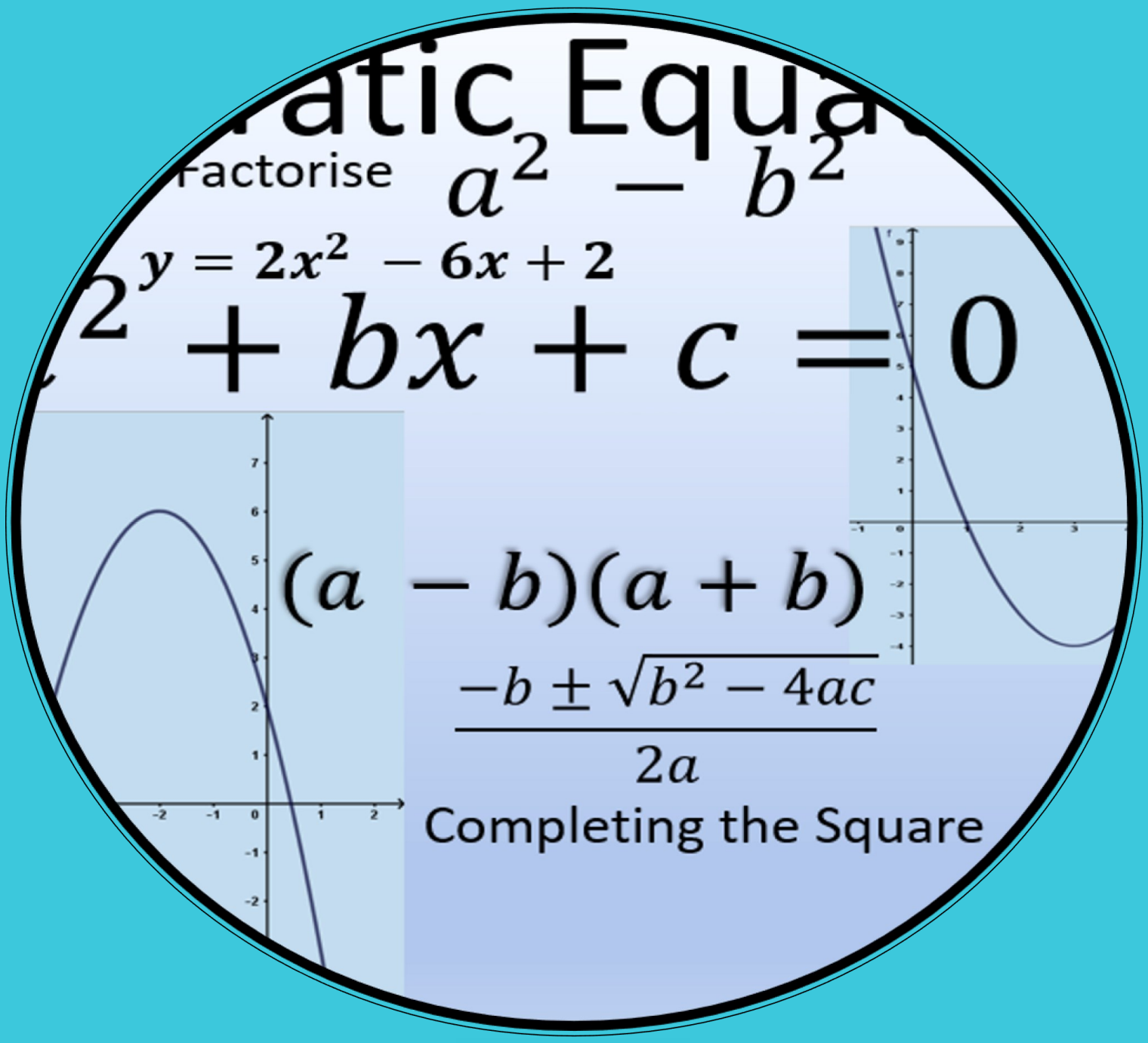

Quadratic Equations

Pupil Name

Handbook Designed by Dr I. Akinyemi

Timetable

Timetable – Tutorials

Tutorial	Date	Time	Location
1 (Baseline)			
2			
3			
4			
5			
6 (Final Assignment)			
7 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1		
Tutorial 2		
Tutorial 3		
Tutorial 4		
Tutorial 5		

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Uni Pathways – Pupil Feedback Report

Name of RIS Teacher	Dr Akinyemi
Topic of Assignment	Quadratic Equations
Name of Pupil	
Name of School	St Clere's School, Butts Lane, Stanford Le Hope. Essex

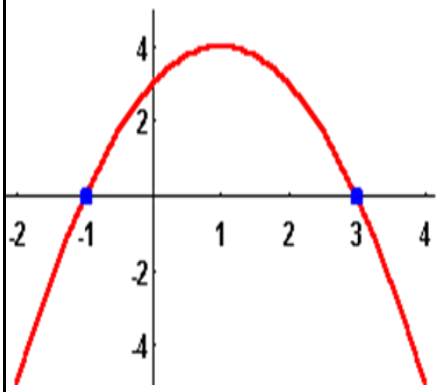
Learning Feedback Comment 1 - *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 2 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 3 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Resilience Comment	
How you showed learning resilience during the course *Enter feedback here*	How you could build learning resilience in the future *Enter feedback here*

Glossary of key words

Words	**Meaning**
Coefficient	A multiplier placed before a variable e.g bx—b is the coefficient of x
Coordinates	Values that shows position on a graph
Factorise	Work out the factors of an expression
Integer	A whole number
Linear	Involving variable with highest power of one. Graph is a straight line
Parabola	Graphical shape of a quadratic equation
Quadratic	Involving variable with highest power of two
Roots of an equation	Value of variable when y=0 i.e the x intercepts
Solve	Work out the value of the variable (usually x)
Substitute	Use in place of. This is used when the value of the variable is known
Table of values	Table showing value of dependent variable as the independent variable changes
Turning point	Point where the gradient of a graph changes from increasing to decreasing and vice versa
Variable	A quantity that changes in value

Knowledge Organisers

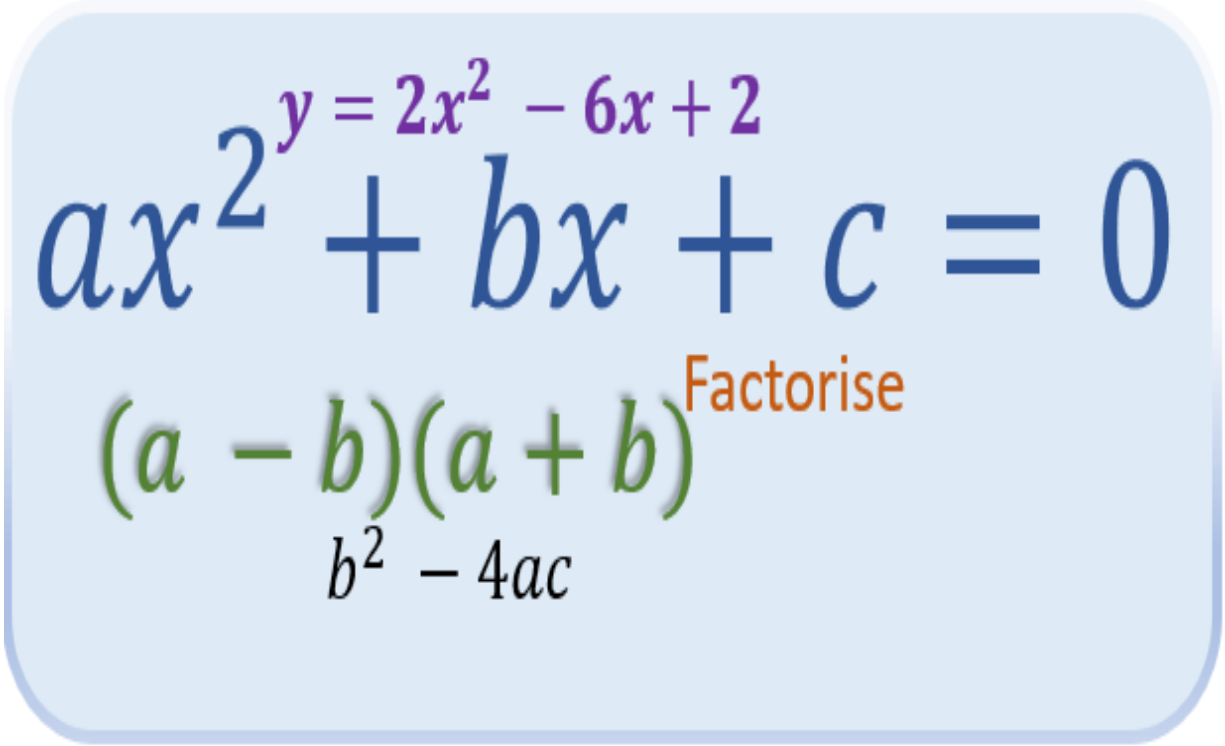
Topic/Skill	Definition/Tips	Example
1. Definition of Quadratics	$\boldsymbol{ax^2 + bx + c}$	Examples of quadratic expressions: x^2 $8x^2 - 3x + 7$ Examples of non-quadratic expressions: $2x^3 - 5x^2$ $9x - 1$
2. Factorising Quadratics		$x^2 + 7x + 10 = (x+5)(x+2)$ (because 5 and 2 add to give 7 and multiply $x^2 + 2x - 8 = (x+4)(x-2)$ (because +4 and -2 add to give +2 and multiply to give -8)
3. Difference of Two Squares	An expression of the form $\boldsymbol{a^2 - b^2}$ can be factorised to give $\boldsymbol{(a+b)(a-b)}$	$x^2 - 25 =$ $16x^2 - 81 =$
4. Solving Quadratics $(ax^2 = b)$		$2x^2 = 98$ $x^2 = 49$ $x = \pm 7$
5. Solving Quadratics $(ax^2 + bx = 0)$	**Factorise** and then **solve = 0**.	$x^2 - 3x = 0$
6. Solving Quadratics by Factorising	**Factorise** the quadratic in the usual way. **Solve = 0** Make sure the equation = 0 before factorising	Solve $x^2 + 3x - 10 = 0$

