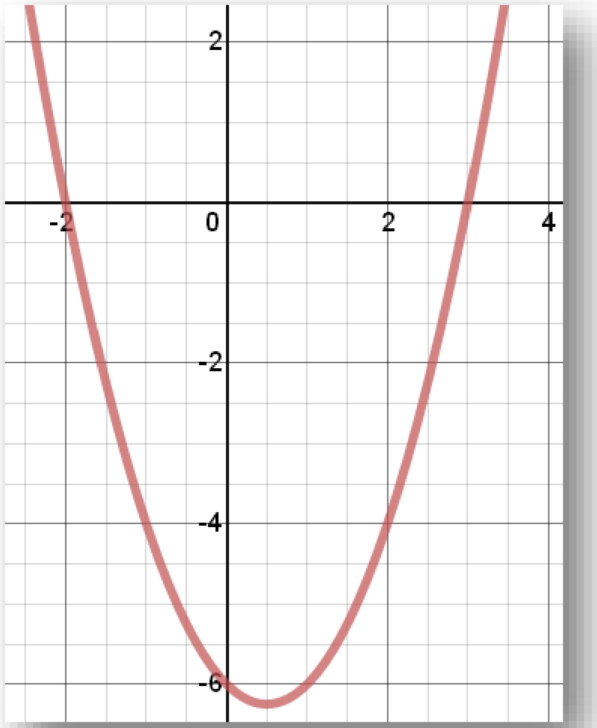
Warm Up

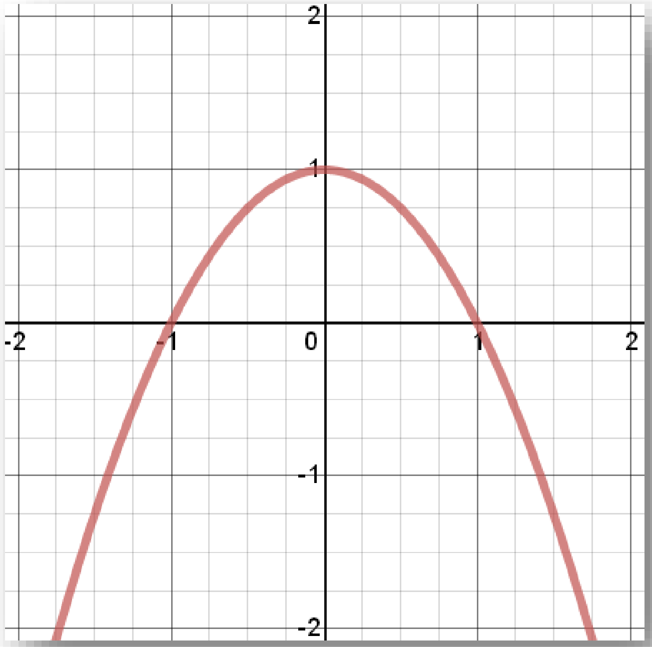
Use the following graphs to determine requested information



Zeros :

Vertex:

Axis of Symmetry:



Roots :

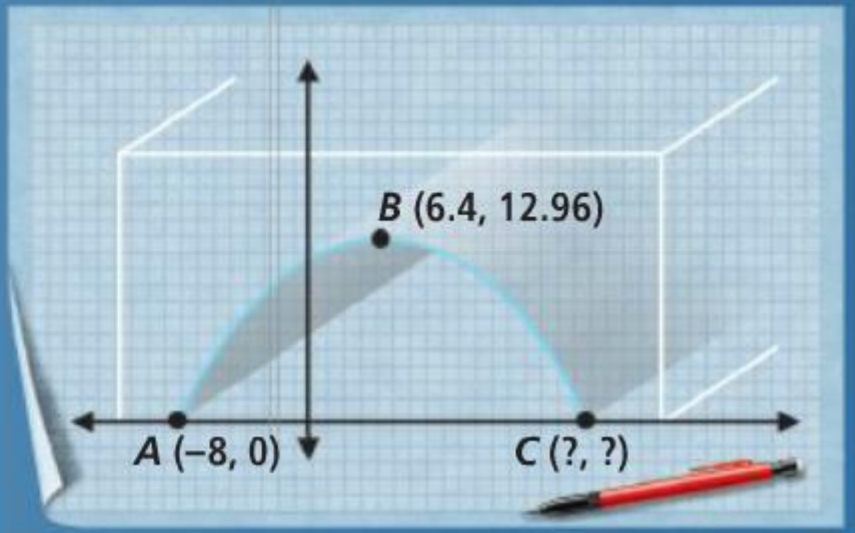
Maximum:

Axis of Symmetry:

Warm Up

SOLVE IT! Getting Ready!

