norwest CHRISTIAN COLLEGE
STRENGTH OF PURPOSE

Student Name: _____

Year 10 MATHEMATICS 5.2/5.3 2023

TASK 2 – Half Yearly Examination

General Instructions

- Reading time – 5 minutes
- Working time – 90 minutes
- Show all necessary working / units
- Board approved calculators are allowed
- Exam guidelines
  - ✓ Use black pen for your working
  - ✓ Use a pencil and ruler for diagrams
  - ✓ Marks may be lost for poorly organised written work.

Total Marks – 80

Section 1 5.2 – 40 marks

Suggested time: 40 mins

Section 2 5.3 – 40 marks

Suggested time: 50 mins

Examiner's use only			**D.Hua, V.Chan, B.Su, B. Vincent, J. Barter**	
Question	**Indices and Algebra**	**Equations and Formulas**	**Linear and non-linear relations**	**Total**
Section 1 (5.2)				/40
1-3,13-15	/12			
7-8,11-12		/12		
4-6,9-10,16-18			/16	
Section 2 (5.3)				/40
2,6	/7			
3,7		/8		
1,4,5,8,9			/25	
				/80

Section 2 – 5.2 (40 marks)
Attempt Questions 1 to 18
Allow approximately 50 minutes for this section

Multiple Choice Questions 1-10

1. The expanded form of $5a(4a + 3)$ is:

   A. $20a^2 + 3$
   B. $20a + 15$
   C. $9a^2 + 8a$
   D. $20a^2 + 15a$

2. When simplified, $x^3y^6 \times xy^7$ is:

   A. x^3y^{42}
   B. x^3y
   C. x^4y^{13}
   D. x^4y^{14}

3. $(5a^3b^2)^2$ simplifies to:

   A. $10a^6b^4$
   B. $25a^6b^4$
   C. $10a^5b^4$
   D. $25a^5b^4$

4. The gradient of a line parallel to $y = 10x + 5$ is:

   A. 0.5
   B. 2
   C. 10
   D. 5

5. On which of the following lines does the point $(4, -10)$ lie?

A. $y = 2x + 5$

B. $y = 3x - 2$

C. $y = 5 - 2x$

D. $y = 2 - 3x$

6. The gradient of the line joining the points $(1, 2)$ and $(3, 6)$ is:

A. -2

B. 2

C. 3

D. -3

7. $x \leq 2$ is a solution to the inequality:

A. $x - 2 < 0$

B. $2x + 3 \geq 7$

C. $-4x \geq -8$

D. $x - 10 > 12$

8. When 3 less than 4 lots of a number is doubled, the result is 12. This translates to which equation?

A. $6x - 4 = 12$

B. $2(4x - 3) = 12$

C. $2(3x - 4) = 12$

D. $2x = 12$

9. When the expression $(x + 2)(x - 5)$ is expanded, the result will be:

A. $x^2 - 3x + 10$

B. $x^2 - 3x - 10$

C. $x^2 + 3x - 10$

D. $x^2 + 3x + 10$

10. The graph of $y = -x^2 + 3$ will be:

A. a straight line

B. a concave up parabola

C. an exponential curve

D. a concave down parabola

Short Answer Questions 11-18
Answer the questions in the spaces provided. Your responses should include relevant mathematical reasoning and/or calculations.
Marks **CANNOT** be awarded for poorly organised written work.

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11. Solve for x in the following equations.

a. $5x = 2x + 12$ (2 marks)

$5x - 2x = 12$ ✓

$3x = 12$

$x = 4$ ✓

b. $\frac{x}{3} - 12 = 4$ (2 marks)

$\frac{x}{3} = 4 + 12$ ✓

$\frac{x}{3} = 16$

$x = 48$ ✓

c. $3(2x + 4) - 4(x + 2) = 6$ (3 marks)

$6x + 12 - 4x - 8 = 6$ ✓

$2x + 4 = 6$ ✓

$2x = 2$

$x = 1$ ✓

12. Solve the simultaneous equations $4x + 3y = -1$ and $y = 2x - 7$ (3 marks)
by using the method of substitution.

$4x + 3(2x - 7) = -1$ ✓
$4x + 6x - 21 = -1$
$10x - 21 = -1$
$10x = 20$
$x = 2$ ✓
$\therefore y = -3$ ✓

