

Date: _____

6.4 The Quadratic Formula

We can find roots of a quadratic equation that cannot be factored directly using the **quadratic formula**.

$$\text{Quadratic Formula: } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$ax^2 + bx + c = 0$$

Where a, b, and c are the coefficients from a quadratic equation in **standard form**.



This formula allows us to find roots (or solve equations) without having to partial factor and write in vertex form.

Warnings About the Formula:

- Sign errors are common. Use brackets to substitute!
- Factoring is often more efficient, so don't forget how to do it.
- You should get two answers! Don't forget to add and subtract the root.
- BEDMAS errors are common. Be careful and make sure you know how to work your calculator!!



Example: Solve $5x^2 - 4x - 3 = 0$ using the quadratic formula. Round your solutions to two decimal places.

$$a = 5$$

$$b = -4$$

$$c = -3$$

$$x = \frac{4 \pm \sqrt{(-4)^2 - 4(5)(-3)}}{2(5)}$$

$$x = \frac{4 \pm \sqrt{16 + 60}}{10}$$

$$x = \frac{4 \pm \sqrt{76}}{10}$$

$$x = \frac{4 + \sqrt{76}}{10}$$

$$= 1.27$$

$$x = \frac{4 - \sqrt{76}}{10}$$

$$= -0.47$$



Now solve $x^2 - x - 6 = 0$ by factoring and by using the formula. Which was more efficient?

Formula

$$a = 1 \quad b = -1 \quad c = -6$$

$$x = \frac{1 \pm \sqrt{(-1)^2 - 4(1)(-6)}}{2(1)}$$
$$= \frac{1 \pm \sqrt{25}}{2}$$

$$x = \frac{1 + 5}{2}$$

$$x = 3$$

$$x = \frac{1 - 5}{2}$$

$$x = -2$$

Factor

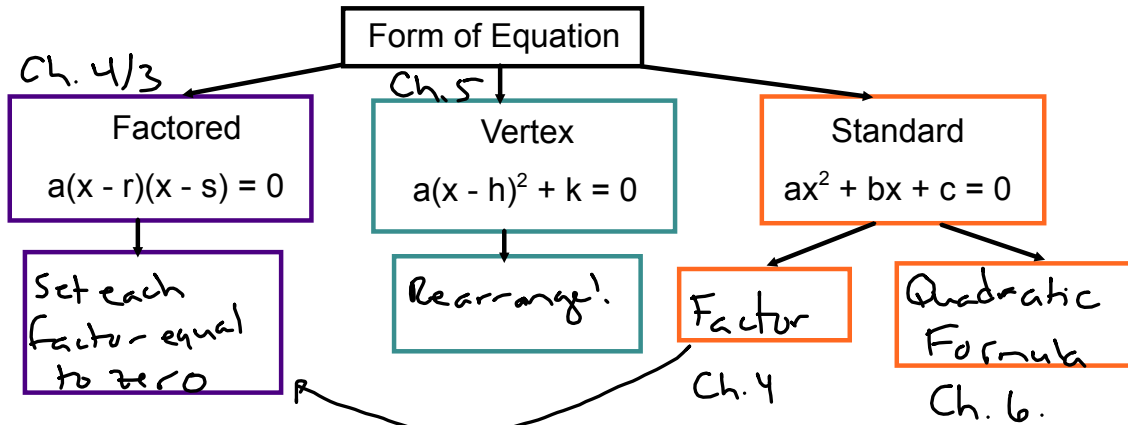
$$(x - 3)(x + 2) = 0$$

$$x = 3$$

$$x = -2$$

Same!

When you are **solving quadratic equations**, always choose the most appropriate/efficient method.



More Practice:

1) Find the roots of $y = 2x^2 - 6x + 2$ when $y = -1.5$. (0.79, -1.5) and (2.21, -1.5)

$$2x^2 - 6x + 2 = -1.5$$

$$2x^2 - 6x + 3.5 = 0$$

QF (decimal !!)

$$a = 2 \quad c = 3.5$$

$$b = -6$$

$$x = \frac{6 \pm \sqrt{8}}{4}$$

$$= 2.21$$

$$x = \frac{6 - \sqrt{8}}{4}$$

$$= 0.79$$

2) Determine the roots of $(x+4)^2 = 2(x+5)$. Round to two decimal places.

$$(x+4)(x+4) = 2x+10$$

$$x^2 + 4x + 4x + 16 = 2x + 10$$

$$x^2 + 6x + 6 = 0$$

QF $a = 1$

$$b = 6$$

$$c = 6$$

$$x = \frac{-6 \pm \sqrt{12}}{2}$$

$$= -1.27$$

$$x = \frac{-6 \pm \sqrt{(6)^2 - 4(1)(6)}}{2(1)}$$

$$= \frac{-6 \pm \sqrt{36 - 24}}{2}$$

$$x = \frac{-6 - \sqrt{12}}{2}$$

$$= -4.73$$



3) Solve $-2(x + 4)^2 + 12 = 0$. Report your answers as exact values.

Rearrange:

$$-2(x+4)^2 + 12 = 0$$

$$\frac{-2(x+4)^2}{-2} = \frac{-12}{-2}$$

$$\sqrt{(x+4)^2} = \pm\sqrt{6}$$

$$x+4 = \pm\sqrt{6}$$

Leave square
root, fractions

$$x = -4 \pm \sqrt{6}$$

Answers as exact
values.

4) A triangle's height is 5 cm longer than its base. The area of the triangle is 53 cm^2 . Determine the dimensions of the triangle.

5) A ball is thrown from a building. Its path is modelled by $h = -5t^2 + 8t + 10$, where h is height in m and t is time in seconds. Determine the length of time that the ball spends above 12 m.