As part of an engineering project, your team is drawing a highway tunnel on a coordinate system. The tunnel opening is in the shape of a parabola. You need to finish the drawing. What are the coordinates of point C? Explain your reasoning.



What do we know about parabolas that can help up?

Solving Quadratic Equations

Objectives

Solve quadratic equations using factoring.

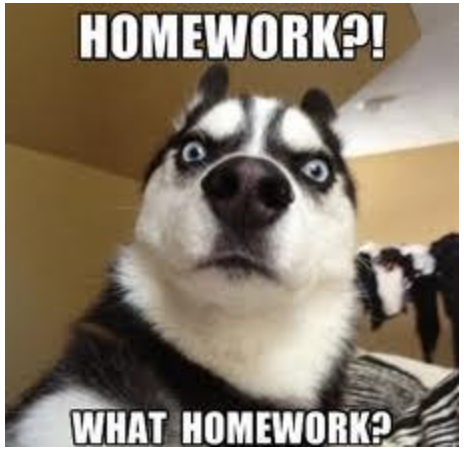
Solve quadratic equations using a graphing calculator.

Homework

Packet page 49: 2-12 even

Packet page 50: 14-22 even

Homework Questions?



Exercises

Factor each expression.

1. $x^2 + 6x + 8$ $(x + 4)(x + 2)$
2. $x^2 - 4x + 3$ $(x - 3)(x - 1)$
3. $2x^2 - 6x + 4$ $2(x - 2)(x - 1)$
4. $2x^2 - 11x + 5$ $(2x - 1)(x - 5)$
5. $2x^2 - 7x - 4$ $(2x + 1)(x - 4)$
6. $4x^2 + 16x + 15$ $(2x + 5)(2x + 3)$
7. $x^2 - 5x - 14$ $(x + 2)(x - 7)$
8. $7x^2 - 19x - 6$ $(7x + 2)(x - 3)$
9. $x^2 - x - 72$ $(x - 9)(x + 8)$
10. $2x^2 + 9x + 7$ $(2x + 7)(x + 1)$
11. $x^2 + 12x + 32$ $(x + 4)(x + 8)$
12. $4x^2 - 28x + 49$ $(2x - 7)(2x - 7)$
13. $x^2 - 3x - 10$ $(x - 5)(x + 2)$
14. $2x^2 + 9x + 4$ $(2x + 1)(x + 4)$
15. $9x^2 - 6x + 1$ $(3x - 1)(3x - 1)$
16. $x^2 - 10x + 9$ $(x - 1)(x - 9)$
17. $x^2 + 4x - 12$ $(x + 6)(x - 2)$
18. $x^2 + 7x + 10$ $(x + 5)(x + 2)$
19. $x^2 - 8x + 12$ $(x - 6)(x - 2)$
20. $2x^2 - 5x - 3$ $(2x + 1)(x - 3)$
21. $x^2 - 6x + 5$ $(x - 1)(x - 5)$
22. $3x^2 + 2x - 8$ $(3x - 4)(x + 2)$

Homework Questions?

Exercises

Factor each expression.

23. $x^2 - 12x + 36$
    $(x - 6)^2$

24. $x^2 + 30x + 225$
    $(x + 15)^2$

25. $9x^2 - 12x + 4$
    $(3x - 2)^2$

26. $x^2 - 64$
    $(x + 8)(x - 8)$

27. $9x^2 - 42x + 49$
    $(3x - 7)^2$

28. $25x^2 - 1$
    $(5x + 1)(5x - 1)$

29. $27x^2 - 12$
    $3(3x + 2)(3x - 2)$

30. $49x^2 + 42x + 9$
    $(7x + 3)^2$

31. $16x^2 - 32x + 16$
    $16(x - 1)^2$

32. $9x^2 - 16$
    $(3x + 4)(3x - 4)$

33. $8x^2 - 18$
    $2(2x + 3)(2x - 3)$

34. $81x^2 + 126x + 49$
    $(9x + 7)^2$

35. $125x^2 - 100x + 20$
    $5(5x - 2)^2$

36. $-x^2 + 196$
    $-(x + 14)(x - 14)$

37. $-16x^2 - 24x - 9$
    $-(4x + 3)^2$

SOLVING QUADRATIC EQUATIONS

What exactly does that mean?

When we solve quadratic equations, we're looking for the **zeros** of the function.

The **zeros** of a quadratic equation are found at x values that cause the function value (or y) to equal 0.

The **zeros** of the quadratic function are also referred to as **?**

If $3x = 0$, what is the value of x?

