}$

13. To solve $t^2 - 12t = 10$, Josh completes the square on the left-hand side of the equation. What value must he add to both sides of the equation to achieve this?

- A. 12 B. 36 C. 120 D. 144

14.	What is the solution to $3x^2 + 5x - 1 = 0$, correct to one decimal place? A. $x = -1.8$ or $x = 0.2$. B. $x = -0.2$ or $x = 1.8$ C. $x = -1.4$ or $x = -0.2$. D. $x = 0.2$ or 1.4
15.	For what value of s is $s^4 - 12 = 21.1776$? A. $x = -2.4$ or $x = 2.4$ B. $x = 2.4$ only. C. $x = -5.76$ or $x = 5.76$. D. $x = 5.76$ only.
16.	Make q the subject of the equation $u = \sqrt{w^3 + mq}$. A. $q = \frac{w^3 - u^2}{m}$ B. $q = \frac{u^2 - w^3}{m}$ C. $q = \frac{m}{u^2 - w^3}$ D. $q = \frac{m}{w^3 - u^2}$

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Section 3

Longer Answer Section

Write all working and answers in the spaces provided on this test paper.

Marks

1. (a) Solve $5x^2 - 8x - 5 = 2x(x + 3)$

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(b) Solve $\frac{2x}{x + 1} = \frac{x + 1}{x}$.

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Marks

(c) Two positive numbers differ by 12.5 and have a product of 456.

i) If the smaller number is n , write an expression for the larger number.

1

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ii) Write an equation for the product of the two numbers.

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iii) Solve the equation to find the value of the two numbers.

3

2. Find the x values of the points which simultaneously solve these equations.

3

$$\begin{cases} y = 8x^2 - 24x \\ y = 10x - 35 \end{cases}$$

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Multiple Choice Answer Sheet

Non Linear Equations

Name _____

Completely fill the response oval representing the most correct answer.

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| 2. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
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| 15. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 16. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |

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Non Linear Equations

Non Calculator Section

ANSWERS

Question	Working and Answer
1.	$p^2 = 49$ $p = \pm\sqrt{49}$ $= \pm 7$
2.	$2x^2 = 128$ $x^2 = \frac{128}{2} = 64$ $x = \pm\sqrt{64}$ $x = \pm 8$
3.	$k^2 - 36 = 0$ $(k + 6)(k - 6) = 0$ $\text{OR } k^2 = 36$ $k = \pm 6$
4.	$\frac{b^2}{3} = 27$ $b^2 = 27 \times 3 = 81$ $b = \pm\sqrt{81}$ $= \pm 9$
5.	$2e^2 + 5 = 23$ $2e^2 = 23 - 5 = 18$ $e^2 = \frac{18}{2} = 9$ $e = \pm\sqrt{9}$ $= \pm 3$
6.	$(m - 5)(m - 9) = 0$ $m = 5 \text{ or } m = 9$

Question	Working and Answer
7.	$s(2s + 5) = 0$ $s = 0$ or $2s + 5 = 0$ $s = 0$ or $2s = -5$ $s = 0$ or $s = -\frac{5}{2}$
8.	$m^2 - 14m + 48 = 0$ $(m - 6)(m - 8) = 0$ $m = 6$ or $m = 8$
9.	$y^2 + 12y + 20 = 0$ $(y + 2)(y + 10) = 0$ $y = -2$ or $y = -10$
10.	$t^2 + 7t - 44 = 0.$ $(t - 4)(t + 11) = 0$ $t = 4$ or $t = -11$
11.	$w^2 - w - 72 = 0.$ $(w - 9)(w + 8) = 0$ $w = 9$ or $w = -8$
12.	$2x^2 + 17x + 21 = 0$ $2x^2 + 14x + 3x + 21 = 0$ $2x(x + 7) + 3(x + 7) = 0$ $(2x + 3)(x + 7) = 0$ $2x = -3$ or $x = -7$ $x = -\frac{3}{2}$ or $x = -7$
13.	$3d^2 - 17d - 56 = 0$ $3d^2 - 24d + 7d - 56 = 0$ $3d(d - 8) + 7(d - 8) = 0$ $(3d + 7)(d - 8) = 0$ $3d = -7$ or $d = 8$ $d = -\frac{7}{3}$ or $d = 8$