13. Use index laws to simplify the following and express the solution with positive indices where required:

a. $3x^2 \times (2x)^3$ (2 marks)

$24x^5$ — (1)
✓ (1)

b. $6p^4q \div 2pq^3$ (2 marks)

$\frac{3p^3}{q^2}$ — (1)
— (1)

14. Simplify $\frac{x}{2} + \frac{x}{3}$ (2 marks)

$= \frac{3x}{6} + \frac{2x}{6}$ ✓
$= \frac{5x}{6}$ ✓

15. An initial investment of \$5 000grows every year according to the formula $A = 5\,000\,(1.01)^n$ where A is the value of the investment after n years. Find the value of the investment after 8 years, giving the answer in scientific notation rounded to 2 significant figures. (3 marks)

$A = 5000\,(1.01)^8$ ✓

$= 5414.28$

$\doteq 5.4 \times 10^3$ ✓ scientific ✓ sig fig

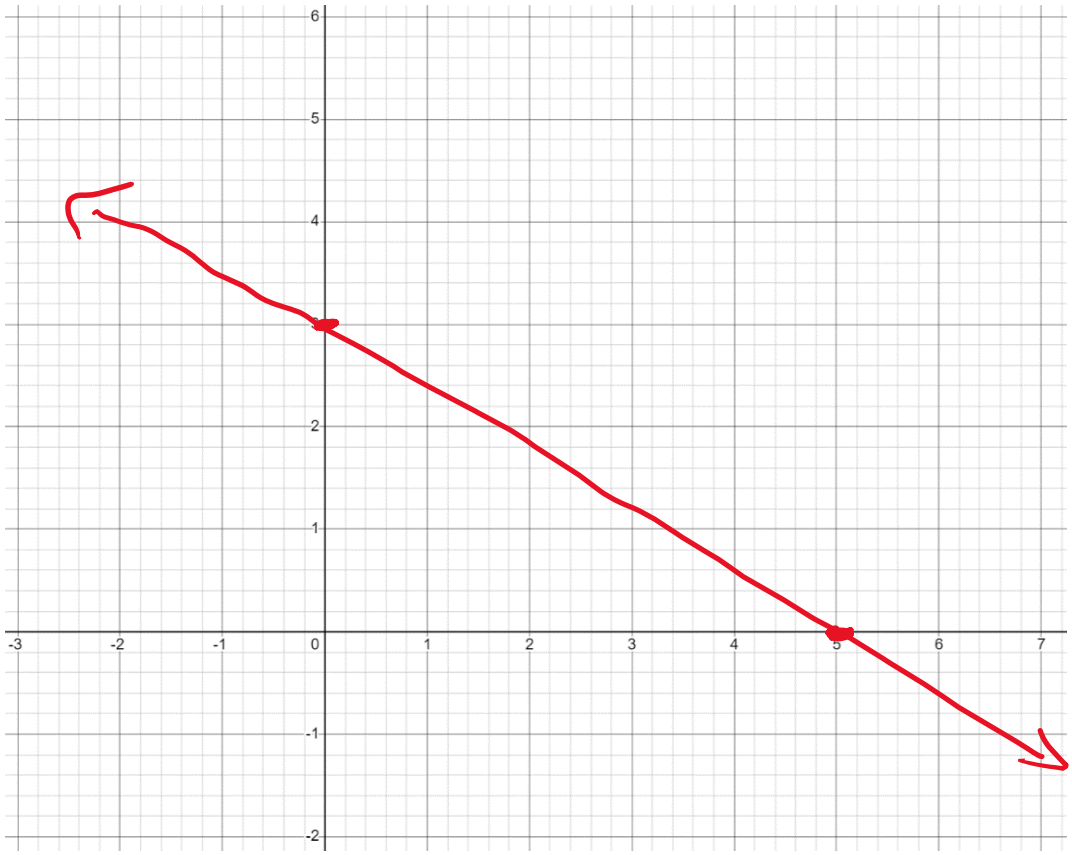
16. For the equation $3x + 5y = 15$:

a. Calculate the x and y intercepts. (2 marks)

let $x = 0$, $y = 3$ ✓

$y = 0$, $x = 5$ ✓

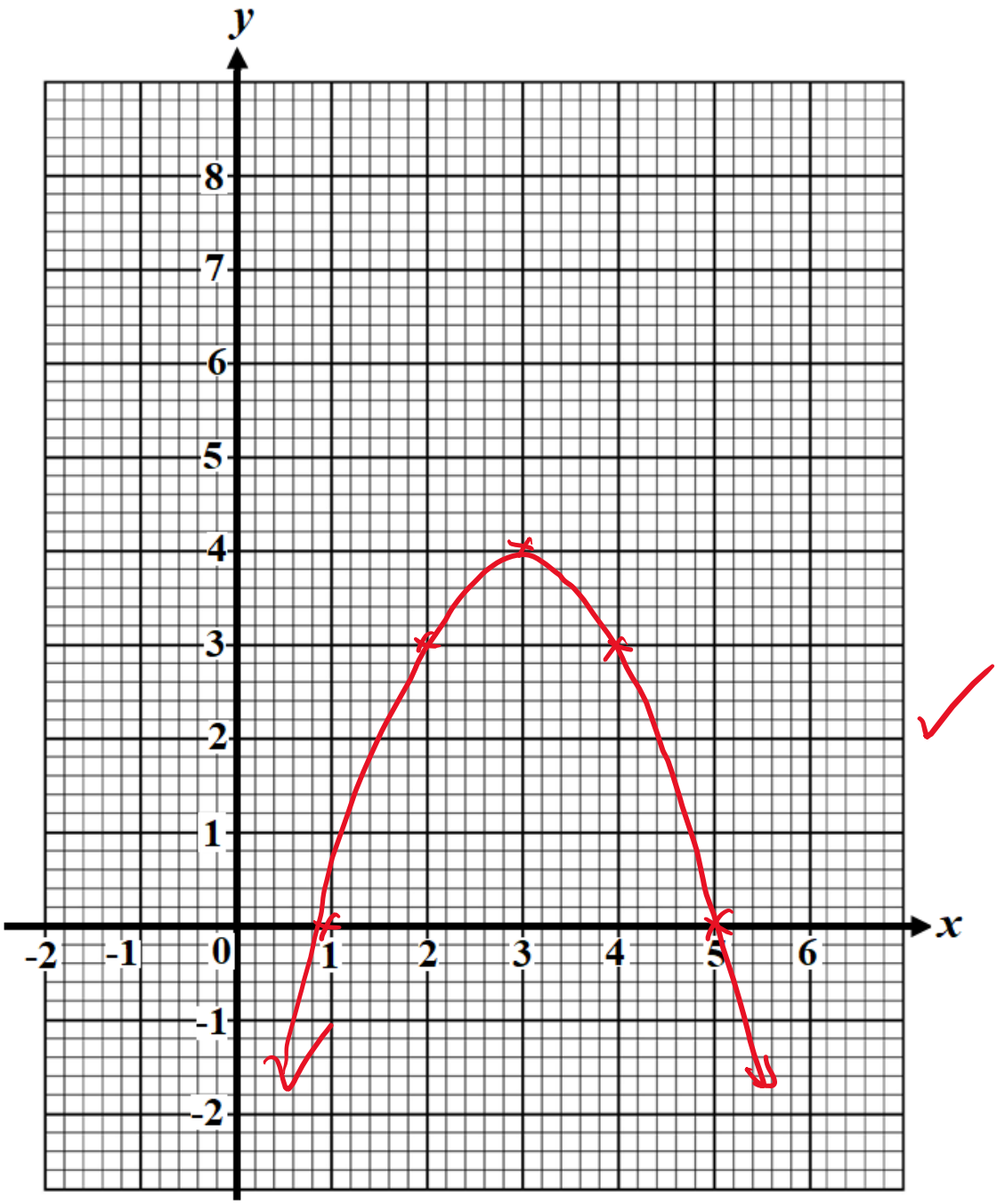
b. Hence or otherwise, sketch $3x + 5y = 15$. (1 mark)



