Unit: Parabolas (the quadratic graphs)

The Message

This notes is purposely prepared to help Year 3 RGS students for their T1W8 assessment Math Comprehension.

In the past few years, most of RGS students in our tuition centre have achieved GP 4.0 in Math. To benefit more students, we will be sharing more resources with you. Please feel free to share this notes with your friends.

If you need any further coaching or like to join our RGS tuition classes, please contact us.

This notes aims to help students to master the skills to:

- Deduce shape, axial intercepts, line of symmetry, coordinates and nature of turning point.
- Sketch graphs of quadratic functions.

Question to Ponder: What is a quadratic function?

A quadratic function can be represented the form of $f(x) = ax^2 + bx + c,\ a \neq 0$.

Concept: Why a cannot be 0?

If $a = 0$, the function is $f(x) = bx + c$. It is a linear function.

For example: the graph of $y = 2x + 1$ is a line, NOT a parabola.

The graph of $y = x^3 + 1$ is NOT a parabola.

It is important for you to know the following important features of parabolas.

- Shape
- x – intercepts
- y – intercepts
- Line of symmetry
- Turning point

Shape: depends on the value of a

value of a	**Graph**
$a > 0$	∪
$a < 0$	∩

The x-intercepts: lie on the x-axis.

To find out the value(s) of the x-intercepts, we must set the quadratic function to zero, i.e. let y =0, find the corresponding value of x.

For example, $y = x^2 + 5x + 6$,

$(x+2)(x+3)=0$.

$x = -2$ or $x = -3$.

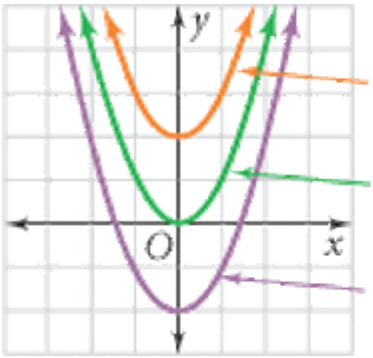
The x-intercepts are -2 and -3.

Note:

The number of x-intercept depends on the number of solution of $ax^2 + bx + c = 0$.

How many solutions there are

Depends on the value of discriminant $b^2 - 4ac$.



Discriminant is negative. NO x-intercept

Discriminant is 0. 1 x-intercept

Discriminant is positive. 2 x-intercepts

The *y*-intercept lies on the *y*-axis, we must set $x = 0$,
find the corresponding value of *y*.

Alternatively, make the equation into the general form: $y = ax^2 + bx + c$. the *y*-intercept = *c*.

For example, $y = x^2 + 5x + 6$,   *y-intercept = 6.*

Line of symmetry: $x = -b/2a$

Remember, a quadratic function has the following form:

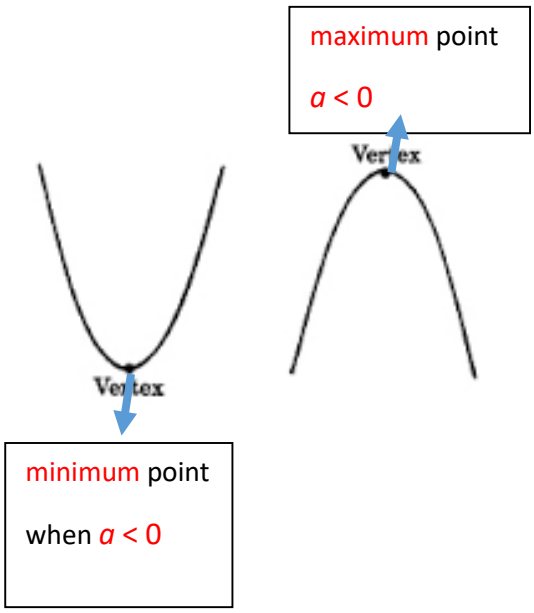
$y = ax^2 + bx + c$

For example

Follow 4 steps to use an equation to calculate the line of symmetry for $y = x^2 + 2x$

1. Identify *a* and *b* for $y = \mathbf{1}x^2 + \mathbf{2}x$. **a = 1; b = 2**
2. Plug into the equation $x = -b/2a$. ***x = -2/(2*1)***
3. Simplify. ***x* = -2/2**
4. The line of symmetry is ***x* = -1**.

Turning point (vertex) of a parabola: also known as the maximum or minimum point of a parabola:



How to find the *coordinates* of the turning point?
Sub $x = -b/2a$ into the function, find the value of y.

Example:
For the graph $y = 2x^2 + x - 3$.
(1) line of symmetry,
(2) coordinates of the turning point of
(3) state its nature of the turning point.

(1) $x = -b/2a$

$= -\frac{1}{2\times 2}$

$= -\frac{1}{4}$

Therefore the line of symmetry is $x = -\frac{1}{4}$.

[comment: the final answer must in this form of $x =$____]

(2) sub. $x=-\frac{1}{4}$ into the equation, $y = 2(-\frac{1}{4})^2 + (-\frac{1}{4}) - 3 = -3\frac{1}{8}$

Therefore the coordinates are $(-\frac{1}{4}, -3\frac{1}{8})$.

[comment: must present the final answer as a point in this form of (x,y)]

(3) $a = 2$, hence it is a U shape graph. The turning point is a minimum point.

The End

All the best to everyone!