Chapter 9: Quadratic Functions

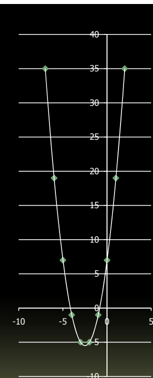
9.3 SIMPLIFYING RADICAL EXPRESSIONS

Vertex formula

- $f(x)=Ax^2+Bx+C$ standard form
- X coordinate of vertex is $-\frac{B}{2A}$
- Use this value in equation to find y coordinate of vertex
- 'form' is the way a function is written
- 'formula' is a method to solve it

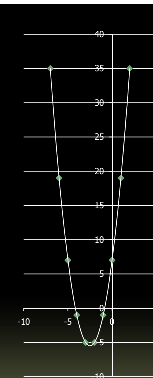
$f(x)=2x^2+10x+7$

- Graph of the function
- Can find vertex from function
- Find axis of symmetry using A and B



$f(x)=2x^2+10x+7$

- Vertex formula for x = $-\frac{B}{2A}$
- $\frac{-10}{2\cdot 2} = \frac{-5}{2}$
- $Y=2(\frac{-5}{2})^2+10(\frac{-5}{2})+7$
- $Y=(\frac{25}{2})-25+7=(\frac{25}{2})-(\frac{36}{2})$
- $= \frac{-11}{2}$
- Vertex: $(\frac{-5}{2}, \frac{-11}{2})$



Simplifying Radical Expressions

- Radical: square roots and higher roots
- Shorthand method of writing roots
  - Use fractional exponent
  - Not necessarily a fractional value of exponent
- Some roots are 'rational'
  - Can be written as a ratio: exact value
- Some roots are 'irrational'
  - Can only be written exact in 'root' form

Square Roots

- Radical Sign: $\sqrt{}$
- $\sqrt{9}$ number is radicand
- Entire expression is the radical
- Has a value: this one's value is 3
- 3 is the principal square root of 9
- The square roots of 9 include —3 also

$\sqrt{2x+5}$

- Also a radical expression
- Radicand is a binomial
  - Composed of 2 terms
  - Separated by addition
- Important to recognize it is binomial, not factors

$\sqrt{49}$ $-\sqrt{49}$ $\sqrt{-49}$

- Not the same thing!!
- First has principal sq.rt. of 7: $7 \cdot 7=49$
- Second —7: — (7)(7)
- Third: not a real number
  - There is not a real number you can multiply by itself to get a negative product
- When radicand is negative, there is not a real square root

Irrational square roots: $\sqrt{48}$

- Calculator says 6.92820323
- Not exact value!
- We won't use these approximations, except to verify our simplified versions
- We will learn method to simplify irrational roots

Simplify square root: $\sqrt{36}$

- $\sqrt{36} = 6$
- $36 = 9 \cdot 4$
- $\sqrt{36} = \sqrt{9 \cdot 4} = \sqrt{9} \cdot \sqrt{4}$
- $= 3 \cdot 2 = 6$
- Apply this method to irrational roots

Simplify square root: $\sqrt{48}$

- $\sqrt{48} \approx 6.92820323$
- $48 = 16 \cdot 3$
- $\sqrt{48} = \sqrt{16 \cdot 3} = \sqrt{16} \cdot \sqrt{3}$
- $= 4 \cdot \sqrt{3}$
- Leave irrational part of root under radical sign

Simplify square root: $\sqrt{72}$

- $\sqrt{72} \approx 8.485281374$
- $72 = 36 \cdot 2$
- $\sqrt{72} = \sqrt{36 \cdot 2} = \sqrt{36} \cdot \sqrt{2}$
- $= 6 \cdot \sqrt{2}$
- Leave irrational part of root under radical sign

Simplify square root: $\sqrt{72}$

- $\sqrt{72} = \sqrt{2 \cdot 2 \cdot 3 \cdot 3 \cdot 2}$
- Prime factors of 72
- $\sqrt{72} = \sqrt{2 \cdot 2} \quad \sqrt{3 \cdot 3} \cdot \sqrt{2}$
- $= 2 \cdot 3\sqrt{2}$
- $= 6\sqrt{2}$

Square root of quotient (division, fraction)

$$\sqrt{\frac{16}{49}} = \frac{\sqrt{16}}{\sqrt{49}} = \frac{4}{7}$$

Square root of quotient (division, fraction)

$$\sqrt{\frac{5}{9}} = \frac{\sqrt{5}}{\sqrt{9}} = \frac{\sqrt{5}}{3}$$

Not simplified, because a fraction is under the radical sign

Square root of quotient (division, fraction)

$$\sqrt{\frac{50}{81}} = \frac{\sqrt{25 \cdot 2}}{\sqrt{9 \cdot 9}} = \frac{5\sqrt{2}}{9}$$

Not simplified, because a fraction is under the radical sign

Square root of quotient (division, fraction)

$$\sqrt{\frac{7}{3}} = \frac{\sqrt{7}}{\sqrt{3}} = \frac{\sqrt{7}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{7 \cdot 3}}{\sqrt{3 \cdot 3}} = \frac{\sqrt{21}}{3}$$

Not simplified, because a fraction is under the radical sign

Also not simplified because there is a radical in the denominator

Square root of quotient (division, fraction)

$$\sqrt{\frac{3}{20}} = \frac{\sqrt{3}}{\sqrt{4 \cdot 5}} = \frac{\sqrt{3}}{2\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{3 \cdot 5}}{2\sqrt{5 \cdot 5}} = \frac{\sqrt{15}}{10}$$

Not simplified, because a fraction is under the radical sign

Also not simplified because there is a radical in the denominator

Simplifying a radical quotient

- Note numerator is binomial

$$\frac{6+3\sqrt{2}}{12}=\frac{6}{12}+\frac{3\sqrt{2}}{12}=\frac{1}{2}+\frac{\sqrt{2}}{4}=\frac{2}{4}+\frac{\sqrt{2}}{4}=\frac{2+\sqrt{2}}{4}$$

- FIRST write each term of numerator over the denominator!!
- Reduce each fraction
- Can then rewrite over single denominator if you choose: doesn't really matter

Simplifying a radical quotient

$$\frac{8-\sqrt{28}}{10}=\frac{8}{10}-\frac{\sqrt{28}}{10}=\frac{4}{5}-\frac{\sqrt{4\cdot 7}}{10}=\frac{4}{5}-\frac{2\sqrt{7}}{10}$$
$$=\frac{4}{5}-\frac{\sqrt{7}}{5}=\frac{4-\sqrt{7}}{5}$$

- FIRST write each term of numerator over the denominator!!
- Reduce each fraction and simplify radical
- Can then rewrite over single denominator if you choose: doesn't really matter

Square Root Solutions for Quadratic Equations

- Section 9.4
- Homework due on quiz day for chapter 9
- November 3, next Wednesday

Use Square Root property

- If you do the same thing to both sides of equation, it is still a valid equation
- Including taking square root
- Be sure to write ( ) around each side, so you take the square root of the entire side, not of separate terms on the side

$\sqrt{49}$ $-\sqrt{49}$ $\sqrt{-49}$

- Third: not a real number
  - There is not a real number you can multiply by itself to get a negative product
- When radicand is negative, there is not a real square root
- But radicand is -1·49…
- Define sq. rt. of -1 as "i" for imaginary

i is the square root of —1

- Factor out from negative radicands FIRST
- The proceed to simplify the root
- When solving equations, use both roots
- ± sign: plus or minus
- Write +, then underline it with the —
- If results has ± radical, ok to leave ±
- If result is ± a value, add or subtract value from the rest, and get two answers