7. Factorising Quadratics when $a \neq 1$	When a quadratic is in the form $ax^2 + bx + c$ 1. Multiply a by c = ac 2. Find two numbers that add to give b and multiply to give ac. 3. Re-write the quadratic, replacing bx with the two numbers you found. 4. Factorise in pairs – you should get the same bracket twice	Factorise $6x^2 + 5x - 4$
8. Solving Quadratics by Factorising ($a \neq 1$)	**Factorise** the quadratic in the usual way. **Solve = 0** Make sure the equation = 0 before factorising.	Solve $2x^2 + 7x - 4 = 0$
9. Quadratic Graph	A '**U-shaped**' curve called a **parabola**. The equation is of the form $y = \boldsymbol{ax^2 + bx + c}$, where a, b and c are numbers, $\boldsymbol{a \neq 0}$. If $\boldsymbol{a < 0}$, the parabola is **upside down**.	
10. Roots of a Quadratic	A root is a **solution**. The roots of a quadratic are the $\boldsymbol{x}$-**intercepts of the quadratic graph**.	

11. Completing the Square (when a = 1)	A quadratic in the form $x^2 + bx + c$ can be written in the form $(\boldsymbol{x} + \boldsymbol{p})^2 + \boldsymbol{q}$ 1. Write a set of brackets with x in and **half** the value of b. 2. Square the bracket. 3. Subtract $\left(\frac{b}{2}\right)^2$ and add c. 4. Simplify the expression. You can **use the completing the square form** to help **find the maximum or minimum** of quadratic graph.	Complete the square of $y = x^2 - 6x + 2$ Answer:
12. Completing the Square (when a ≠ 1)	A quadratic in the form $ax^2 + bx + c$ can be written in the form **p** $(\boldsymbol{x} + \boldsymbol{q})^2 + \boldsymbol{r}$ Use the same method as above, but factorise out a at the start.	Complete the square of $4x^2 + 8x - 3$ Answer:
13. Solving Quadratics using the Quadratic Formula	A quadratic in the form $ax^2 + bx + c = 0$ can be solved using the formula: $\boldsymbol{x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$ Use the formula if the quadratic does not factorise easily.	Solve $3x^2 + x - 5 = 0$

Tutorial 1—Baseline Assignment

Tutorial 2 – Defining Quadratic Equations and factorising



What is the Purpose of Tutorial 2?

- To recognise quadratic equations in its different forms
- Understand meaning of solving quadratic equations
- Understanding factors

Starter: What are the key features of a quadratic? List 4 that you know?

Defining quadratic equations

Quadratic equation is written as $y = ax^2 + bx + c$ where:

- Highest power of x *must be 2*
- *a, b and c* are integers, where $a \neq 0$
- The equation can be factorised
- The roots of the equation are values of x when $y=0$ i.e. x - intercepts
- The turning point of the graph is the maximum or minimum point called the vertex and gradient=0

Practice: Defining quadratic equations

1) State the general form of a quadratic equation.

2)The coefficient of x^2 is a. Explain why this variable cannot be zero?

3)What type of shape do we get when plotting quadratic graphs?

Assessment: Defining quadratic equations

Which of these equations are quadratics?

A	$2x^2+3x+7=0$
B	$20 - y = y^2$
C	$3x(x-6)=15$
D	$z(z-1)=3$

Solving quadratic equations—Factorising method

Solving quadratic equations means finding the roots of the equation or solving for x. There are 3 main methods that can be used to solve quadratic equations: factorising, using quadratic formula and completing the square. Sometimes, we can also use graphs if we know the right range of values to plot. Here, we work through some examples using the factorising method.

Worked example 1

$$x^2 - 13x - 30 = 0$$

The first thing to do is always ensure your equation is of the form $ax^2 + bx + c = 0$

Step 1:
a = 1 b = -13 c = -30
ac = 1 x (-30) = -30

What 2 numbers multiply together to give -30 and add to give -13? (ans: -15 and 2)

Step 2: Rewrite the equation
$x^2 - 15x + 2x - 30 = 0$

Step 3: Factor the terms
x(x -15) +2(x -15) = 0

Step 4: Collect common factors
(x -15) (x+2) = 0

Step 5:
If (x -15) = 0, x = 15

If (x+2) = 0, x = -2

Worked example 2
$2x^2+7x+3=0$
Step 1:
a = 2 b = 7 c = 3
ac = 2 x 3 = 6

What 2 numbers multiply together to give 6 and add to give 7? (ans: 1 and 6)

Step 2: Rewrite the equation
$2x^2 + x + 6x + 3 = 0$

Step 3: Factor the terms
x(2x + 1) +3(2x + 1) = 0

Step 4: Collect common factors
(2x + 1) (x+3) = 0

Step 5:
If (2x + 1) = 0, x = - 0.5

If (x+3) = 0, x = -3

Worked example 3 (difference of 2 squares)
$27x^2=12$

In this case, before proceeding to step 1, rearrange the equation to the general form.
$27x^2 - 12=0$

Next, we can factor out 3 from the equation:

$3(9x^2 - 4) =0$

Step 1:
a = 9 b = 0 c = -4
Here we see that the values for a and c (without the sign) are square numbers. $3^2 = 9$ and $2^2 = 4$ so we use another method to factorise. This method is the difference of 2 squares. We proceed as follows:

Step 2: Rewrite the equation
$3(3^2x^2—2^2) = 0$
$3[(3x)^2 - 2^2] = 0$

Step 3: work out the factors for the terms
To factor the difference of 2 squares, we use the +x– rule
3[(3x + 2)(3x - 2)]
+ x -

Step 4: Collect common factors
We skip this step

Step 5:
If (3x + 2) = 0, x = - 0.67 (to 2 d.p)

If (3x-2) = 0, x = 0.67 (to 2 d.p)

Practice: Solve using factorising method

A) $x^2 + 7x +12 = 0$

B) $6x^2 + 7x—3 = 0$

C) $x^2—36 = 0$

D) $3x^2 + 12 = 0$

E) $(x + 3)^2— (2x—1)^2 = 0$

F) $(2x—5) (x + 1)= -12x$

G) $(x—7)^2 + x2 = (x + 1)^2$

H) $9x^3—81x = 0$

Assessment: Solving quadratic equations (factorising)

1) Solve $x^2 = 4(x-3)^2$

2) Factorise and solve $4x^2 - 9 = 0$

3) There are n sweets in a bag. 6 of the sweets are orange and the rest of the sweets are yellow.

