

High School Mathematics Test 2015

Year 10A

Non Linear Equations

Non Calculator

- Graph simple nonlinear relations with and without the use of digital technologies and solve simple related equations (ACMNA296)
- 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. Find the values of m for which $m^2 = 81$.

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2. Solve the equation $3p^2 = 75$.

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3. For what values of w is $w^2 - 49 = 0$?

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4. For what values of p is $p^2 - 17 = 47$?

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5. Solve for w : $3w^2 - 19 = 8$.

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6.	Solve $(y + 9)(y - 5) = 0$
7.	Solve the equation: $s^2 + 9s + 14 = 0$
8.	Solve : $t^2 - 4t - 21 = 0$?
9.	Solve $p^2 - 12p + 35 = 0$
10.	Solve $r^2 + 2r - 80 = 0$
11.	Solve $3u^2 + 7u + 2 = 0$
12.	Solve $5m^2 - 34m - 7 = 0$

13. Give the exact values for which $k^2 + 9k + 2 = 0$.

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14. Find the solutions to $3e^2 - e - 6 = 0$, correct to two decimal places.

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15. Determine how many solutions (if any) there are to the equation $9x^2 - 6x + 1 = 0$.
Explain your answer.

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16. Make r the subject of $V = \frac{4\pi r^3}{3}$.

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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 $(m - 2)(m - 6) = 0$ are:

- A. $m = -2$ or $m = -6$. B. $m = -2$ or $m = 6$.
C. $m = 2$ or $m = -6$. D. $m = 2$ or $m = 6$.

2. For what values of x is $(4x - 3)(2x + 7) = 0$?

- A. $x = -\frac{3}{4}$ or $x = \frac{7}{2}$. B. $x = -\frac{4}{3}$ or $x = \frac{2}{7}$.
C. $x = \frac{3}{4}$ or $x = -\frac{7}{2}$. D. $x = \frac{4}{3}$ or $x = -\frac{2}{7}$.

3. The solutions to $25a^2 - 36 = 0$ are:

- A. $x = -\frac{6}{5}$ or $x = \frac{6}{5}$. B. $x = -\frac{6}{5}$ only.
C. $x = -\frac{5}{6}$ or $x = \frac{5}{6}$. D. $x = \frac{5}{6}$ only.

4. What are the solutions to $p^2 + 14p + 49 = 0$?

- A. $p = -7$ or $p = 7$. B. $p = 0$ or $p = 7$.
C. $p = -7$ only. D. $p = 7$ only.

5. The solutions to $e^2 + 3e - 88 = 0$ are:

- A. $e = -11$ or $e = -8$. B. $e = -11$ or $e = 8$.
C. $e = 11$ or $e = -8$. D. $e = 11$ or $e = 8$.

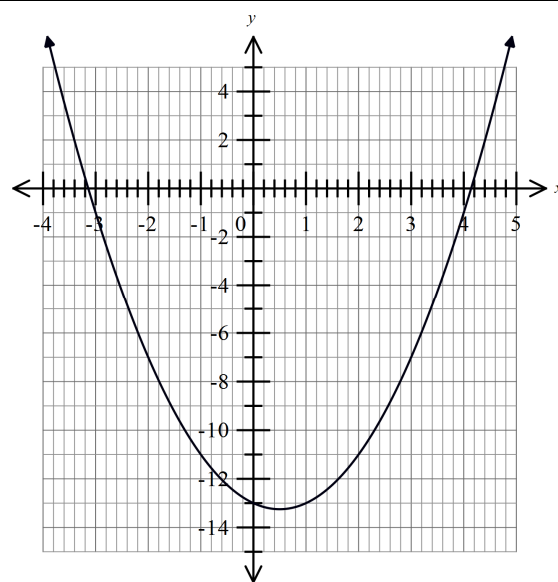
6. Solve $2p^2 + p - 36 = 0$.

