



Formula. This formula is <u>given</u> on the National 5 Mathematics exam paper. The roots of $ax^2 + bx + c = 0$ are given by: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

The quadratic formula can be used to solve <u>any</u> quadratic equation. We usually use it when you can't factorise the expression.

Important – you <u>must</u> rearrange the equation so that is has = 0 on the right-hand side. If you do not do this, you will risk losing <u>all</u> of the marks.

In the N nal 5 exam, a clue to use the formula (rather than factorising) is where the question tells you to "**give your answers correct to 2** (or 1) **decimal places**" etc. Remember you should always state your unrounded answer before rounding (see page 6).

Example 1

Solve the equation $3x^2 + 2x - 6 = 0$, giving your answers correct to two decimal places.

Solution

<u>Step 1</u> – check the equation has '= 0' on the RHS. It does, so we can proceed.

<u>Step 2</u> – write down what a, b and c are: a = 3, b = 2, c = -6

<u>Step 3</u> – substitute into the formula and solve – **being very careful when dealing** with negative signs:



If the number under the square root sign works out to be negative, then you will not be able to complete the formula. This means either that:

- You have made a mistake with negative numbers and need to check your working (realistically this is the most likely thing that would have happened in an exam)
- Or the equation has no solution (happens a lot in real life, but less likely in an exam)

Example 2

Solve the equation $2x^2 - 5x - 1 = 3$, giving your answers correct to 2 d.p.

Solution

<u>Step 1</u> – check the equation has '= 0' on the right-hand side. It does not, so we have to rearrange:

$$2x^{2} - 5x - 1 - 3 = 0$$
$$2x^{2} - 5x - 4 = 0$$

<u>Step 2</u> – write down what a, b and c are: a = 2, b = -5, c = -4

<u>Step 3</u> – substitute into the formula and solve – **being very careful when dealing** with negative signs:



Answer: $x = 3 \cdot 14$ and x = -0.64

Exercise 1

1. Solve these equations using the quadratic formula.

a)	$3x^2 + 7x + 2 = 0$	(b)	$2a^2 + 5a + 2 = 0$	(c)	$3c^2 + 8c + 5 = 0$
d)	$2p^2 + 11p + 9 = 0$	(e)	$2y^2 + 11y + 5 = 0$	(f)	$3d^2 + 11d + 6 = 0$
g)	$2x^2 - 7x + 3 = 0$	(h)	$2a^2 - 5a + 3 = 0$	(i)	$5p^2 - 17p + 6 = 0$
j)	$5b^2 - 7b + 2 = 0$	(k)	$6x^2 - 7x + 2 = 0$	(l)	$4y^2 - 11y + 6 = 0$
m)	$3x^2 - 2x - 1 = 0$	(n)	$2a^2 - a - 3 = 0$	(0)	$4p^2 - 4p - 3 = 0$
p)	$2c^2 + 7c - 4 = 0$	(q)	$6y^2 - 11y - 2 = 0$	(r)	$3w^2 + 10w - 8 = 0$

2. Solve these equations using the quadratic formula, giving your answers correct to 2 decimal places.

a)	$x^2 + 5x + 5 = 0$	(b)	$b^2 + 9b + 2 = 0$	(c)	$p^2 + 4p + 1 = 0$
d)	$c^2 + 4c + 2 = 0$	(e)	$y^2 + 7y + 3 = 0$	(f)	$a^2 + 8a + 5 = 0$
g)	$z^2 - 5z + 1 = 0$	(h)	$q^2 - 12q + 4 = 0$	(i)	$w^2 - 6w + 2 = 0$
j)	$d^2 - 10d + 8 = 0$	(k)	$x^2 - 3x + 1 = 0$	(1)	$m^2 - 7m + 4 = 0$
m)	$y^2 + 8y - 3 = 0$	(n)	$k^2 + 4k - 6 = 0$	(0)	$c^2 + 2c - 9 = 0$

3. Solve these equations using the quadratic formula, giving your answers correct to 2 decimal places.

a)	$3x^2 + 8x + 5 = 0$	(b)	$2b^2 + 9b + 3 = 0$	(c)	$2p^2 + 5p + 1 = 0$
d)	$1 + 6c - 4c^2 = 0$	(e)	$3y^2 + 7y + 3 = 0$	(f)	$5a^2 + 9a + 2 = 0$
g)	$8z^2 - 7z + 1 = 0$	(h)	$3 + 12q - 4q^2 = 0$	(i)	$3w^2 - 6w + 2 = 0$
j)	$5d^2 - 10d + 4 = 0$	(k)	$5x^2 - 7x + 1 = 0$	(l)	$3+8m-2m^2=0$
m)	$5y^2 + 8y - 2 = 0$	(n)	$5 - 2k - 6k^2 = 0$	(0)	$10c^2 + 2c - 1 = 0$
p)	$8-9t-4t^2=0$	(q)	$3 + 3a - 7a^2 = 0$	(r)	$2z^2 + 2z - 9 = 0$