Hannah takes at random a sweet from the bag. She eats the sweet.

Hannah takes at random another sweet from the bag. She eats the sweet.

The probability that Hannah eats two orange sweets is 1/3.

a) Show that $n^2 - n - 90 = 0$

b) Solve $n^2 - n - 90 = 0$ to find the value of n.

4) Show that $(n+3)^2 - (n-3)^2$ is an even number for all positive integer values on n

5) Solve $9x^2 + 7x - 2 = 0$

Plenary: Think about what we have done today. What does it mean to factorise? How is this similar or different from finding factors of numbers?

Notes and working out space

Tutorial 3 – Using quadratic formula and completing the square

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

$$\left(x + \frac{b}{2a}\right)^2 + c - \left(\frac{b}{2a}\right)^2$$

What is the Purpose of Tutorial 3?

- Using quadratic formula
- Understanding completing the square

Starter: Consider the quadratic formula. How will the roots of the equation will be affected by the value of $b^2 - 4ac$

Defining quadratic formula

Quadratic formula is written as: $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

This means that x can either take the value of $x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$ or $x = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$

Worked example 1

$x(x - 2) = 4$

Here, we have to rewrite the equation in the general form: $x^2 - 2x - 4 = 0$

Step 1:

a = 1 b = -2 c = -4

Step 2: Substitute these values into the formula

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-4)}}{2(1)}$$

$$x = \frac{2 \pm \sqrt{4 + 16}}{2} = \frac{2 \pm \sqrt{20}}{2} = \frac{2 \pm 2\sqrt{5}}{2}$$

$$= \frac{2(1 \pm \sqrt{5})}{2}$$

$$= 1 \pm \sqrt{5}$$

$$x = 1 + \sqrt{5} \ or \ x = 1 - \sqrt{5}$$

$$x = 3.24 \ (to \ 2 \ d.p) \ or$$

$$x = -1.24 \ (to \ 2 \ d.p)$$

Worked example 2

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

Step 1:

a = 2 b = -5 c = -2

Step 2: Substitute these values into the formula

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-2)}}{2(2)}$$

$$x = \frac{5 \pm \sqrt{25 + 16}}{4} = \frac{5 \pm \sqrt{41}}{4}$$

$$x = \frac{5 + \sqrt{41}}{4} \qquad x = \frac{5 - \sqrt{41}}{4}$$

Practice: Using Quadratic formula

1) Solve $3x^2 + 6x - 2 = 0$ Give your solutions correct to 2 decimal places

2) Solve $3x^2 - x - 1 = 0$ Give your solutions correct to 2 decimal places

Assessment: Using Quadratic formula

1) Solve $3x^2 - 5x - 1 = 0$ Give your solutions correct to 3 significant figures

2) Solve $3x^2 + 4x - 12 = 0$ Give your solutions correct to 2 decimal places

3)

Alison is using the quadratic formula to solve a quadratic equation.
She substitutes values into the formula and correctly gets

$$x = \frac{-7 \pm \sqrt{49 - 32}}{4}$$

Work out the quadratic equation that Alison is solving.
Give your answer in the form $ax^2 + bx + c = 0$, where a, b and c are integers.

4) The diagram shows a trapezium.

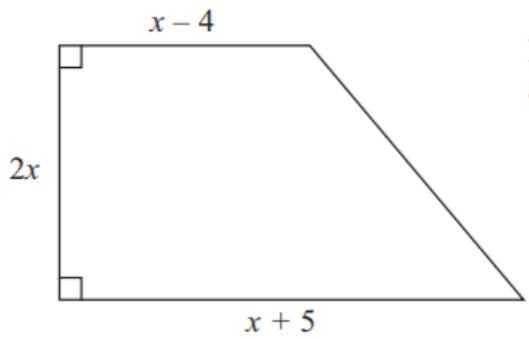


Diagram **NOT** accurately drawn

All the measurements are in centimetres.

The area of the trapezium is 351 cm^2.

(a) Show that $2x^2 + x - 351 = 0$

(b) Work out the value of x.

Notes and working out space

Completing the Square method

Completing the square involves writing the quadratic equation in the form— $(x + p)^2 + q = 0$

Using the general quadratic equation $ax^2 + bx + c = 0$, we can arrive at the completing the square form by doing the following:

Step 1: divide through by the coefficient of x^2

$$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$$

Step 2: divide the coefficient of x by 2 to give $\frac{b}{2a}$

Step 3: rewrite equation as

$$\left(x + \frac{b}{2a}\right)^2 + c - \left(\frac{b}{2a}\right)^2 = 0$$

Worked example 1: - Solve $x^2 + 6x + 7 = 0$

Step 1: divide through by the coefficient of x^2
a = 1 b = 6 c = 7 so equation remains as it is

Step 2: divide the coefficient of x by 2 to give 3

Step 3: rewrite equation as

$$(x+3)^2 = -7 + 3^2$$
$$(x+3)^2 = -7 + 9$$
$$(x+3)^2 = 2$$
$$x + 3 = \pm\sqrt{2}$$
$$x = -3 \pm \sqrt{2}$$

Worked example 2: - Solve $10x^2 + 17x - 4 = 0$

a = 10 b = 17 c = -4

Step 1: divide through by the coefficient of x^2

$$x^2 + \frac{17}{10}x - \frac{4}{10} = 0$$

Step 2: divide the coefficient of x by 2 to give $\frac{17}{20}$

Step 3: rewrite equation as

$$\left(x + \frac{17}{20}\right)^2 = \frac{4}{10} + \left(\frac{17}{20}\right)^2 \longrightarrow \left(x + \frac{17}{20}\right)^2 = 0.4 + 0.7225 = 1.1225$$

$$x + \frac{17}{20} = \pm\sqrt{1.1225} \longrightarrow x = -\frac{17}{20} \pm \sqrt{1.1225}$$

Practice: Using Completing the Square

1) Write the following equations in the form $(x+p)^2+q$ Then solve.

a) $x^2+4x-5=0$

b) $x^2-8x=20$

C) $4x^2+11x+7=0$

Assessment:

Solve by completing the square

1) $x^2+12x+4=0$

2) $4x^2+8x-9=0$

3) $6x-7-x^2=p-(x+q)^2$ where p and q are integers.
Find the value of p and the value of q.

4) For all values of x, $x^2-10x+7=(x-p)^2-q$
Find the value of the constants p and q.

5) (a) Write $3x^2-12x-1$ in the form $a(x-b)^2+c$ where a, b and c are integers.