When two things are multiplied together and the answer is zero, one or both of the things has to equal zero.

In this case x has to equal zero.

Zero Product Property

If $ab = 0$ then $a = 0$ or $b = 0$

To solve this equation, we factor and find what values of x will make each factor equal to zero.

$$x^2 - 5x + 6 = 0$$
$$(x-2)(x-3) = 0$$

Set each factor equal to zero and solve

$$(x-2) = 0 \qquad (x-3) = 0$$

$$x = 2 \qquad x = 3$$

Solving Quadratic Equations

Solve the quadratic equation $x^2 - 10x + 16 = 0$

$(x - 8)\ (x - 2) = 0, x = 8$ and $x = 2$

Solving Quadratic Equations

Solve the quadratic equation $2x^2 = 7x + 4$

The equation must be equal to zero to solve. Move all the terms to one side.

The equation becomes $2x^2 - 7x - 4 = 0$

Now factor and solve.

$(x-4)(2x+1) = 0, x = 4$ and $x = -\frac{1}{2}$

You do problems 3 and 11 on packet page 49.

Solve by Graphing

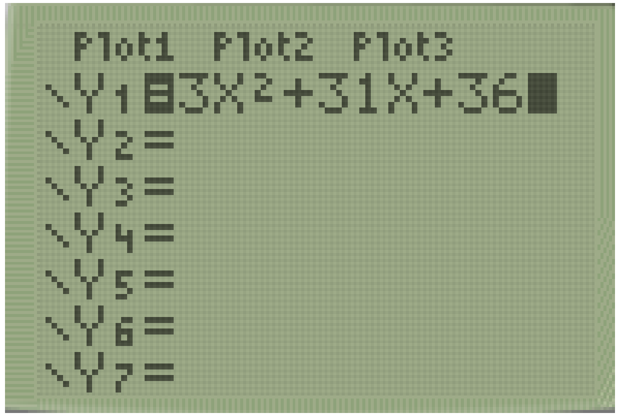
Solve the quadratic equation $3x^2 + 31x + 36 = 0$

Some equations are too difficult to solve by factoring.

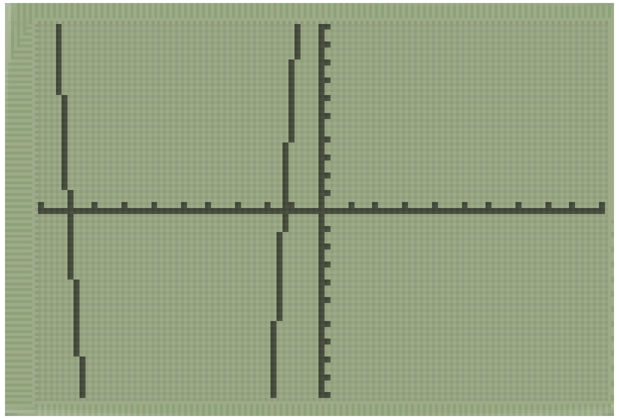
In this case we will use the graphing calculator to solve.

Solve by Graphing

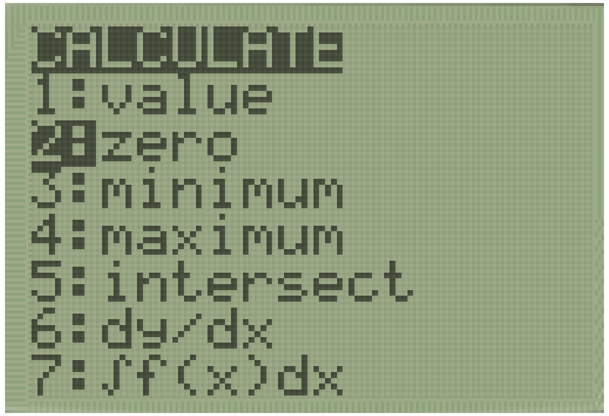
Solve the quadratic equation $3x^2 + 31x + 36 = 0$