- A. $p = -\frac{9}{2}$ or $p = -4$. B. $p = -\frac{9}{4}$ or $p = -2$.
C. $p = -\frac{9}{4}$ or $p = 2$. D. $p = -\frac{9}{2}$ or $p = 4$.

7. The graph of $y = x^2 - x - 13$ is shown.

Estimate the solution to $x^2 - x - 13 = 0$

- A. $x = -4.2$ or $x = 3.2$.
B. $x = -3.9$ or $x = 2.9$.
C. $x = -3.2$ or $x = 4.2$.
D. $x = -2.9$ or $x = 3.9$.



8. Find all the solutions to $2x^2 - 12x = x - 18$

- A. $x = -4\frac{1}{2}$ or $x = -2$. B. $x = -1\frac{3}{4}$ or $x = 10\frac{1}{4}$.
C. $x = 0$ or $x = 6$. D. $x = 2$ or $x = 4\frac{1}{2}$

9. The solutions to $3w^2 + 7w + 3 = 0$ are:

- A. $w = \frac{-7 \pm \sqrt{13}}{6}$ B. $w = \frac{-7 \pm \sqrt{85}}{6}$
C. $w = \frac{7 \pm \sqrt{13}}{6}$ D. $w = \frac{7 \pm \sqrt{85}}{6}$

10.	Solve $n^2 - 8n + 14 = 0$. A. $n = 2.6$ or 4.4 . C. $n = 2.6$ or 6.6 . B. $n = 2.6$ or 5.4 . D. $n = 6.6$ or 9.4 .
11.	For what value of x is $x^3 = 13.824$? A. $x = -2.4$ or $x = 2.4$. C. $x = -4.6$ or $x = 4.6$. B. $x = 2.4$ only. D. $x = 4.6$ only.
12.	Make s the subject of the equation $v^2 = u^2 + 2as$. A. $s = \frac{v^2 - u^2}{2a}$ B. $s = \frac{u^2 - v^2}{2a}$ C. $s = \frac{2a}{v^2 - u^2}$ D. $s = \frac{2a}{u^2 - v^2}$

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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 $3x^2 + 2x - 15 = x(x + 3)$

2

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(b) Solve $\frac{12}{x^2} = \frac{x+1}{x}$.

2

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Marks

(c) A rectangle is to be drawn so that its length is 2.3 metres more than its width.

Its area is to be 12 m^2 .

- i) Using w to represent the width, write expressions for the length and the area of the rectangle.

2

- ii) Write an equation using the area and solve it to find the length and width.

3

2. Solve simultaneously

3

$$\begin{cases} y = x + 8 \\ y = 3x^2 - x \end{cases}$$

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Multiple Choice Answer Sheet

Non Linear Equations

Name _____

Completely fill the response oval representing the most correct answer.

- | | | | | | | | | |
|-----|---|-----------------------|---|-----------------------|---|-----------------------|---|-----------------------|
| 1. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 2. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 3. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
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| 11. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 12. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |

High School Mathematics Test 2015

Year 10A *Non Linear Equations*

Non Calculator

Section 1 Short Answer Section

ANSWERS

No.	WORKING	ANSWER
1.	$m^2 = 81$ $m = \pm\sqrt{81}$ $= \pm 9$	$m = \pm 9$
2.	$3p^2 = 75$ $p^2 = \frac{75}{3} = 25$ $p = \pm\sqrt{25}$ $p = \pm 5$	$p = \pm 5$
3.	$w^2 - 49 = 0$ $(w + 7)(w - 7) = 0$ $w = \pm 7$	$w = \pm 7$
4.	$p^2 - 17 = 47$ $p^2 = 47 + 17 = 64$ $p = \pm\sqrt{64}$ $p = \pm 8$	$p = \pm 8$
5.	$3w^2 - 19 = 8$ $3w^2 = 8 + 19 = 27$ $w^2 = \frac{27}{3} = 9$ $w = \pm\sqrt{9}$ $w = \pm 3$	$w = \pm 3$
6.	$(y + 9)(y - 5) = 0$ $y + 9 = 0$ or $y - 5 = 0$ $y = -9$ or $y = 5$	$y = -9$ or $y = 5$
7.	$s^2 + 9s + 14 = 0$ $(s + 7)(s + 2) = 0$ $s = -7$ or $s = -2$	$s = -7$ or $s = -2$

