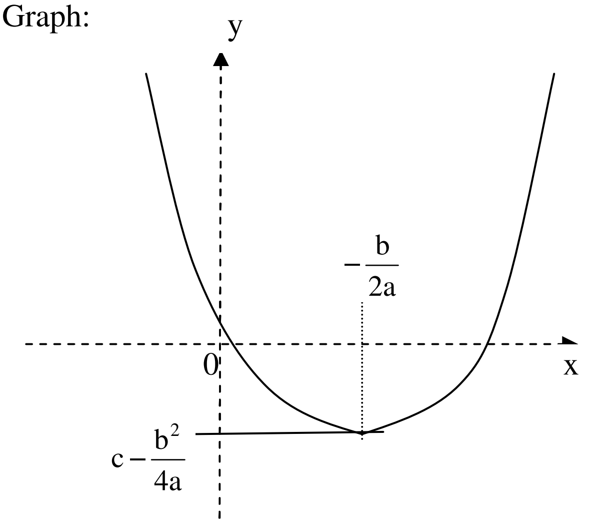
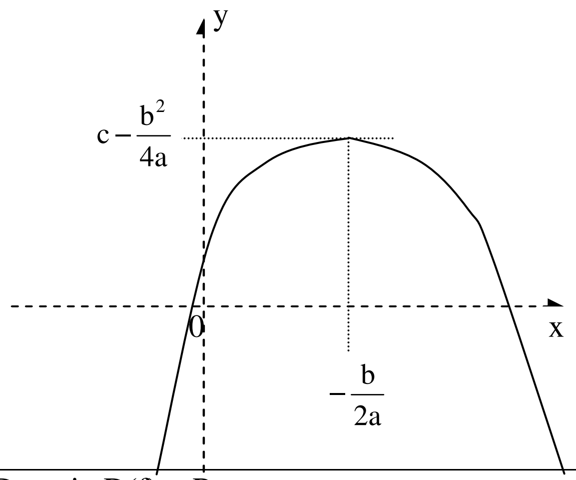
QUADRATIC FUNCTIONS AND THEIR PROPERTIES

Definition: **Quadratic function** is each function given by formula $\mathbf{y = ax^2 + bx + c}$; where a, b, c $\in$ R; $a \neq 0$. Domain of a quadratic function is set of real numbers R. A graph of quadratic function is **parabola** symmetric along axis parallel to y-axis (this axis passes through the vertex).

a > 0 (convex parabola)	**a < 0 (concave parabola)**
Graph: 	Graph: 
Domain D(f) = R	Domain D(f) = R
Range of values V(f) = $\left\langle c-\frac{b^2}{4a},\infty\right)$	Range of values V(f) = $\left(-\infty,c-\frac{b^2}{4a}\right\rangle$
Increasing on $\left\langle\frac{-b}{2a},\infty\right)$	Increasing on $\left(-\infty,-\frac{b}{2a}\right\rangle$
Decreasing on $\left(-\infty,-\frac{b}{2a}\right\rangle$	Decreasing on $\left\langle\frac{-b}{2a},\infty\right)$
Bounded from below	Bounded from above
Pointed minimum at point $-\frac{b}{2a}$	Pointed maximum at point $-\frac{b}{2a}$

To find $x_{1,2}$ = the intersections of parabole with x – axis, you need to set the quadratic function equal to zero, and then calculate the quadratic equation through discriminant, completing the square, factorising or applying Viete´s formulae.

$0 = ax^2 + bx + c$

$D = b^2 - 4ac$, $\qquad x_{1,2} = \dfrac{-b \pm \sqrt{D}}{2a}$

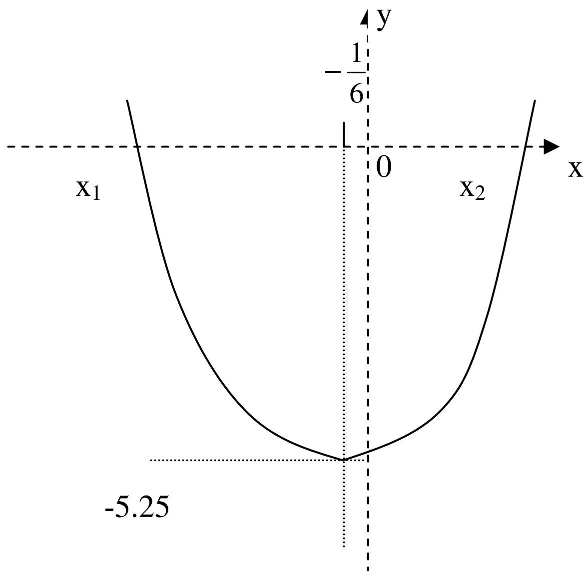
Ex: Find out properties (domain, range of values, monotony, boundaries, maximum/minimum) of function y = $9x^2 + 3x - 5$. Draw a graph of this function.

D(f) = R, V(f) = $\left\langle -5-\frac{3^2}{4x9},\infty\right) = \left\langle -5.25,\infty\right)$

Increasing on $\left\langle \frac{-3}{2x9},\infty\right) = \left\langle -\frac{1}{6},\infty\right)$

Decreasing on $\left(-\infty,-\frac{1}{6}\right\rangle$

Bounded from below; pointed minimum at $\frac{-3}{2x9} = -\frac{1}{6}$



$$x_{1,2} = \frac{-3\pm\sqrt{189}}{18} = \frac{-3\pm 17}{18}$$