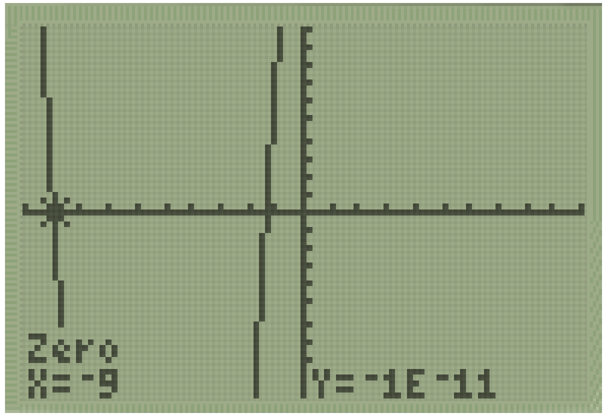
1. Enter the equation into Y=



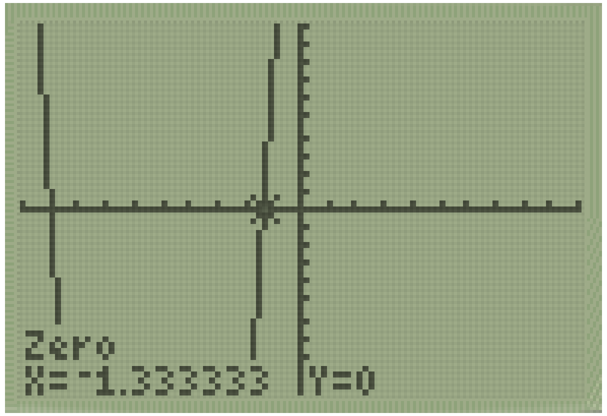
2. Press [Graph]



3. Press [2^{nd}][Trace]



4. Find first zero

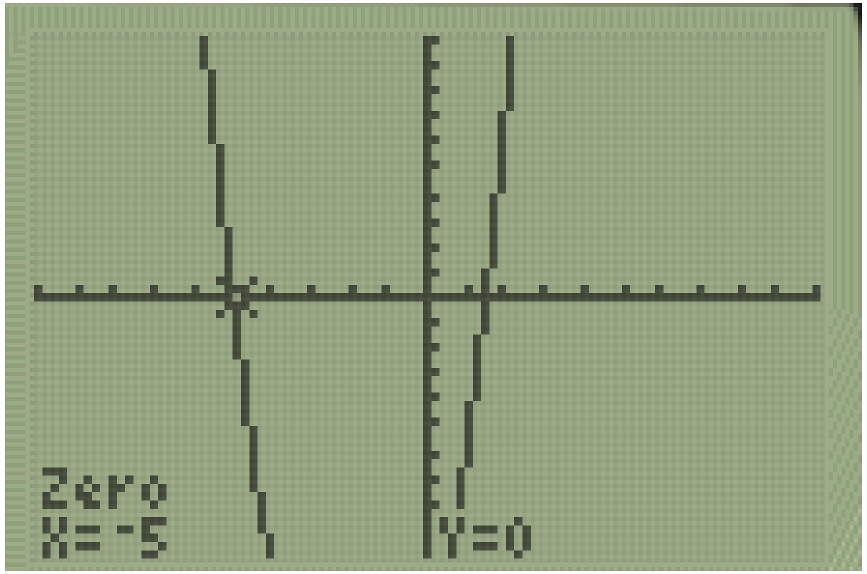


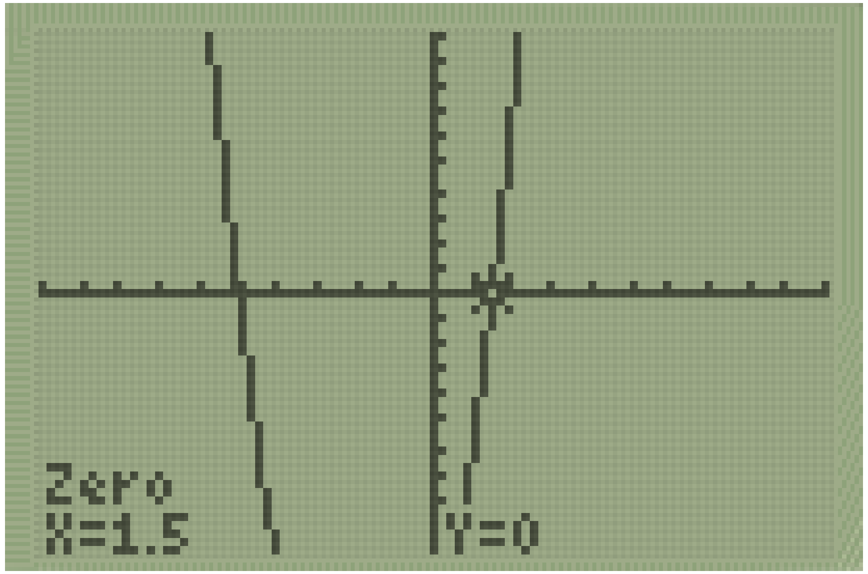
5. Find second zero

Solve by Graphing

Solve $2x^2 + 7x = 15$

Think about what you'll enter into y=





Solve by Graphing

You do problems 16 and 18 on packet page 50.