4. Solve these equations using the quadratic formula, giving your answers correct to 3 significant figures.

a)	$x^2 + 5x + 3 = 0$	(b)	$c^2 + 3c + 1 = 0$	(c)	$m^2 + 8m + 2 = 0$
d)	$y^2 + 7y + 7 = 0$	(e)	$p^2 + 6p + 2 = 0$	(f)	$a^2 + 6a + 3 = 0$
g)	$b^2 - 5b + 2 = 0$	(h)	$z^2 - 9z + 4 = 0$	(i)	$q^2 - 7q + 5 = 0$
j)	$x^2 - 10x + 3 = 0$	(k)	$c^2 - 8c + 8 = 0$	(l)	$w^2 - 4w + 2 = 0$
m)	$k^2 + 12k - 20 = 0$	(n)	$d^2 + 11d - 15 = 0$	(0)	$s^2 + 8s - 17 = 0$
p)	$a^2 + 3a - 9 = 0$	(q)	$y^2 + 2y - 11 = 0$	(r)	$c^2 + 3c - 12 = 0$
s)	$8x^2 + 8x = -1$	(t)	$5b^2 + 3b = 9$	(u)	$2p^2 - 9p = 3$
v)	$7m^2 = 6m - 1$	(w)	$3x^2 = 8 - 3x$	(x)	$4c^2 = 9 + 3c$

Answers

Exercise 1

1. a)
$$-\frac{1}{3}$$
 and -2 (b) $-\frac{1}{2}$ and -2 (c) $-\frac{5}{3}$ and -1 (d) $-\frac{9}{2}$ and -1
e) $-\frac{1}{2}$ and -5 (f) $-\frac{2}{3}$ and -3 (g) $\frac{1}{2}$ and 3 (h) $\frac{3}{2}$ and 1
i) $\frac{2}{5}$ and 3 (j) $\frac{2}{5}$ and 1 (k) $\frac{2}{3}$ and $\frac{1}{2}$ (l) $\frac{3}{4}$ and 2
m) $-\frac{1}{3}$ and 1 (n) $\frac{3}{2}$ and -1 (o) $-\frac{1}{2}$ and $\frac{3}{2}$ (p) $\frac{1}{2}$ and -4
q) $-\frac{1}{6}$ and 2 (r) $\frac{2}{3}$ or -4

3.a)
$$-1 \text{ and } -1.67$$
(**b**) $-0.36 \text{ and } -4.14$ (**c**) $-0.22 \text{ and } -2.28$ **d)** $-0.15 \text{ and } 1.65$ (**e**) $-0.57 \text{ and } -1.77$ (**f**) $-0.26 \text{ and } -1.54$ **g)** $0.70 \text{ and } 0.18$ (**h**) $-3.23 \text{ and } 0.23$ (**i**) $1.58 \text{ and } 0.42$ **j**) $-1.45 \text{ and } -0.55$ (**k**) $1.24 \text{ and } 0.16$ (**l**) $-0.35 \text{ and } 4.35$ **m**) $0.22 \text{ and } -1.82$ (**n**) $-1.09 \text{ and } 0.76$ (**o**) $0.23 \text{ and } -0.43$ **p**) $-2.93 \text{ and } 0.68$ (**q**) $-0.47 \text{ and } 0.90$ (**r**) $1.68 \text{ and } -2.68$

a)	-0.697 and -4.30	(b)	-0.382 and -2.62	(c)	-0.258 and -7.74
d)	-1·21 and -5·79	(e)	-0·354 and -5·65	(f)	–0.551 and –5.45
g)	0.438 and 4.56	(h)	0.469 and 8.53	(i)	0.807 and 6.19
j)	0.310 and 9.69	(k)	1.17 and 6.83	(l)	0.586 and 3.41
m)	-13.5 and 1.48	(n)	-12·2 and 1·23	(0)	–9·75 and 1·75
p)	-4.85 and 1.85	(q)	-4·46 and 2·46	(r)	-5.28 and 2.28
s)	-0.146 and -0.854	(t)	-1.68 and 1.08	(u)	-0.312 and 4.81

4.

v) 0.631 and 0.227 (**w**) 1.21 and -2.21 (**x**) 1.92 and -1.17