Question	Working and Answer
14.	$2r^2 + 9r + 5 = 0$ <p>Cannot be factorised, so use formula $a = 2, b = 9$ and $c = 5$</p> $r = \frac{-9 \pm \sqrt{81 - 4 \times 2 \times 5}}{2 \times 2}$ $r = \frac{-9 \pm \sqrt{81 - 40}}{4}$ $r = \frac{-9 \pm \sqrt{41}}{4}$
15.	$m^2 - 16m = 5$ <p>Halve the coefficient of m (-8) and add the square of this value ($+ 64$) to both sides.</p> $m^2 - 16m + 64 = 5 + 64$ $(m - 8)^2 = 69$ $m - 8 = \pm\sqrt{69}$ $m = 8 \pm \sqrt{69}$
16.	$3z^2 - 11z + 4 = 0$ <p>Cannot be factorised, so use formula $a = 3, b = -11$ and $c = 4$</p> $z = \frac{11 \pm \sqrt{121 - 4 \times 3 \times 4}}{2 \times 3}$ $z = \frac{11 \pm \sqrt{121 - 48}}{6}$ $z = \frac{11 \pm \sqrt{73}}{6}$ $z = 3.26 \text{ or } z = 0.41 \quad (2 \text{ dec places})$
17.	$3x^2 + 5x + 9 = 0$ <p>Cannot factorise, so use formula First find the value of $\Delta = b^2 - 4ac$ $5^2 - 4 \times 3 \times 9 = 25 - 108$ $= -83$</p> <p>Hence equation includes term in $\sqrt{-83}$ So no real solution</p>

Question	Working and Answer
18.	$P = \frac{rw - q}{4a}$ $4aP = rw - q$ $4aP + q = rw$ $w = \frac{4aP + q}{r}$

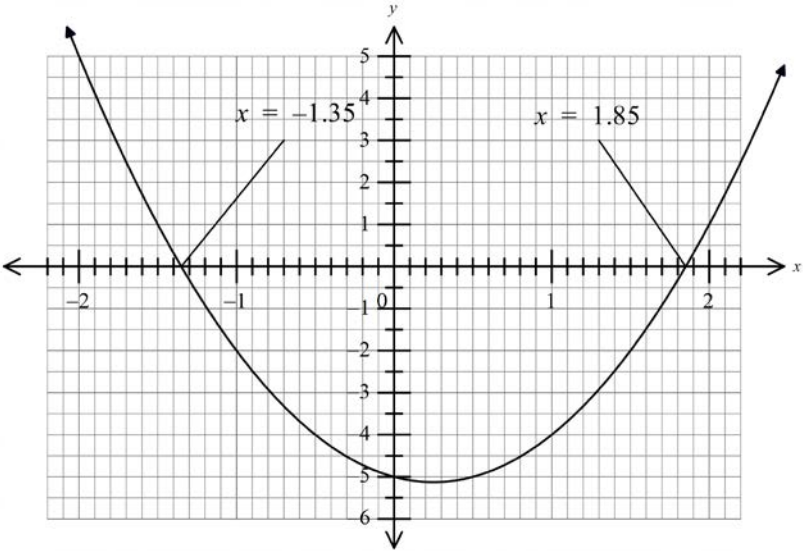
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Calculator Allowed
Multiple Choice
Section

ANSWERS

Question	Working	M C Answer
1.	$(g - 7)(g + 4) = 0$ $g = 7$ or $g = -4$	C
2.	$(x - 8)(x - 3) = 0$ $x = 8$ or $x = 3$	D
3.	$(4x - 3)(2x + 7) = 0$ $4x - 3 = 0$ or $2x + 7 = 0$ $4x = 3$ or $2x = -7$ $x = \frac{3}{4}$ or $x = -\frac{7}{2}$	B
4.	$36x^2 - 25 = 0$ $(6x - 5)(6x + 5) = 0$ $6x - 5 = 0$ or $6x + 5 = 0$ $6x = 5$ or $6x = -5$ $x = \frac{5}{6}$ or $x = -\frac{5}{6}$	B
5.	$w^2 - 12w + 36 = 0$ $(w - 6)(w - 6) = 0$ $(w - 6)^2 = 0$ $w = 6$ only	D
6.	$s^2 + 2s - 48 = 0$ $(s + 8)(s - 6) = 0$ $s = -8$ or $s = 6$	A
7.	$p^2 - 17p + 72 = 0$ $(p - 9)(p - 8) = 0$ $p = 8$ or $p = 9$	C

8.	$2w^2 - 15w + 18 = 0$ $2w^2 - 3w - 12w + 18 = 0$ $w(2w - 3) - 6(2w - 3) = 0$ $(w - 6)(2w - 3) = 0$ $2w - 3 = 0 \text{ or } w = 6$ $2w = 3 \text{ or } w = 6$ $w = \frac{3}{2} \text{ or } w = 6$	C
9.	$5u^2 + 21u - 20 = 0$ $5u^2 - 4u + 25u - 20 = 0$ $u(5u - 4) + 5(5u - 4) = 0$ $(5u - 4)(u + 5) = 0$ $5u = 4 \text{ or } u = -5$ $u = \frac{4}{5} \text{ or } u = -5$	A
10.	 <p>$x = -1.35 \text{ or } x = 1.85$</p>	C
11.	$6x^2 - 13x = 2x^2 - 10$ $4x^2 - 13x + 10 = 0$ $4x^2 - 5x - 8x + 10 = 0$ $x(4x - 5) - 2(4x - 5) = 0$ $(4x - 5)(x - 2) = 0$ $4x = 5 \text{ or } x = 2$ $x = \frac{5}{4} \text{ or } x = 2$	B