(b) Hence, or otherwise, find the minimum value of $y=3x^2-12x-1$

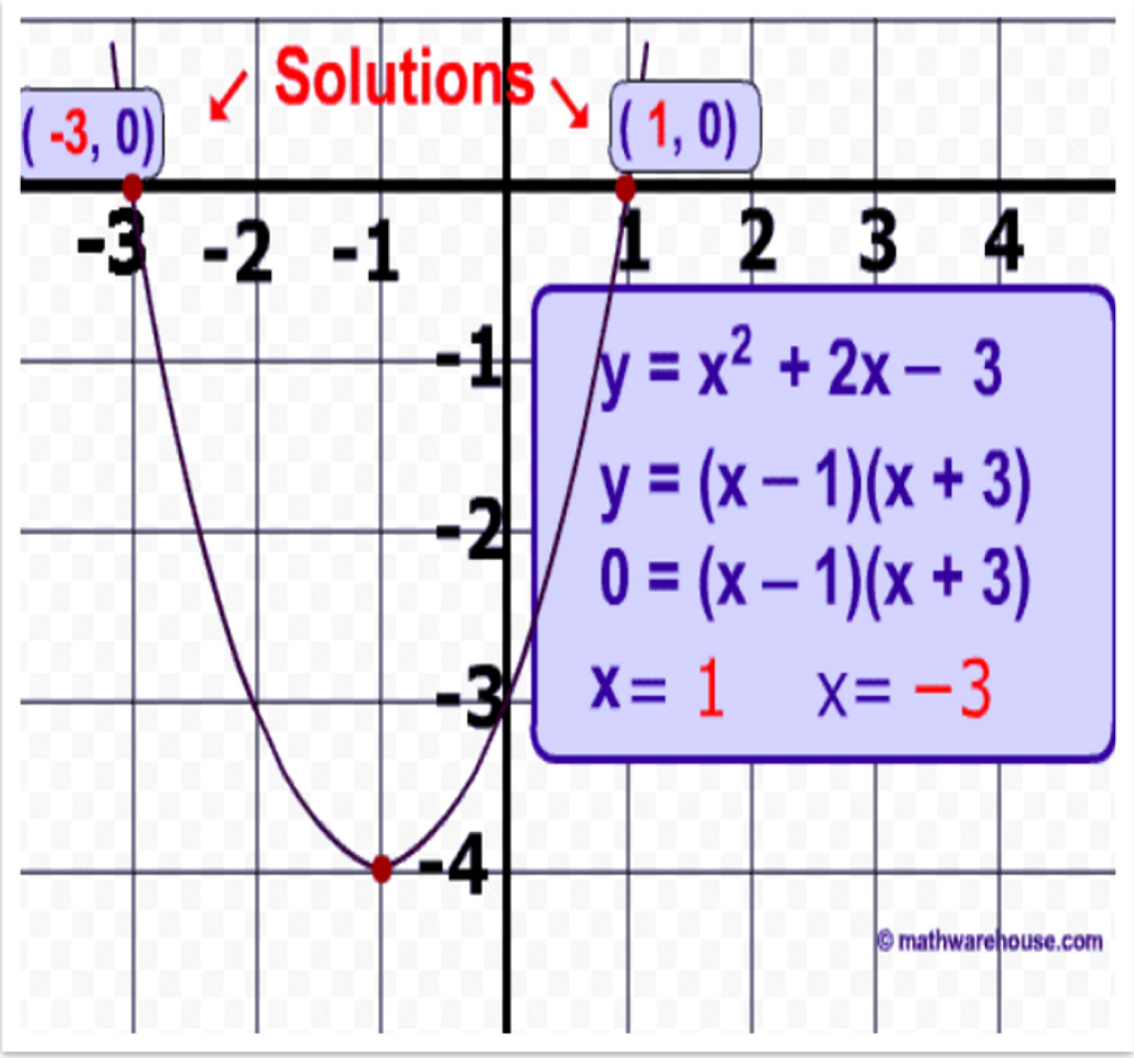
(c) Using your answer to part (b) find the equation of the line of symmetry of the curve $y=3x^2-12x-1$

6) $x^2+hx+15=(x+3)^2+k$
Find the value of the constants h and k.

Plenary: Use completing the square to work out the value of x for $ax^2+bx+c=0$

Notes and working out space

Tutorial 4 – Graphs



What is the Purpose of Tutorial 4?

- Know the shape of a Quadratic graph
- Determine the intercepts and turning points
- Sketch a graph from the quadratic equation

Starter: Without attempting to solve, which of these quadratic equations will have no real roots?

a) $y = (x-5)^2 + 2$ b) $y = (x-5)^2 - 5$ c) $y = (x-3)^2 - 20$ $y = (x+3)^2 - 8$

Defining quadratic graphs

Quadratic graphs are graphs of equations with x^2. The shape of the graph is called a parabola and it has a turning point or vertex which is either the maximum point or minimum point of the graph.

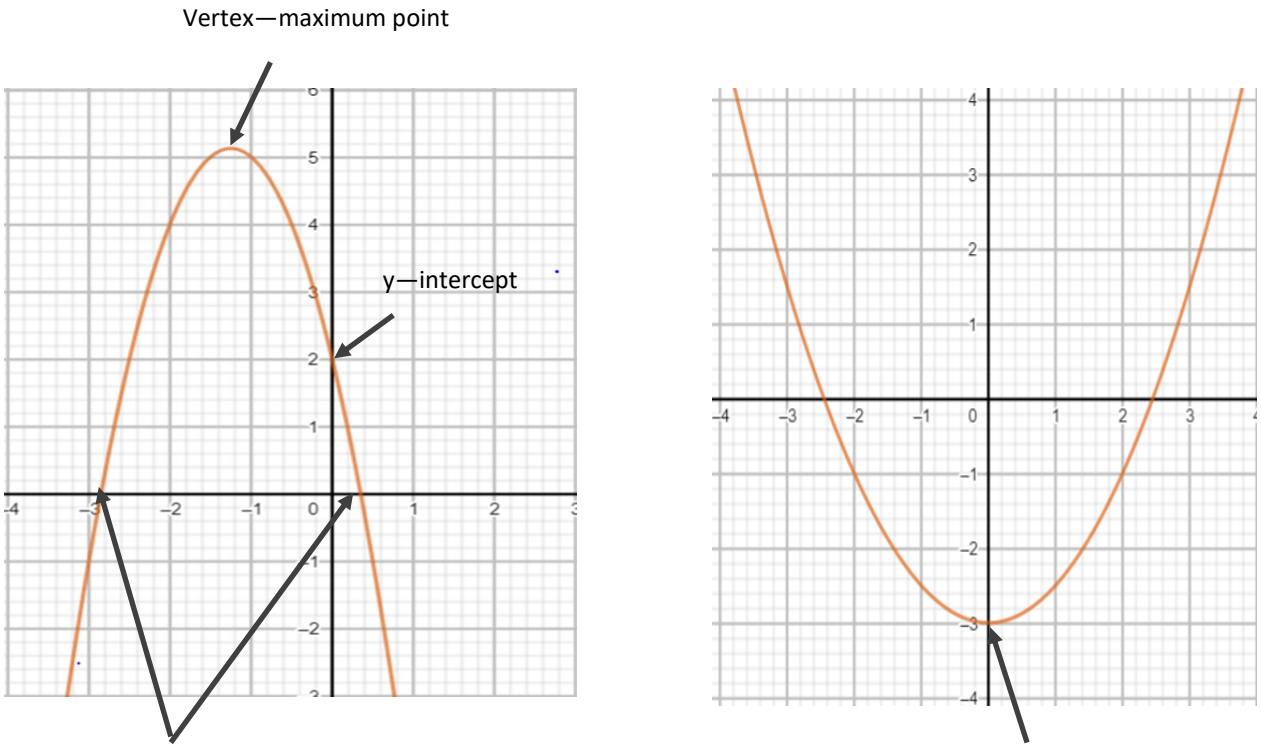


Fig 1: Graph of $y = ax^2 + bx + c$

Plotting quadratic graphs using table of values

Worked example 1

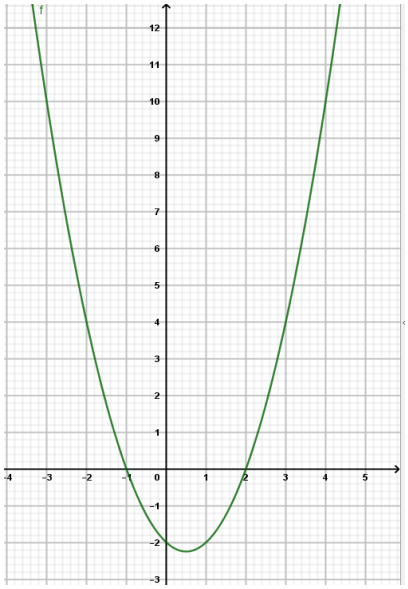
Plot the graph of $y = x^2 - x - 2$ for $-3 \leq x \leq 4$

Use the graph to solve the equation $x^2 - x - 2 = 0$

Step 1: Draw up the table of values

x	-3	-2	-1	0	1	2	3	4
x^2	9	4	1	0	1	4	9	16
$-x$	3	2	1	0	-1	-2	-3	-4
-2	-2	-2	-2	-2	-2	-2	-2	-2
y	10	4	0	-2	-2	0	8	10

Step 2: Plot the points in a graph



Step 3: Read $y = 0$ off the graph

$$x = -1, x = 2$$

Practice: Plotting quadratic graphs using table of values

1. (a) Complete the table of values for $y = x^2 + x$.

x	–3	–2	–1	0	1	2	3
y	6	2		0		6	

(b) On the grid, draw the graph of $y = x^2 + x$.