8.	$t^2 - 4t - 21 = 0$ $(t - 7)(t + 3) = 0$ $t = 7$ or $t = -3$	$t = 7$ or $t = -3$
9.	$p^2 - 12p + 35 = 0$ $(p - 7)(p - 5) = 0$ $p = 7$ or $p = 5$	$p = 7$ or $p = 5$
10.	$r^2 + 2r - 80 = 0$ $(r + 10)(r - 8) = 0$ $r = -10$ or $r = 8$	$r = -10$ or $r = 8$
11.	$3u^2 + 7u + 2 = 0$ $3u^2 + 6u + u + 2 = 0$ $3u(u + 2) + 1(u + 2) = 0$ $(3u + 1)(u + 2) = 0$ $3u = -1$ or $u = -2$ $u = -\frac{1}{3}$ or $u = -2$	$u = -\frac{1}{3}$ or $u = -2$
12.	$5m^2 - 34m - 7 = 0$ $5m^2 - 35m + m - 7 = 0$ $5m(m - 7) + 1(m - 7) = 0$ $(5m + 1)(m - 7) = 0$ $m = -\frac{1}{5}$ or $m = 7$	$m = -\frac{1}{5}$ or $m = 7$
13.	$k^2 + 9k + 2 = 0$ Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $k = \frac{-9 \pm \sqrt{81 - 8}}{2}$ $k = \frac{-9 \pm \sqrt{73}}{2}$	$k = \frac{-9 \pm \sqrt{73}}{2}$
14.	$3e^2 - e - 6 = 0$ $e = \frac{1 \pm \sqrt{1 - -72}}{6}$ $e = \frac{1 \pm \sqrt{73}}{6}$ $e = 1.59$ or -1.26	$= 1.59$ or -1.26

15.	$9x^2 - 6x + 1 = 0$ $x = \frac{6 \pm \sqrt{(-6)^2 - 4 \times 9 \times 1}}{18} = \frac{6 \pm 0}{18}$ <p>Hence there is one real solution of $x = \frac{1}{3}$</p> <p>OR</p> $9x^2 - 6x + 1 = 0$ $(3x - 1)^2 = 0$ $3x = 1$ <p>Hence there is one real solution of $x = \frac{1}{3}$</p>	<p>There is one solution.</p> <p>Need reasoning and working out to receive a mark.</p>
16.	$V = \frac{4\pi r^3}{3}$ $3V = 4\pi r^3$ $r^3 = \frac{3V}{4\pi}$ $r = \sqrt[3]{\frac{3V}{4\pi}}$	$r = \sqrt[3]{\frac{3V}{4\pi}}$

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Section 2

Multiple Choice Section

ANSWERS

No.	WORKING	ANSWER
1.	$(m - 2)(m - 6) = 0$ $m - 2 = 0$ or $m - 6 = 0$ $m = 2$ or $m = 6$	D
2.	$(4x - 3)(2x + 7) = 0$ $4x = 3$ or $2x = -7$ $x = \frac{3}{4}$ or $x = -\frac{7}{2}$	C
3.	$25a^2 - 36 = 0$ $(5a - 6)(5a + 6) = 0$ $a = \pm \frac{6}{5}$	A
4.	$p^2 + 14p + 49 = 0$ $(p + 7)^2 = 0$ $p = -7$	C
5.	$e^2 + 3e - 88 = 0$ $(e + 11)(e - 8) = 0$ $e = -11$ or $e = 8$	B
6.	$2p^2 + p - 36 = 0$ $2p^2 + 9p - 8p - 36 = 0$ $p(2p + 9) - 4(2p + 9) = 0$ $(2p + 9)(p - 4) = 0$ $p = -\frac{9}{2}$ or $p = 4$	D
7.	From graph $x = -3.2$ or $x = 4.2$.	C