A little radical review

take note

Properties Properties of Exponents

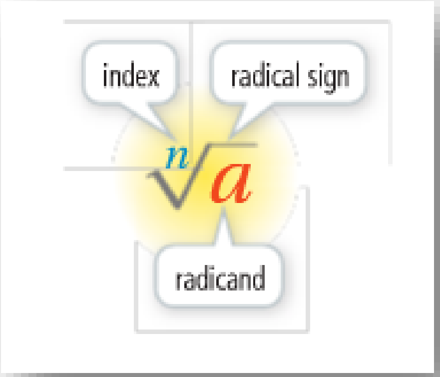
- $a^0 = 1, a \neq 0$
- $\frac{a^m}{a^n} = a^{m-n}$
- $a^{-n} = \frac{1}{a^n}$
- $(ab)^n = a^n b^n$
- $(a^m)^n = a^{mn}$
- $a^m \cdot a^n = a^{m+n}$
- $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Example

Simplify and rewrite each expression using only positive exponents.

a. $(5a^3)(-3a^{-4})$

b. $(-4x^{-3}y^5)^2$



Essential Understanding Corresponding to every power, there is a root. For example, just as there are squares (second powers), there are square roots. Just as there are cubes (third powers), there are cube roots, and so on.

$5^2 = 25$	5 is a square root of 25.
$5^3 = 125$	5 is a cube root of 125.
$5^4 = 625$	5 is a fourth root of 625.
$5^5 = 3125$	5 is a fifth root of 3125.

This pattern suggests a definition of an *n*th root.

take note

Property nth Roots of nth Powers

For any real number a, $\sqrt[n]{a^n} = \begin{cases} a \text{ if } n \text{ is odd} \\ |a| \text{ if } n \text{ is even} \end{cases}$

It is easy to overlook this rule for simplifying radicals. It is particularly important that you remember it when the radicand contains a variable expression. You must *include* the absolute value when n is even, and you must *omit* it when n is odd.

What is a simpler form of each radical expression?

A $\sqrt{16x^8}$

$$\sqrt{16x^8} = \sqrt{4^2(x^4)^2} = \sqrt{(4x^4)^2} = |4x^4| = 4x^4$$

You need to include absolute value symbols because the index of a square root is 2, which is even. However, $|4x^4| = 4x^4$ because x^4 is always nonnegative.

B $\sqrt[3]{a^6b^9}$

C $\sqrt[4]{x^8y^{12}}$

take note

Property Combining Radical Expressions: Products

If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, then $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$.

Can you simplify the product of the radical expressions? Explain.

A $\sqrt[3]{6} \cdot \sqrt{2}$

B $\sqrt[3]{-4} \cdot \sqrt[3]{2}$

“ImPerfect” Squares

If you are commanded to find $\sqrt[2]{12}$

More "ImPerfect" Squares

If you are commanded to find $\sqrt[4]{y^5}$

More "ImPerfect" Squares

If you are commanded to find $\sqrt[3]{x^9y^4}$

Find the simplest form of $\sqrt[3]{54x^5}$

take note

Property Combining Radical Expressions: Quotients

If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers and $b \neq 0$, then $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$.

What is the simplest form of the quotient?

$$\frac{\sqrt{18x^5}}{\sqrt{2x^3}}$$

$$\frac{\sqrt[3]{162y^5}}{\sqrt[3]{3y^2}}$$

take note

Property Combining Radical Expressions: Sums and Differences

Use the Distributive Property to add or subtract like radicals.

$$a\sqrt[n]{x} + b\sqrt[n]{x} = (a + b)\sqrt[n]{x} \qquad a\sqrt[n]{x} - b\sqrt[n]{x} = (a - b)\sqrt[n]{x}$$

What is the simplified form of each expression?

A $3\sqrt{5x} - 2\sqrt{5x}$

B $6x^2\sqrt{7} + 4x\sqrt{5}$

C $12\sqrt[3]{7xy} - 8\sqrt[5]{7xy}$

Problem 3 Simplifying Before Adding or Subtracting

What is the simplest form of the expression? $\sqrt{12} + \sqrt{75} - \sqrt{3}$

Conjugates are expressions, like $\sqrt{a} + \sqrt{b}$ and $\sqrt{a} - \sqrt{b}$, that differ only in the signs of the second terms. When a and b are rational numbers, the product of two radical conjugates is a rational number.

So why do we care?

What is the product $(5 - \sqrt{7})(5 + \sqrt{7})$?

Because really cool things happen when we multiply conjugates!

What is each product?

a. $(6 - \sqrt{12})(6 + \sqrt{12})$

b. $(3 + \sqrt{8})(3 - \sqrt{8})$