The Quadratic Polynomial and the Parabola

Quadratic polynomial $-\ ax^2 + bx + c$

Quadratic function $-\ y = ax^2 + bx + c$

Quadratic equation $-\ ax^2 + bx + c = 0$

Coefficients $-\ a, b, c$

Indeterminate $-\ x$

Roots $-$ Solutions to the quadratic equation

Zeroes $-\ x$ intercepts of the quadratic function

a quadratic with
$a = 1$
is called **monic**

e.g. Find the roots of $x^2 - 1 = 0$

$$x^2 - 1 = 0$$

$$x^2 = 1$$

$$x = \pm 1$$

$\therefore$ the roots are $x = -1$ and $x = 1$

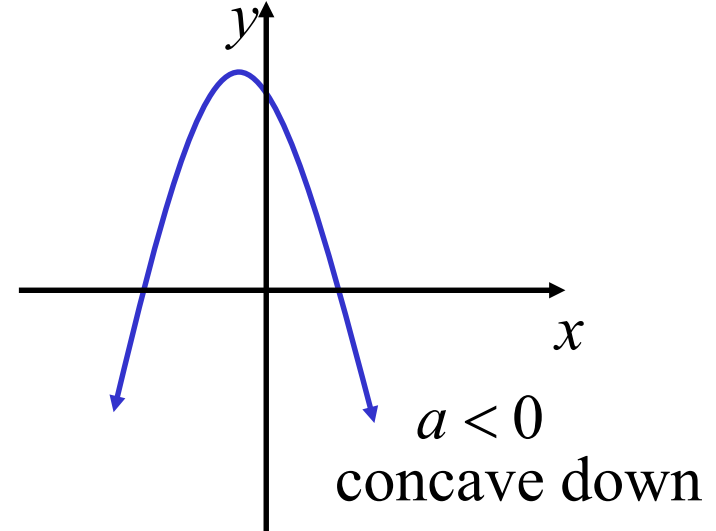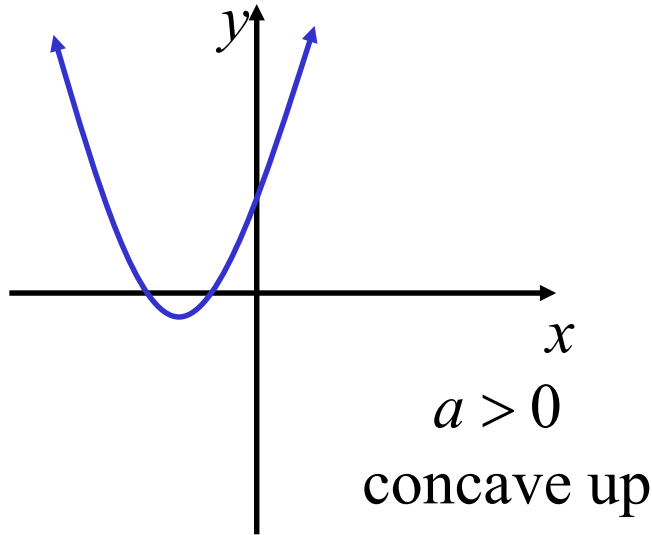# *Graphing Quadratics*

The graph of a quadratic function is a parabola.

$$y = ax^2 + bx + c$$

a

$a > 0$
concave up

$a < 0$
concave down

c $= y$ intercept

zeroes (roots) $= x$ intercepts

$x = \dfrac{-b}{2a}$ $=$ axis of symmetry

Note: AOS is the average of the zeroes

vertex x value is the AOS

y value is found by substituting AOS into the function.
(It is the maximum/minimum value of the function)

e.g. Graph $y = x^2 + 8x + 12$

$\underline{\mathbf{a}} = 1 > 0$ $\therefore$ concave up

$\underline{\mathbf{zeroes}}$ $\quad x^2 + 8x + 12 = 0$

$$(x+6)(x+2) = 0$$

$$x = -6 \text{ or } x = -2$$

$\therefore$ x intercepts are

$(-6, 0)$ and $(-2, 0)$

$\underline{\mathbf{AOS}}$ $\quad x = \dfrac{-b}{2a}$ $\quad OR \quad x = \dfrac{-6-2}{2}$

