

Completing the square

Use it when there is a number or a minus in front of x^2 , or you need a maximum.

1 Take a out

Take it out of the x^2 and x terms only.

$$a\left(x^2 + \frac{b}{a}x\right) + c$$

$-x^2$? take out -1 : the sign of the x term changes

2 Inside the bracket

Complete the square inside. Halve the number of x .

$$a\left[\left(x + \frac{\text{half}}{2}\right)^2 - \left(\frac{\text{half}}{2}\right)^2\right] + c$$

the half can be a fraction: keep it exact

3 Multiply by a

Multiply the $-\text{half}^2$ by a . Keep the $+c$.

$$a\left(x + \frac{\text{half}}{2}\right)^2 - a \times \left(\frac{\text{half}}{2}\right)^2 + c$$

a negative? then $-a \times \text{half}^2$ adds on

4 Answer

Work out the numbers at the end.

$$a(x + p)^2 + q$$

check: expand it back

5 Maximum or minimum

The turning point is $(-p, q)$.

a positive: **minimum** q

a negative: **maximum** q

the largest value of $q - (x + p)^2$ is q

6 In a problem

Say what the turning point means.

x coordinate: when or where

y coordinate: the greatest or least

give the answer in the words of the question, with units

The Maths Habit

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