17. a. Fill in the table for the given equation below and then plot the graph of this equation on number plane below. (2 marks)

$$y = -x^2 + 6x - 5$$

x	1	2	3	4	5
y	0	3	4	3	0



b. From the graph sketched, identify:

i. The x-intercepts. (1 mark)

$x = 1, 5$

ii. The axis of symmetry. (1 mark)

$x = 3$

iii. The vertex. (1 mark)

$(3, 4)$

18. Find the equation of the line that is parallel to $y = 2x + 3$ and passes through the point $(1, 5)$. (3 marks)

$m = 2$ ✓

$y - y_1 = m(x - x_1)$

$y - 5 = 2(x - 1)$ ✓

$y - 5 = 2x - 2$

$y = 2x + 3$ ✓

Section 2 – 5.3 (40 marks)
Attempt Questions 1 to 9.
Allow approximately 50 minutes for this section

Multiple Choice Questions 1-5

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1 If $ax^2 + bx + c = 0$ has no solutions then:

(A) $\Delta = 0$ (B) $\Delta > 0$

(C) $\Delta \approx 0$ (D) $\Delta < 0$

2 $\frac{6x^{-2}y^{-1}}{9x^{-5}y^{3}}$ expressed with positive indices is:

(A) $\frac{2x^3}{3y^4}$

(B) $\frac{2x^7}{3y^2}$

(C) $\frac{2y^4}{3x^3}$

(D) $\frac{2y^3}{3x^4}$

3 The gradient and the y-intercept, respectively, of the equation $4x + 2y - 6 = 0$ are?

(A) 3 and -2

(B) -2 and 3

(C) 2 and -3

(D) -3 and -2

$2y = -4x + 6$

$y = -2x + 3$

4 Compared to the graph $y = x^2$, the graph of $y = 4x^2$ is:

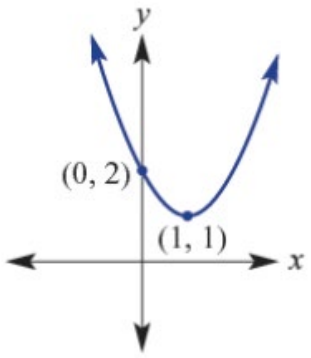
(A) translated 2 units left

(B) translated 2 units right

(C) narrower

(D) wider

5 The rule for a concave up parabola with turning point (1, 1):



(A) $y = (x + 1)^2 + 1$

(B) $y = (x - 1)^2 + 1$

(C) $y = (x + 1)^2 + 2$

(D) $y = (x - 1)^2 + 2$

Short Answer Questions 6-9
Answer the questions in the spaces provided. Your responses should include relevant mathematical reasoning and/or calculations.
Marks **CANNOT** be awarded for poorly organised written work.

Question 6 (Indices and surds) **(6 marks)**

(a) Simplify: (2)

$\sqrt{300} - \sqrt{48} - 3\sqrt{27}$

$= 10\sqrt{3} - 4\sqrt{3} - 9\sqrt{3}$ ✓

$= -3\sqrt{3}$ ✓

(b) Rationalise the denominator of the following expression (2)

$\frac{5}{\sqrt{3}-2}$

$\frac{5}{\sqrt{3}-2} \times \frac{\sqrt{3}+2}{\sqrt{3}+2}$ ✓ $= \frac{5\sqrt{3}+10}{3-4}$

$= -(5\sqrt{3}+10)$ ✓

$= -5\sqrt{3} - 10$

(c) Solve for x: (2)

$5^{2x} = 125^{x+1}$

$5^{2x} = 5^{3x+3}$

$\therefore 2x = 3x + 3$ ✓

$-x = 3$

$x = -3$ ✓

Question 7 Equations, inequalities, and simultaneous equations (7 marks)

(a) Solve for x

1) $2(x+3)-3(x-4)=19$ (2)

$2x+6-3x+12=19$ ✓

$-x+18=19$

$-x=1$

$x=-1$ ✓

2) $\frac{x+6}{3}=\frac{2x+4}{4}$ (2)

$4(x+6)=3(2x+4)$

$4x+24=6x+12$ ✓

$12=2x$

$x=6$ ✓

(b) Two lines l_1 and l_2 have equations $y = 2x + 1$ and $y = -\frac{x}{2} - 4$ respectively.