$$= \dfrac{-8}{2} \qquad\qquad = -4$$

$$= -4$$

$\underline{\mathbf{vertex}}$ $\quad y = (-4)^2 + 8(-4) + 12$

$$= -4$$

$\therefore$ vertex is $(-4, -4)$

$\underline{\mathbf{c}} = 12$ $\therefore$ y intercept is $(0, 12)$
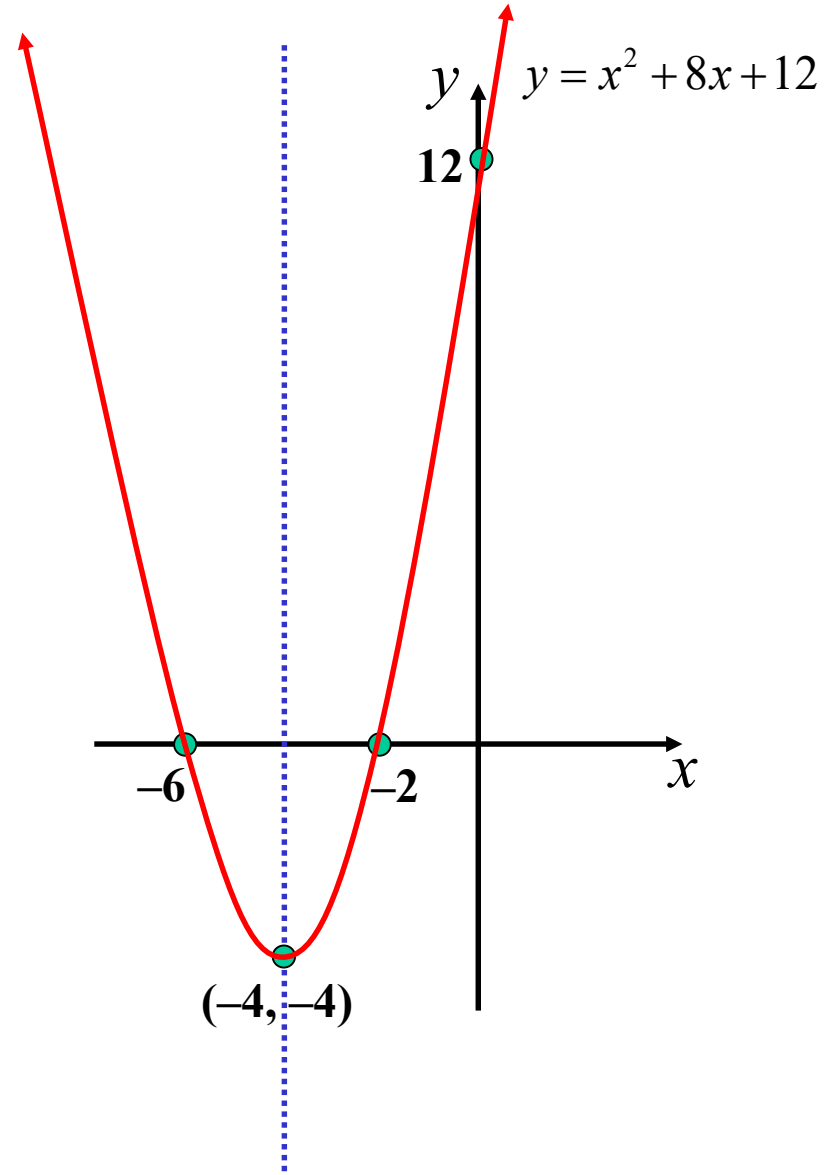
(*ii*) Find the quadratic with;

a) roots 3 and 6

$$y = a\left(x^2 - 9x + 18\right)$$

$$-(6+3) \qquad 6 \times 3$$

b) monic roots $3 + \sqrt{2}$ and $3 - \sqrt{2}$

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

$$-\left(3 + \sqrt{2} + 3 - \sqrt{2}\right)$$

$$\left(3 + \sqrt{2}\right)\left(3 - \sqrt{2}\right)$$

c) roots 2 and 8 and vertex (5,3)

$$y = a\left(x^2 - 10x + 16\right)$$

$$(5,3): \quad 3 = a\left(5^2 - 10(5) + 16\right)$$

$$3 = -9a$$

$$a = -\frac{1}{3}$$

$$\therefore y = -\frac{1}{3}\left(x^2 - 10x + 16\right)$$

Exercise 3D; 1a, 2b(ii), 3a, 4 (*use desmos*), 5bd, 7bf, 9cf, 10c, 11ad, 12, 14, 15