12.	$2d^2 - 7d + 2 = 0$ Cannot factorise so use the formula $a = 2, b = -7$ and $c = 2$ $d = \frac{7 \pm \sqrt{49 - 4 \times 2 \times 2}}{2 \times 2}$ $= \frac{7 \pm \sqrt{49 - 16}}{4}$ $= \frac{7 \pm \sqrt{33}}{4}$	D
13.	To complete the square (for a monic quadratic in t) we halve the coefficient of t , square this and add to both sides. Coefficient of $x = b = -12$, so add $\left(-\frac{12}{2}\right)^2$ to both sides ie add 36	B
14.	$3x^2 + 5x - 1 = 0$ Use the formula $a = 3, b = 5 \quad c = -1$ $x = \frac{-5 \pm \sqrt{25 - 4 \times 3 \times (-1)}}{2 \times 3}$ $= \frac{-5 \pm \sqrt{25 + 12}}{6}$ $= \frac{-5 \pm \sqrt{37}}{6}$ $= 0.18046 \text{ or } -1.847127$ $x = -1.8 \text{ or } 0.2 \text{ (to 1 decimal place)}$	A
15.	$s^4 - 12 = 21.1776$ $s^4 = 33.1776$ $s = \pm \sqrt[4]{33.1776}$ $= -2.4 \text{ or } 2.4$	A
16.	$u = \sqrt{w^3 + mq}$ $u^2 = w^3 + mq$ $u^2 - w^3 = mq$ $q = \frac{u^2 - w^3}{m}$	B

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Multiple Choice Answer Sheet

Non Linear Equations

Name _____

Completely fill the response oval representing the most correct answer.

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Question	Working and Answer	Marks
1.	<p>(a)</p> $5x^2 - 8x - 5 = 2x(x + 3)$ $5x^2 - 8x - 5 = 2x^2 + 6x$ $3x^2 - 14x - 5 = 0$ $3x^2 + x - 15x - 5 = 0$ $x(3x + 1) - 5(3x + 1) = 0$ $(3x + 1)(x - 5) = 0$ $3x = -1 \text{ or } x = 5$ $x = -\frac{1}{3} \text{ or } x = 5$	<p>3 marks for complete solution</p> <p>2 marks for solution with a minor error</p> <p>1 mark for attempt that includes expanding and simplifying</p>
	<p>(b)</p> $\frac{2x}{x + 1} = \frac{x + 1}{x}$ $\frac{2x}{x + 1} \times x(x + 1) = \frac{x + 1}{x} \times x(x + 1)$ $2x \times x = (x + 1)^2$ $2x^2 = x^2 + 2x + 1$ $x^2 - 2x - 1 = 0$ $x = \frac{2 \pm \sqrt{4 + 4}}{2}$ $= \frac{2 \pm \sqrt{8}}{2}$ $= 1 \pm \sqrt{2} \quad (\text{Not required to simplify surds})$	<p>3 marks for complete solution</p> <p>2 marks for solution with a minor error</p> <p>1 mark for attempt that includes expanding and simplifying</p>

Question	Working and Answer	Marks
	<p>(c) i) Since they differ by 12.5 and n is the smaller, the larger number is $n + 12.5$</p> <p>ii) The equation is $n(n + 12.5) = 456$</p> <p>iii)</p> $n(n + 12.5) = 456$ $n^2 + 12.5n = 456$ $2n^2 + 25n - 912 = 0$ <p>Using formula</p> $a = 2, b = 25, c = -912$ $n = \frac{-25 \pm \sqrt{625 - 4 \times 2 \times (-912)}}{2 \times 2}$ $= \frac{-25 \pm \sqrt{7921}}{4}$ $= \frac{-25 \pm 89}{4}$ $n = 16 \text{ or } n = -28.5$ <p>But n is a positive number, so $n = 16$ and $n + 12.5 = 28.5$</p> <p>The two numbers are 16 and 28.5</p> <p>Can also be done by factorising, completing the square or guess and check.</p>	<p>1 mark</p> <p>1 mark</p> <p>3 marks for correctly solving the equation and giving the answer</p> <p>2 marks for a mainly correct solution with a minor error</p> <p>1 mark for an incorrect attempt at solving the equation that shows some correct working</p>
2.	$\begin{cases} y = 8x^2 - 24x \\ y = 10x - 35 \end{cases}$ $8x^2 - 24x = 10x - 35$ $8x^2 - 34x + 35 = 0$ $8x^2 - 14x - 20x + 35 = 0$ $2x(4x - 7) - 5(4x - 7) = 0$ $(4x - 7)(2x - 5) = 0$ $4x = 7 \text{ or } 2x = 5$ $x = \frac{7}{4} \text{ or } x = \frac{5}{2}$	<p>3 marks complete solution which includes substitution to create quadratic equation, solution of quadratic and writing of answers.</p> <p>2 marks partially correct solution, for example not substituting correctly or not solving the quadratic correctly and writing two answers.</p> <p>Allocate 1 mark for working that includes some correct reasoning and calculations.</p>