1. Show the two lines are perpendicular (1)

$m_{l_1} = 2$ $m_{l_2} = -\frac{1}{2}$

$2 \times -\frac{1}{2} = -1$ ✓

$\therefore$ Perpendicular

2. Find the point at which l_1 and l_2 intersect. (2)

$2x + 1 = -\frac{x}{2} - 4$ ✓

$\frac{5x}{2} = -5$

$5x = -10$

$x = -2$ } ✓

$y = -3$ }

Question 8 Quadratic equations **(7 marks)**

(a) Simplify fully (3)

$$\frac{6x+18}{9(x^2+4x+4)} \times \frac{x^2-4}{x+3}$$

$$= \frac{6(x+3)}{9(x+2)(x+2)} \times \frac{(x+2)(x-2)}{x+3}$$

$$= \frac{2(x-2)}{3(x+2)}$$

(b) Use the quadratic formula to solve the equation below, leaving your answer in exact values (2)

$$2x^2 - 5x - 8 = 0$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$= \frac{5 \pm \sqrt{25 - 4 \times 2 \times -8}}{2 \times 2}$$

$$= \frac{5 \pm \sqrt{89}}{4}$$

(c) For which values of k does the quadratic equation $2x^2 - 3x + k = 0$ have 1 solution? (2)

$\Delta = b^2 - 4ac$

$= 3^2 - 4 \times 2 \times k$ ✓

$= 9 - 8k = 0$ for 1 solution

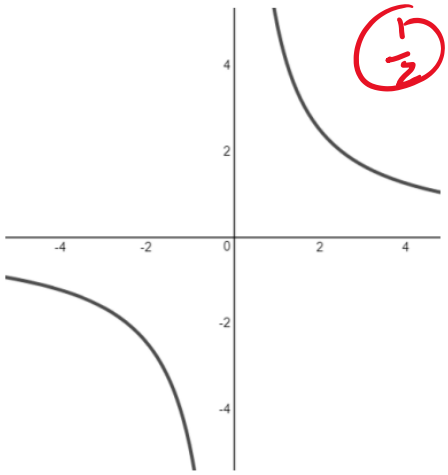
$9 = 8k$

$\frac{9}{8} = k$ ✓

Question 9 Functions **(15 marks)**

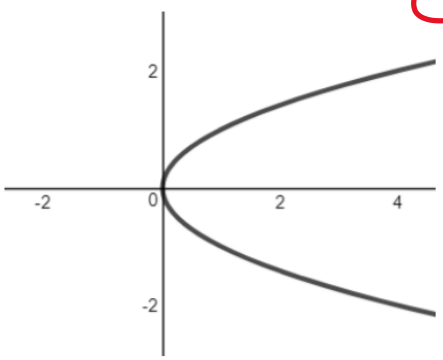
(a) Determine whether the following graphs are functions or relations (1)

a



F ½

b



R !

(b) If $f(x) = x^2 - 6x$, find x when $f(x) = -9$. (2)

$x^2 - 6x = -9$

$x^2 - 6x + 9 = 0$

$(x-3)^2 = 0$

$\therefore x = 3$

(c) If $f(x) = x^2 - 4$ and $g(x) = 3x - 6$, find:

1) $f(0) + g(3)$ (2)

$= -4 + 3 = -1$ ✓ ✓

2) $(g(x))^2 + g(x^2)$ (2)