2. (a) Complete the table for $y = x^2 - 2x - 4$

x	–2	–1	0	1	2	3	4
y	4		–4	–5		–1	

(b) On the grid, draw the graph of $y = x^2 - 2x - 4$

Sketching quadratic graphs from known properties

It is important to note that quadratic equations can be sketched/plotted if answers to these questions are known,

1. Does the graph have a maximum or minimum point?

a) The graph has a minimum point when a is positive e.g. $y = x^2 - 3x - 2$ will have a minimum point

b) The graph has a maximum point when a is negative e.g. $y = 6 - x^2 - x$ will have a maximum point

2. What are the coordinates of the turning point?

a) The solution to a quadratic equation gives the values of the x intercepts.

b) If the x intercepts are known, the equation of the line through the turning point is: $x = \frac{x_1 + x_2}{2}$. This line is the line of symmetry for the graph. The y coordinate for the turning point can then be calculated by substituting this value of into the quadratic equation.

OR

Use the p and q values from completing the square as coordinate of turning point is (-p, q)

3. What is the value for the y intercept

The y intercept of the graph is derived by substituting x = 0 into the quadratic equation

Worked example 2

Sketch the graph of $y = x^2 + x - 6$

Step 1: Solve the equation to obtain the x intercepts
Using factorising or completing the square method we know that $(x+3)(x-2) = 0$ or $x = -3, x = 2$

Step 2: Calculate the coordinates of the turning point
Obtain the x coordinate of the turning point as follows: $x = \dfrac{-3+\ 2}{2} = -\dfrac{1}{2}$

Obtain the y coordinate as follows: $y = \left(-\dfrac{1}{2}\right)^2 - \dfrac{1}{2} - 6 = -6\dfrac{1}{4}$

OR

Write the quadratic equation using the completing the square form:

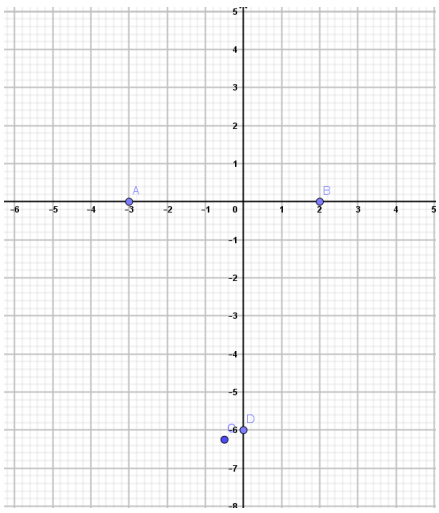
$$\left(x + \frac{1}{2}\right)^2 = 6 + \frac{1}{4} \longrightarrow \left(x + \frac{1}{2}\right)^2 = 6\frac{1}{4}$$

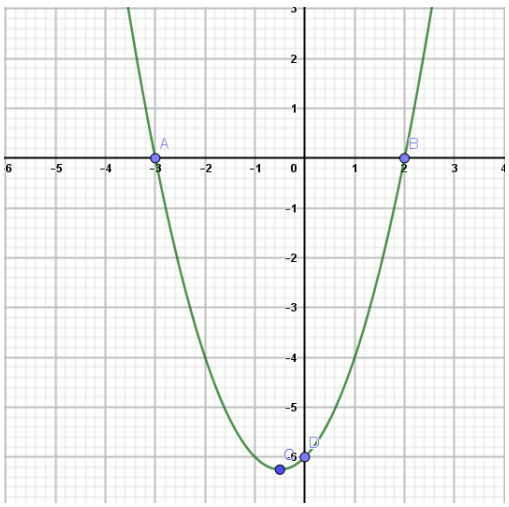
And turning point coordinates are $\left(-\dfrac{1}{2}, -6\dfrac{1}{4}\right)$

Step 3: Obtain y intercept by substituting x=0 into the quadratic equation

$$y\ intercept = -6$$

Step 4: Sketch the graph





Practice: Sketching graphs from known properties

1) Solve $y = (x + 1)(x - 3)$

Use the values of x and other properties to sketch the graph of the equation.

2) Sketch the graph of $y = 3 - 4x - x^2$

Use completing the square method to determine the coordinates of the turning point

3) Sketch the graph of $y = 2x^2 - 4x + 5$

Use completing the square method to determine the coordinates of the turning point

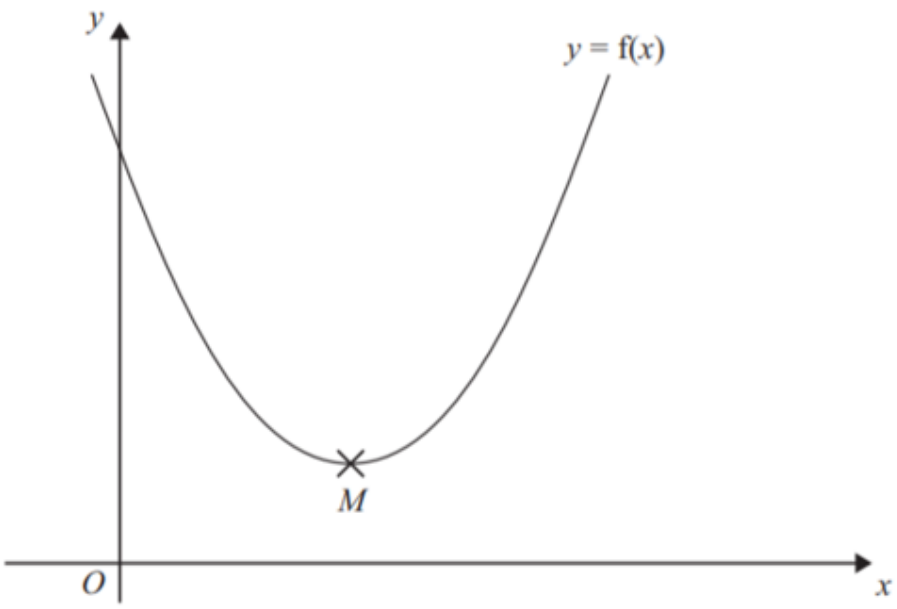
Assessment: Using Quadratic graphs

1) The expression $x^2 - 8x + 21$ can be written in the form $(x - a)^2 + b$ for all values of x.

a) Find the value of a and the value of b.

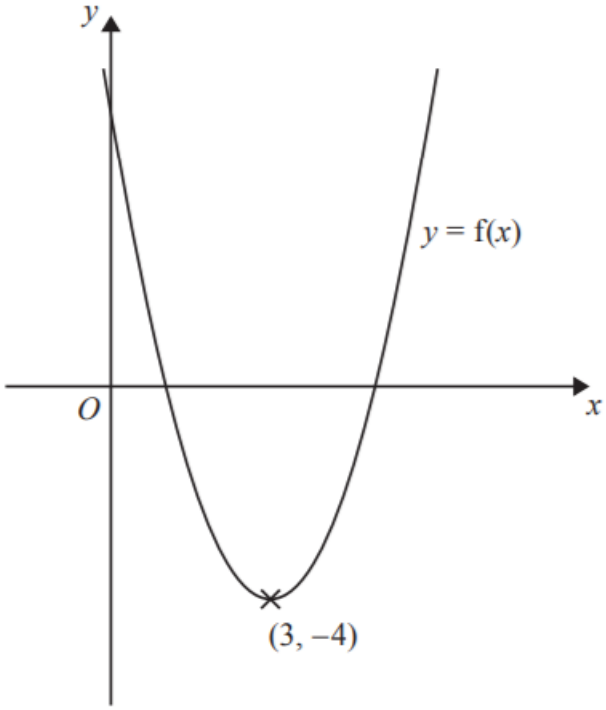
b) The equation of a curve is $y = f(x)$ where $f(x) = x^2 - 8x + 21$

The diagram shows part of a sketch of the graph of $y = f(x)$



The minimum point of the curve is M. Write down the coordinates of M

2)



