

# Quadratic function

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$$a > 0$$

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# Effect of a bigger $|a|$

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# Axis of symmetry

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# Parabola

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# Vertex

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$$\text{Axis of symmetry of } y = x^2 - 6x + 5$$

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the curved graph of a quadratic function

$$f(x) = ax^2 + bx + c \text{ with } a \neq 0$$

the parabola opens downwards; the vertex is  
a maximum

the parabola opens upwards; the vertex is a  
minimum

the turning point of the parabola, a  
maximum or a minimum

a narrower parabola

$$x = -\frac{-6}{2} = 3$$

the vertical line through the vertex;  $x = -\frac{b}{2a}$

**y-intercept**

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**x-intercepts (zeros,  
roots)**

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**How many x-intercepts can a  
parabola have?**

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**Standard form**

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**Factorised form**

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**Vertex form**

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**Vertex of  $y = (x + 2)^2 - 7$**

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**x-intercepts of  $y = (x - 2)(x + 5)$**

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where  $y = 0$ ; solve the quadratic equation

where  $x = 0$ ; the constant  $c$  in standard form



$y = ax^2 + bx + c$ ; shows the  $y$ -intercept

0, 1 or 2



$y = a(x - h)^2 + k$ ; shows the vertex  $(h, k)$

$y = a(x - p)(x - q)$ ; shows the  $x$ -intercepts  $p$  and  $q$



2 and -5

$(-2, -7)$ : the sign inside the bracket changes



## Factorised to standard form

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## Standard to factorised form

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## Standard to vertex form

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Write  $y = 2x^2 - 12x + 13$  in vertex form

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## Vertex to standard form

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## Factorised to vertex form

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When is each form most useful?

$y = a(x - h)^2 + k$  as a transformation of  $y = x^2$

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solve  $y = 0$  to get  $p$  and  $q$ , then  $y = a(x - p)(x - q)$

expand the brackets

$$h = 3, k = -5, \text{ so } y = 2(x - 3)^2 - 5$$

$$h = -\frac{b}{2a}, k = f(h), \text{ then } y = a(x - h)^2 + k$$

$$h = \frac{p + q}{2}, \text{ then find } k \text{ by substituting } h$$

expand the bracket and collect like terms

stretch factor  $a$ , then  $h$  units right and  $k$  units up

standard:  $y$ -intercept; factorised:  $x$ -intercepts; vertex: maximum or minimum

## Domain of a quadratic function

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## Range if $a > 0$ and the vertex is $(h, k)$

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## Range if $a < 0$ and the vertex is $(h, k)$

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## Range of $f(x) = x^2 - 6x + 5$ for $0 \leq x \leq 4$

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## Steps to sketch a parabola

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## TI-Nspire: find the vertex

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## TI-Nspire: find the x-intercepts

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## TI-Nspire: find where two graphs meet

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$$y \geq k$$

all real numbers,  $x \in \mathbb{R}$ , unless restricted

check the vertex  $(3, -4)$  and the ends:  $-4 \leq y \leq 5$

$$y \leq k$$

Graphs page, menu → Analyze Graph →  
Minimum or Maximum

shape from  $a$ ,  $y$ -intercept,  $x$ -intercepts, axis  
and vertex, then a smooth symmetrical  
curve

enter both functions, menu → Analyze Graph  
→ Intersection

Graphs page, menu → Analyze Graph →  
Zero

# TI-Nspire: table of values

Height  $h = -5t^2 + 20t$ : maximum height

vertex at  $t = 2$ , so  $h = 20$  m

menu → Table → Split-screen Table (or ctrl + T)