$= (3x-6)^2 + 3x^2 - 6$ ✓

$= 9x^2 - 36x + 36 + 3x^2 - 6$

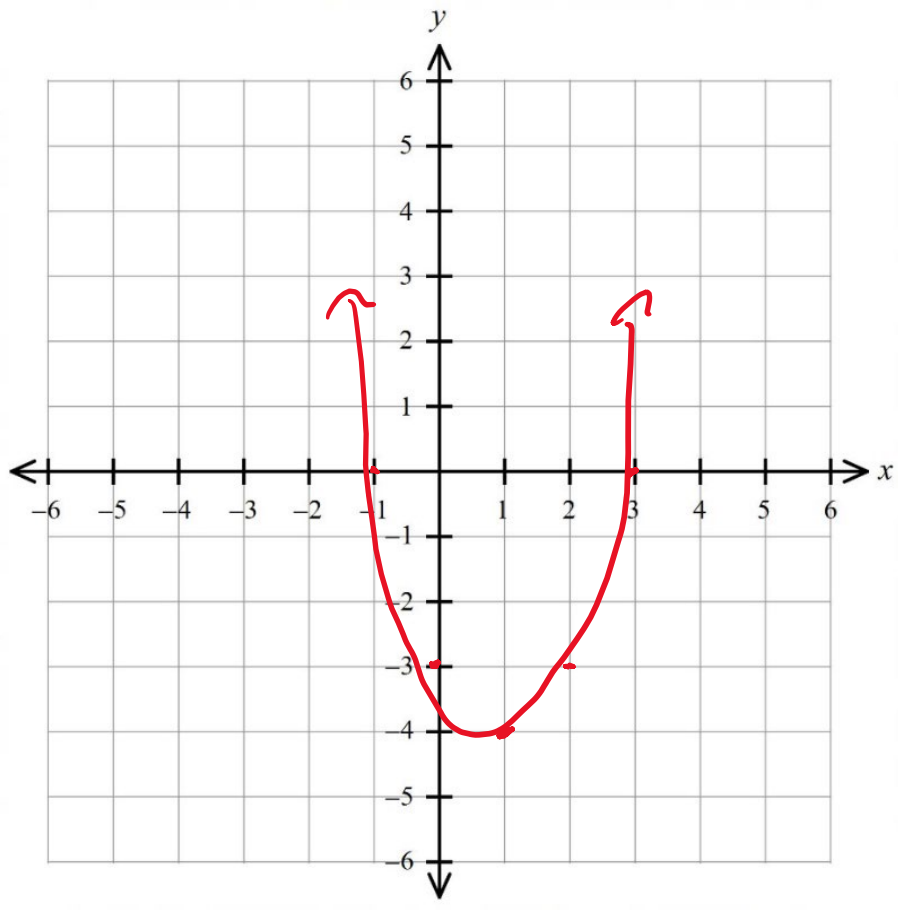
$= 12x^2 - 36x + 30$ ✓

(d) 1) By completing the square, show that $f(x) = x^2 - 2x - 3$ can be written as $f(x) = (x-1)^2 - 4$ (2)

$f(x) = x^2 - 2x + 1 - 4$ ✓

$= (x-1)^2 - 4$ ✓

2) Draw the graph of $y = (x-1)^2 - 4$, showing clearly the coordinates of the vertex and the x and y intercepts. (2)



(e) The area of a particular rectangle, R, in square centimetres can be expressed as $A = 8l - l^2$, where l is the length of the rectangle.

1) Explain why the length of the rectangle cannot be greater than 8cm. (1)

If $l > 8$, then $A < 0$. Since area cannot be negative, therefore l cannot be greater than 8cm.

2) By finding the axis of symmetry, or otherwise, show that the maximum area of the rectangle is $16cm^2$. (2)

$x = \frac{-b}{2a} = \frac{-8}{-2} = 4$ ✓

$A = 8(4) - 4^2$

$= 16\,cm^2$ ✓

3) What are the dimensions of the rectangle that give a maximum area of $16cm^2$? (1)

If $l = 4cm$

$A = l \times w$

$16 = 4 \times w$

$w = 4\,cm$ ∴ The dimensions are 4 x 4. ✓

END OF EXAM

Norwest Christian School
Mathematics Formulas (Stage 5)

Indices

$a^m \times a^n = a^{m+n}$

$a^m \div a^n = a^{m-n}$

$(a^m)^n = a^{m \times n}$

$a^{-m} = \frac{1}{a^m}$

$a^0 = 1$

$a^{\frac{1}{m}} = \sqrt[m]{a}$

Surds

$\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$

$\sqrt{a} \div \sqrt{b} = \sqrt{\frac{a}{b}}$

Equation of straight line

$y = mx + c$

$y - y_1 = m(x - x_1)$

Right angled triangle

$a^2 + b^2 = c^2$

Distance and Midpoint

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Quadratic Formula

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$