Graphs of quadratic curves

Starter

1. (Review of last lesson) Here are the equations of 9 straight lines:

A.	$y = -x + 7$	B.	$4x + 12y = 5$	C.	$2y = x - 7$
D.	$x + 3y = 10$	E.	$y = x - 3$	F.	$y = 5 - 5x$
G.	$y = 3 - 2x$	H.	$5x + y = 12$	I.	$y = 2x + 4$

(a) Find two pairs of parallel lines.
(b) Find two pairs of perpendicular lines.
(c) Find one line which is neither parallel nor perpendicular to any of the other lines.

2. Find the value of $x^2 - 6x + 5$ when:(a) $x = 3$ (b) $x = -4$.

3. (a) Copy and complete the table of values for integers over the given range $y = x^2 + 3x - 2$.

x	-4	-3	-2	-1	0	1	2	3
y	2				-2			16

(b) Plot the points on graph paper and draw a smooth curve through the points.

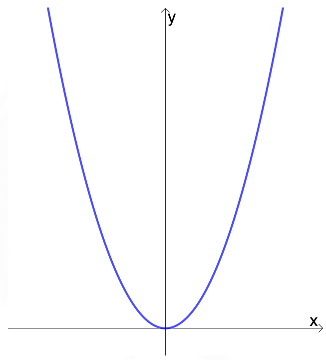
Notes

When the highest power of x in a polynomial is 2 the equation is a ***quadratic***.

Quadratic curves are called ***parabolas***.

The general equation of a parabola is $y = ax^2 + bx + c$.

The graph to the right is the basic parabola, $y = x^2$.

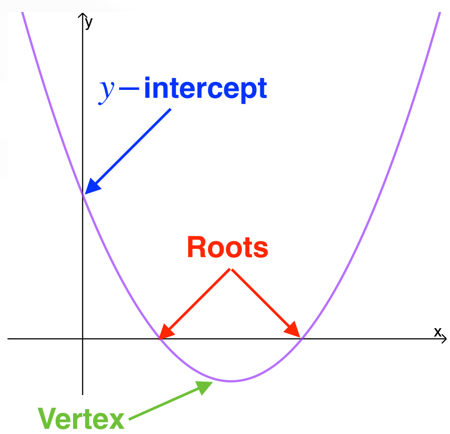


Points of interest

Vertex — the vertex is the maximum or minimum of the curve.

$y-$**intercept** — where the curve crosses the y-axis.

Roots — where the curve meets or crosses the x-axis.



Success Criteria — drawing a curve

1. Draw a table of values for integers over the required range

   E.g. range is $-3 \le x \le 3$ so $x = -3, -2, -1, 0, 1, 2, 3$

2. Complete the table of values using your calculator — where there is an x in the equation use brackets.

Equation	On calculator
$y = x^2 + 3$	$(\quad)^2 + 3$
$y = 7 - 4x - x^2$	$7 - 4(\quad) - (\quad)^2$
$y = x(x - 2)$	$(\quad)((\quad) - 2)$
$y = 3x^2 + 8x - 9$	$3(\quad)^2 + 8(\quad) - 9$

3. Plot the points.
4. Draw a ***smooth curve*** through the points — remember, the bottom is not flat and there should not be any kinks in the curve.

E.g. 1 (a) Draw the graph of $y = 4 + x - x^2$ for $-2 \le x \le 3$.

x	-2	-1	0	1	2	3
$y = 4 + x - x^2$						

(b) Hence write down the coordinates of:
(i) the roots
(ii) the vertex, stating whether it is a maximum or a minimum
(iii) the $y-$intercept

Working: (a) On the calculator: $4 + (\quad) - (\quad)^2$

x	-2	-1	0	1	2	3
$y = 4 + x - x^2$		2				

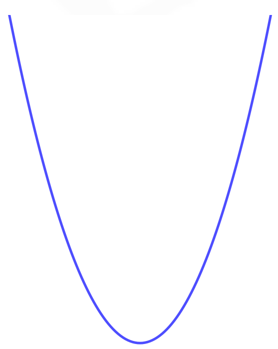
Shape of parabolas

The different shape of parabola is given by the coefficient of x^2 i.e. the value of a in $y = ax^2 + bx + c$.

Concave-up

$a > 0 \quad \Rightarrow \quad y = +x^2 \ldots$

The vertex is a maximum.

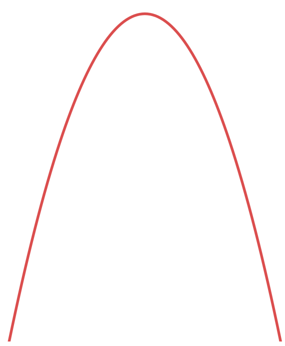


E.g. $y = 2x^2 - 5x + 8$

Concave-down

$a < 0 \quad \Rightarrow \quad y = -x^2 \ldots$

The vertex is a minimum.



E.g. $y = -4x^2 + 9x - 7$

E.g. 2 State whether these parabolas are concave-up or concave-down.

(a) $y = 5x^2 - 6x - 13$ (b) $y = -3x^2 + x + 8$

(c) $y = 9 - x^2$ (d) $y = 7 - 3x + 2x^2$

Working: (a) $y = 5x^2 - 6x - 13$: $a > 0$ $\Rightarrow$ concave-up

Video: Drawing quadratic graphs

Solutions to Starter and E.g.s

Exercise

9-1 class textbook:	p185 M6.9 Qu 1-9
A*-G class textbook:	p169 M6.9 Qu 1-10
9-1 homework book:	p66 M6.9 Qu 1-4
A*-G homework book:	p48 M6.9 Qu 1-5

Summary

The general equation of a parabola is $y = ax^2 + bx + c$.

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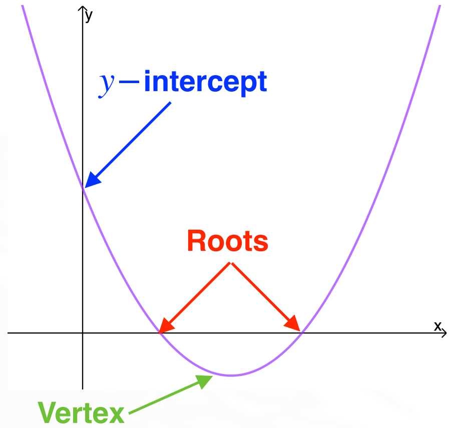
$y-$**intercept** — where the curve crosses the y-axis.

Roots — where the curve meets or crosses the x-axis.



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Concave-up	$a > 0$	$\Rightarrow$	$y = +x^2 \ldots$
Concave-down	$a < 0$	$\Rightarrow$	$y = -x^2 \ldots$