The diagram shows part of the curve with equation $y = f(x)$.
The coordinates of the minimum point of this curve are $(3, -4)$

Write down the coordinates of the minimum point of the curve with equation

(i) $y = f(x) + 3$

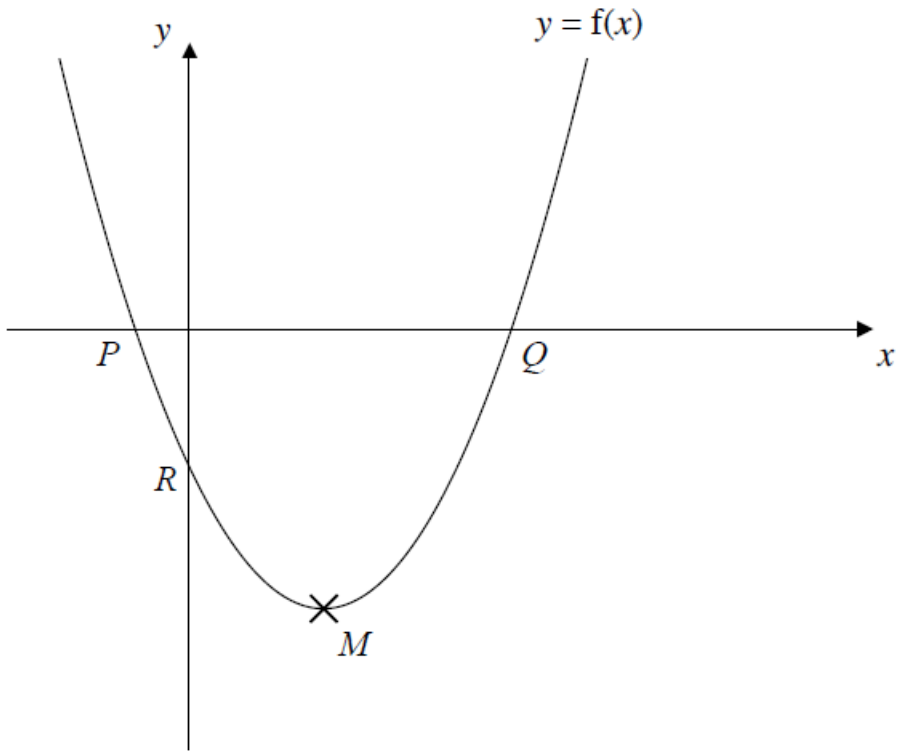
(ii) $y = f(2x)$

(iii) $y = f(-x)$

3)

$f(x) = x^2 - 4x - 5$

The diagram show a sketch of the graph of $y = f(x)$

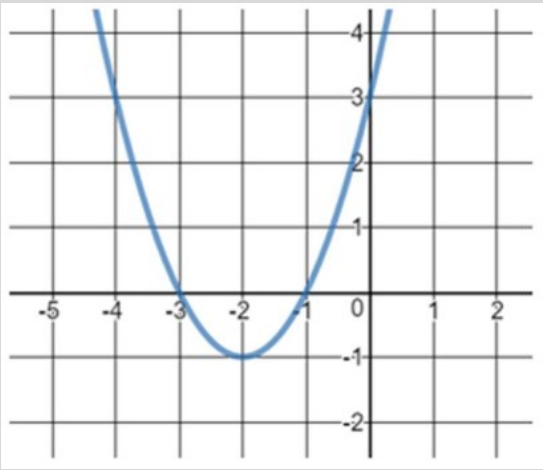


The minimum point of the curve is M.

The points at which the curve crosses the x-axis and the y-axis are P, Q and R.

Find the coordinates of the points M, P, Q and R.

Plenary: Which of the following could be the equation of this curve?



$a)\ y = (x+1)(x+3)$

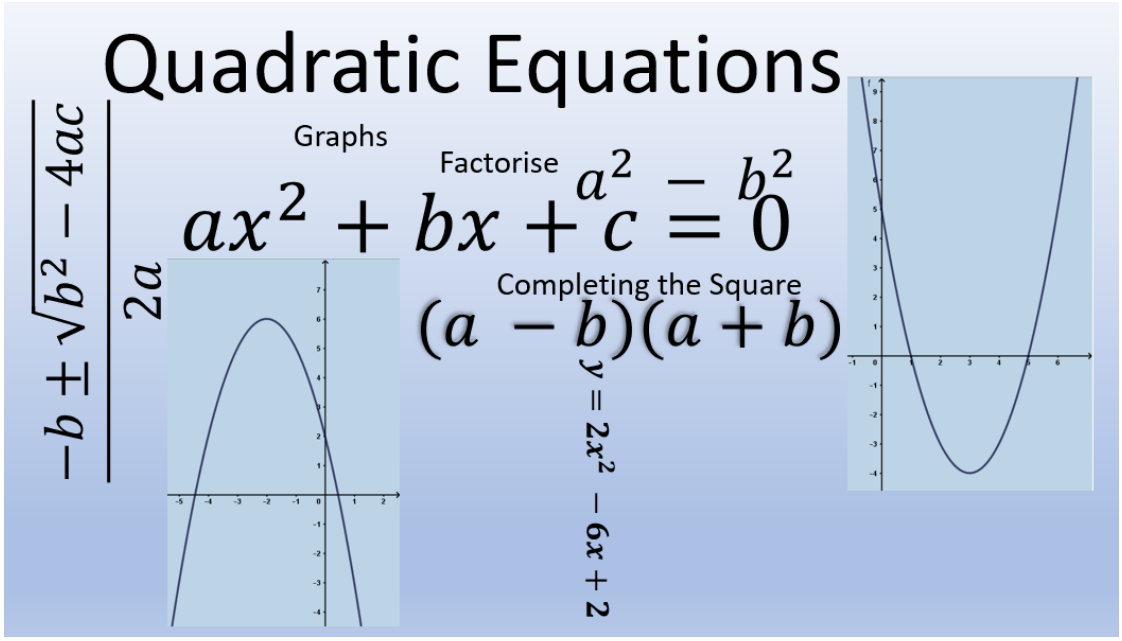
$b)\ y = (x-1)(x-3)$

$c)\ y = (x+1)(x-3)$

$d)\ y = (x-1)(x+3)$

Notes and working out space

Tutorial 5 – Quadratic and Linear equations



What is the Purpose of Tutorial 5?

- Solving Linear and Quadratic simultaneous equations algebraically
- Solving Linear and Quadratic simultaneous equations using graphs
- Using Quadratic graph to solve similar quadratic equation

Starter: List the different methods you know to solve linear simultaneous equations? Do you think these can be applied with system of quadratic and linear equations?

Solving quadratic and linear simultaneous equations algebraically

Worked example 1

Solve $y = x^2 + x - 2 \qquad (1)$

$y = 2x + 4 \qquad (2)$

We can equate (1) and (2) since they are both equal to y

This gives $2x + 4 = x^2 + x - 2$

Rearranging, we get $x^2 + x - 2x - 2 - 4 = 0$

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

Using factorising method $(x + 2)(x - 3)$

$$x = -2 \quad or \quad x = 3$$

We now substitute each value of x into equation (2)

$$when\ x = -2, \quad y = 0$$

$$when\ x = 3, \quad y = 10$$

Practice: Solving quadratic and linear simultaneous equations algebraically

Solve the following system of equations algebraically

1) $y = x^2 - 4$

$y = -3$

2) $y = x^2 + x - 2$

$y = -x + 1$

3) $y = x^2 - 6x + 9$

$y + x = 5$

Assessment: Solving quadratic and linear simultaneous equations algebraically

1) In attempting to solve the simultaneous equation below, which of the following is a valid step?

$$x^2 + y^2 = 16$$
$$x - y = 3$$

a) $x + 3y = 13$ b) $x^2 + (3 - x)^2 = 16$ c) $2y + 3 = 16$ d) $x^2 + (x - 3)^2 = 16$

2) How many solutions are there for this system of simultaneous equations? Explain why?

