

If you can't solve a quadratic by factoring or completing the square, you can always use the quadratic formula! The quadratic formula will let you solve any quadratic equation! ☺

Recall that a quadratic equation in **standard form** is:  $ax^2 + bx + c = 0$ .

**Quadratic Formula:** Let  $a$ ,  $b$ , and  $c$  be real numbers where  $a \neq 0$ . The solutions of the quadratic equation  $ax^2 + bx + c = 0$  are:

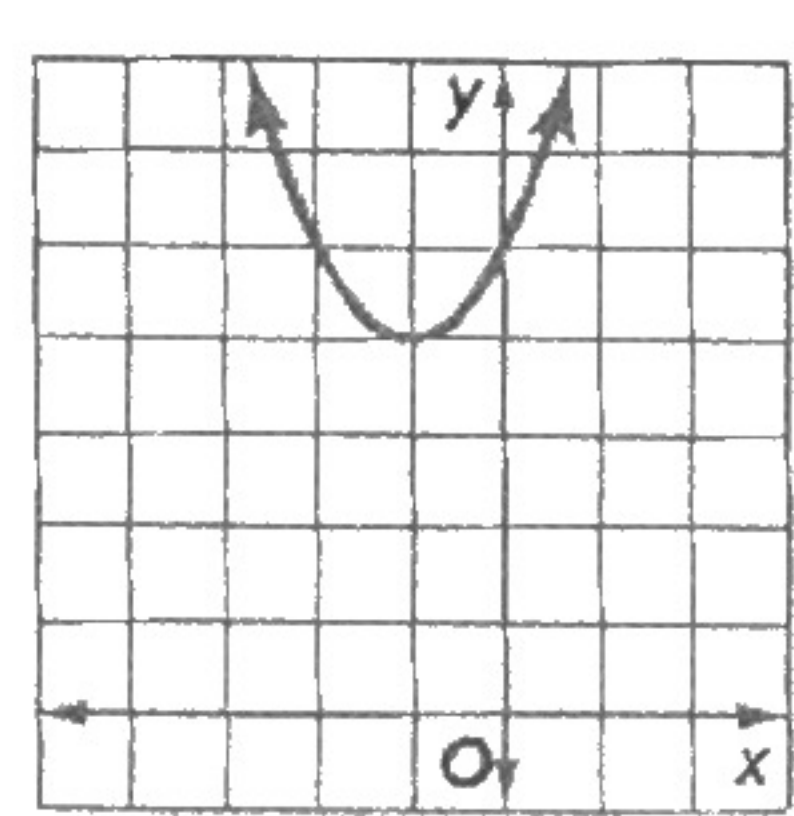
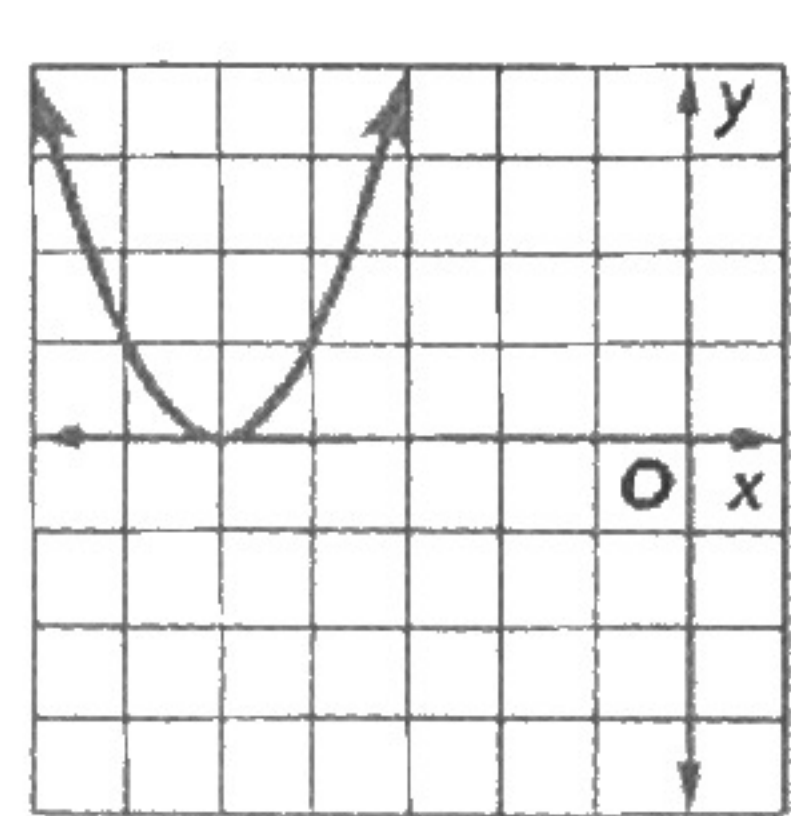
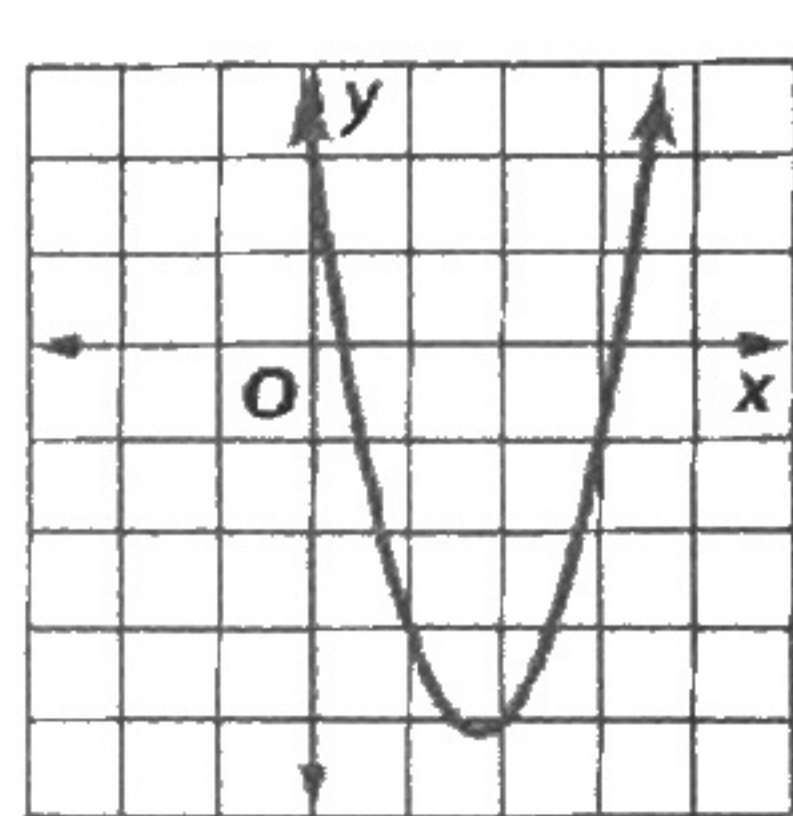
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Watch these videos:

<https://www.youtube.com/watch?v=2lbABbfU6Zc>

<https://www.youtube.com/watch?v=-gwz6d9NYz0>

**Graphical Display:**

Discriminant	$b^2 - 4ac = -16$ negative	$b^2 - 4ac = 0$ zero	$b^2 - 4ac = 33$ positive
Graph of Related Function			
Real Solutions	0	1	2

**Applying the Quadratic Formula:**

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

remember -  $ax^2 + bx + c$

**Example of a quadratic equation with 2 real solutions:**

1. Solve  $2x^2 - 5x = -3$   
 $2x^2 - 5x + 3 = 0$

$a = 2$     $b = -5$     $c = 3$

①  $\frac{5 \pm 1}{4} = \frac{6}{4} = \frac{3}{2}$

$x = \frac{5 \pm \sqrt{(-5)^2 - 4(2)(3)}}{2(2)} = \frac{5 \pm \sqrt{25 - 24}}{4} = \frac{5 \pm \sqrt{1}}{4} = \frac{5 \pm 1}{4}$  ②  $\frac{5 - 1}{4} = \frac{4}{4} = 1$

**Example of a quadratic equation with 1 real solution:**

2. Solve  $4x^2 + 10x = -10x - 25$   
 $4x^2 + 20x + 25 = 0$

$a = 4$     $b = 20$     $c = 25$

$x = \frac{-20 \pm \sqrt{(20)^2 - 4(4)(25)}}{2(4)} = \frac{-20 \pm \sqrt{400 - 400}}{8} = \frac{-20 \pm \sqrt{0}}{8} = \frac{-20}{8} = \frac{-5}{2}$

Example of a quadratic equation with imaginary solutions (No real solutions).

3. Solve  $x^2 - 6x = -10$

$a = 1$   $b = -6$   $c = 10$

$$x^2 - 6x + 10 = 0$$

$$x = \frac{6 \pm \sqrt{(-6)^2 - 4(1)(10)}}{2(1)} = \frac{6 \pm \sqrt{36 - 40}}{2} = \frac{6 \pm \sqrt{-4}}{2}$$

can't take  $\sqrt{\quad}$   
of a  
negative

no real  
solutions

Try on your own: Solve the following quadratic equations using the quadratic formula.

1)  $x^2 - 4x = 12$

$$x^2 - 4x - 12 = 0$$

$$x = \frac{4 \pm \sqrt{(-4)^2 - 4(1)(-12)}}{2(1)}$$

$$x = \frac{4 \pm \sqrt{16 + 48}}{2}$$

$$x = \frac{4 \pm \sqrt{64}}{2} = \frac{4 \pm 8}{2}$$

$$x = \frac{4 + 8}{2} = \frac{12}{2} = \boxed{6}$$

$$x = \frac{4 - 8}{2} = \frac{-4}{2} = \boxed{-2}$$

2)  $5x^2 + 50x = -125$

$$5x^2 + 50x + 125 = 0$$

$$x = \frac{-50 \pm \sqrt{(50)^2 - 4(5)(125)}}{2(5)}$$

$$x = \frac{-50 \pm \sqrt{2500 - 2500}}{10}$$

$$x = \frac{-50 \pm \sqrt{0}}{10} = \frac{-50}{10} = \boxed{-5}$$