8.	$2x^2 - 12x = x - 18$ $2x^2 - 13x + 18 = 0$ $2x^2 - 9x - 4x + 18 = 0$ $x(2x - 9) - 2(2x - 9) = 0$ $(x - 2)(2x - 9) = 0$ $x = 2 \text{ or } x = \frac{9}{2}$ $x = 2 \text{ or } x = 4\frac{1}{2}$	D
9.	$3w^2 + 7w + 3 = 0$ <p>Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$</p> $w = \frac{-7 \pm \sqrt{49 - 36}}{6}$ $w = \frac{-7 \pm \sqrt{13}}{6}$	A
10.	$n^2 - 8n + 14 = 0$ $n = \frac{8 \pm \sqrt{64 - 56}}{2}$ $n = \frac{8 \pm \sqrt{8}}{2}$ $n = 2.6 \text{ or } 5.4.$	B
11.	$x^3 = 13.824$ $x = \sqrt[3]{13.824}$ $x = 2.4$	B
12.	$v^2 = u^2 + 2as$ $v^2 - u^2 = 2as$ $s = \frac{v^2 - u^2}{2a}$	A

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Multiple Choice Answer Sheet

Non Linear Equations

Name ANSWERS

Completely fill the response oval representing the most correct answer.

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|-----|---|----------------------------------|---|----------------------------------|---|----------------------------------|---|----------------------------------|
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Year 10A	<i>Non Linear Equations</i>		Calculator Allowed
Section 3 Longer Answer Section			
ANSWERS			
			Marks
1.	(a) $3x^2 + 2x - 15 = x(x + 3)$ $3x^2 + 2x - 15 = x^2 + 3x$ $2x^2 - x - 15 = 0$ $2x^2 - 6x + 5x - 15 = 0$ $2x(x - 3) + 5(x - 3) = 0$ $(2x + 5)(x - 3) = 0$ $x = -\frac{5}{2} \text{ or } x = 3$	2 marks for correct answers. 1 mark for working with a single error in logic or calculation.	
	(b) $\frac{12}{x^2} = \frac{x + 1}{x} \text{ (NB } x \neq 0)$ Multiply by x^2 $12 = x(x + 1)$ $x^2 + x - 12 = 0$ $(x + 4)(x - 3) = 0$ $x = -4 \text{ or } x = 3$	2 marks for correct answers. 1 mark for working with a single error in logic or calculation.	

	<p>(c) i) i) $l = w + 2.3$ $A = l \times w$ $A = w(w + 2.3)$</p> <p>ii) $12 = w(w + 2.3)$ $w^2 + 2.3w - 12 = 0$ $w = \frac{-2.3 \pm \sqrt{5.29 + 48}}{2}$ $w = \frac{-2.3 \pm \sqrt{53.29}}{2}$ $w = \frac{-2.3 \pm 7.3}{2}$ $w = -4.8 \text{ or } 2.5$</p> <p>Since w is a length can only use 2.5 metres. "Width is 2.5 m and length is 4.8 m.</p>	<p>2 marks one for length and 1 for area.</p> <p>1 mark for setting area = 12</p> <p>2 marks for solving correctly</p> <p>1 mark for attempt at solving which has a minor error</p>
2.	$\begin{cases} y = x + 8 \\ y = 3x^2 - x \end{cases}$ <p>Sub 1st into second</p> $x + 8 = 3x^2 - x$ $3x^2 - 2x - 8 = 0$ $3x^2 - 6x + 4x - 8 = 0$ $3x(x - 2) + 4(x - 2) = 0$ $(3x + 4)(x - 2) = 0$ $x = -\frac{4}{3} \text{ or } x = 2$ $y = 6\frac{2}{3} \text{ or } y = 10$ <p>The points of solution are $\left(-1\frac{1}{3}, 6\frac{2}{3}\right)$ and $(2, 10)$</p>	<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>