$$y = 5x - 3$$
$$y = 3x^2 + 6x - 7$$

Solving quadratic and linear simultaneous equations graphically

Worked example 2
Solve these graphically

$$y = x^2 + x - 2 \qquad (1)$$
$$y = 2x + 4 \qquad (2)$$

Step 1: Draw the table of values for both equations

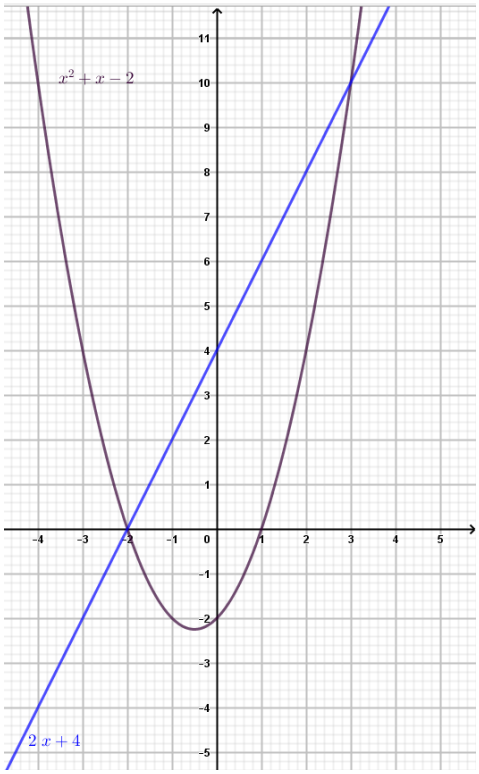
$$y = x^2 + x - 2$$

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	18	10	4	0	-2	-2	0	4	10	18	28

$$y = 2x + 4$$

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-6	-4	-2	0	2	4	6	8	10	12	14

Step 2: On the same grid, plot the graph for each equation



Step 3: Read off the coordinates where the 2 graphs intersect

$$(-2, 0) \; and \; (3, 10)$$

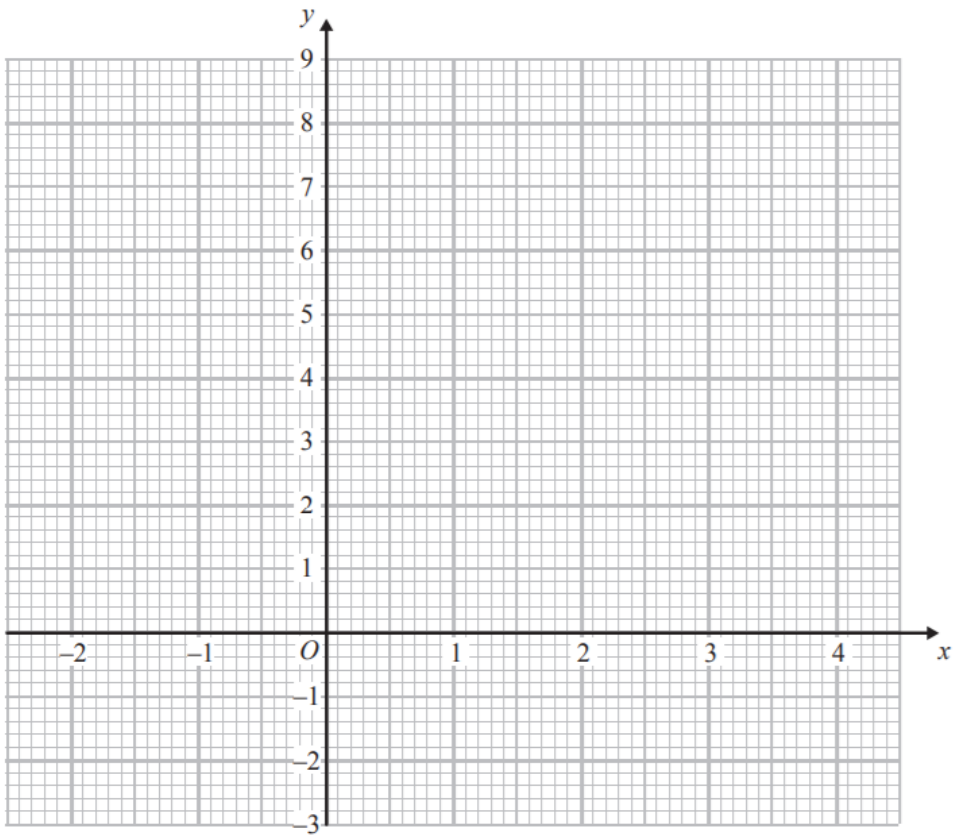
Practice: Solving quadratic and linear simultaneous equations graphically

(a) Complete the table of values for $y = x^2 - 2x - 1$

x	–2	–1	0	1	2	3	4
y	7			–2	–1		

(2)

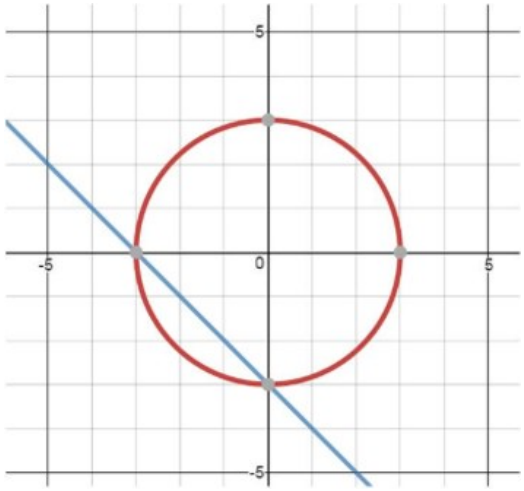
(b) On the grid, draw the graph of $y = x^2 - 2x - 1$ for values of x from –2 to 4



(2)

(c) Solve $x^2 - 2x - 1 = x + 3$

2)



On the axes, the graphs of $x^2 + y^2 = 9$ and $x + y = -3$ have been drawn. Which of the following is solution for the simultaneous equations

$$x^2 + y^2 = 9$$
$$x + y = -3$$

$a)\ (3,0)\ and\ (0,3)$

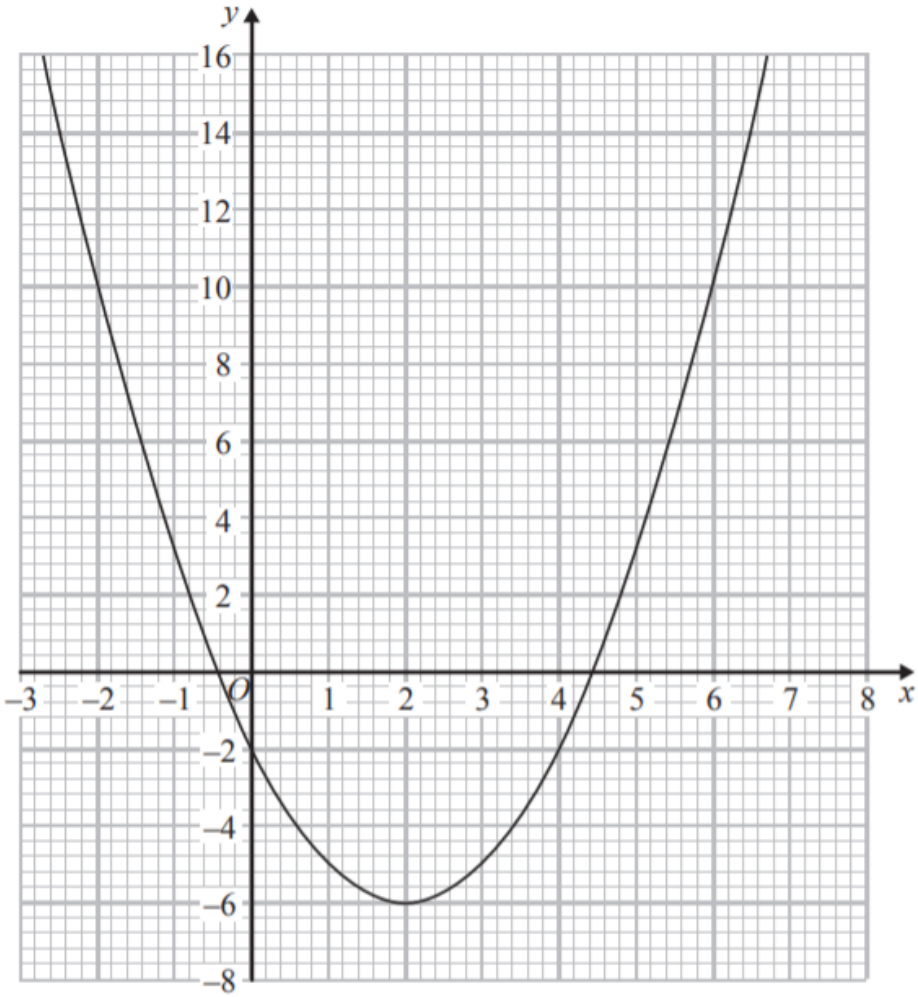
$b)\ (-3,0)$

$c)\ (-3,0)\ and\ (0,-3)$

$d)\ (-3,-3)$

Assessment: Solving quadratic and linear simultaneous equations graphically

The diagram shows the graph of $y = x^2 - 4x - 2$



(a) Use the graph to find estimates for the solutions of

(i) $x^2 - 4x - 2 = 0$

(ii) $x^2 - 4x - 6 = 0$

(b) Use the graph to find estimates for the values of x that satisfy the simultaneous equations

$$y = x^2 - 4x - 2$$

$$x + y = 6$$

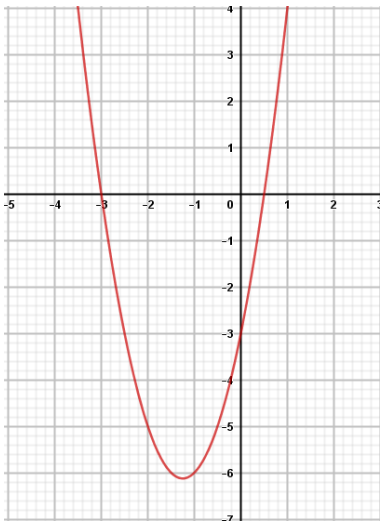
Solving quadratic equations using another similar quadratic graph

For this situation, we will use the graph that we have to solve another equation as shown below.

Worked example 3

Use the graph of $y = 2x^2 + 5x - 3$ to solve the equation $2x^2 + 4x - 3 = 0$

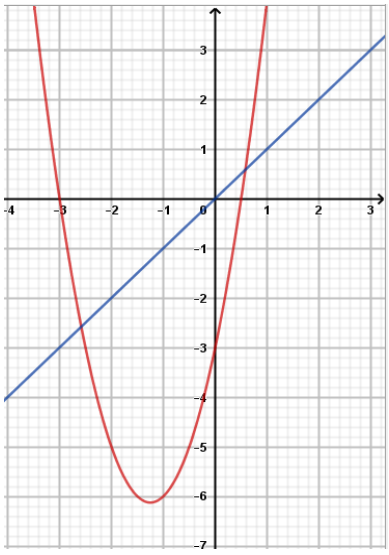
Step 1: Plot the graph of $y = 2x^2 + 5x - 3$



Step 2: Rearrange $2x^2 + 4x - 3 = 0$ so that it looks like $y = 2x^2 + 5x - 3$

$$\begin{array}{r} 2x^2 + 4x - 3 = 0 \\ + x \qquad\qquad \\ \hline 2x^2 + 5x - 3 = y \end{array}$$

Now, plot the graph of $y = x$ over the initial graph and the point of intersection is the required solution

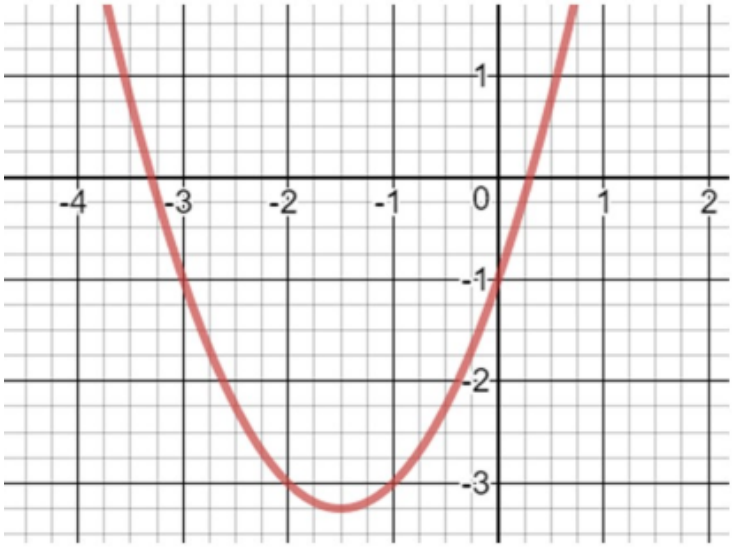


Solution for $2x^2 + 4x - 3 = 0$ is $x = -2.58, x = 0.58$

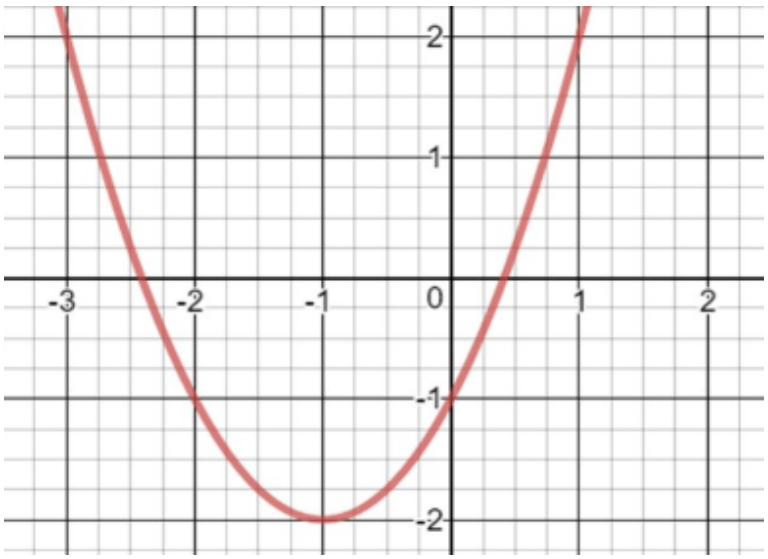
Hint: In order not to get confused at step 2, look at equation with unknown solution and figure out how to go from the unknown to the known. The extra that is arrived at is the line to be drawn.

Practice: Solving quadratic equation using similar graph

1) This is the graph of $y = x^2 + 3x - 1$ Use this graph to solve $x^2 + 4x - 4 = 0$



2) This is the graph of $y = x^2 + 2x - 1$ Use this graph to solve $x^2 + 4x - 2 = 0$



Assessment: Solving quadratic equation using similar graph

1) Plot the graph of $y = x^2 - 6x + 9$ using the range $0 \leq x \leq 6$ With this graph, find the x-intercepts for the equation $y = x^2 - 5x + 4$

2) Plot the graph of $y = x^2 + 4x + 2$ using the range $-5 \leq x \leq 1$ With this graph, find solution to

   A) $y = x^2 + 4x - 1$

   B) $y = x^2 + 4x + 5$

Plenary:

A line with the equation $y = 2x - 9$ intercepts a parabola with the equation $y = x^2 - 6x + 6$ at points P and Q. Find the coordinates of P and Q?

Tutorial 6 – Revision Techniques/Final Assignment

Tutorial 7 – Feedback tutorial

What is the Purpose of Tutorial 7?

- To receive feedback on final assignments.
- To share examples of best practice with the other pupils in your group.
- To write targets for improvement in school lessons.

To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well...	What I could have improved on...

My target for future work is...

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?

What did you find challenging about the programme?	How did you overcome these challenges?

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

It gives credit to the authors of any sources you have referred to or been influenced by.
It supports the arguments you make in your assignments.
It demonstrates the variety of sources you have used.
It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:

Quote directly from another source.
Summarise or rephrase another piece of work.
Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment:** After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].

2. **Bibliography:** This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

Websites – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

Books – Author, date published, title of book (in italics), pages where the information came from.

E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

Articles – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Notes

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