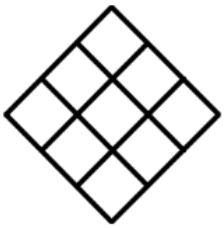
**Activity for 4.1 –** State the area of each square, then represent the area using a power. State the dimension of one of the sides of each square.

**Area**

**Area as a power**

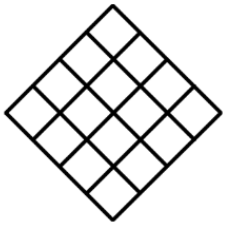
**Dimension of side**



**Area**

**Area as a power**

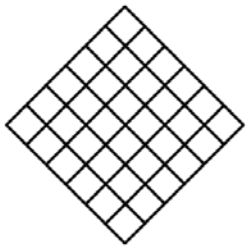
**Dimension of side**



**Area**

**Area as a power**

**Dimension of side**



**Area**

**Area as a power**

**Dimension of side**

The numbers ___ , ___ , ___ , and ___ are called perfect squares because if we use the number of units each number represents we can form square figures.

**List of other perfect squares**

$6 \times 6 =$

$7 \times 7 =$

$8 \times 8 =$

$9 \times 9 =$

$10 \times 10 =$

$11^2 =$

$12^2 =$

$13^2 =$

$14^2 =$

$15^2 =$

$16^2 =$

$17^2 =$

$18^2 =$

$19^2 =$

$20^2 =$

If we are given the area of a square and we want to determine the measurement of one of its sides, what function would we use to accomplish this?

# 4.1 – Radical Expressions – Square Root

Use the terms ***index***, ***radicand***, and ***square root*** to label the following expression:

$$\sqrt[2]{25} = 5$$

**Class Notes –** Evaluate each expression that has a perfect square for its radicand. If an expression contains a radicand that is not a perfect square, write "need calculator".

| | | | | |
|---|---|---|---|---|
| **LP#1** $\sqrt{16}$ | $\sqrt{81}$ | $\sqrt{42}$ | $\sqrt{121}$ | $\sqrt{5}$ |
| **LP#2** $\sqrt{36}$ | $\sqrt{11}$ | $\sqrt{49}$ | $\sqrt{1}$ | $\sqrt{72}$ |

**Class Notes –** Evaluate each expression. State whether the result is rational or irrational. Let $w = 2$, $x = 3$, and $y = 4$.

| | | | |
|---|---|---|---|
| **LP#3** $\sqrt{w}$ | $\sqrt{x}$ | $\sqrt{y}$ | $\sqrt{12x}$ |
| **LP#4** $\sqrt{x-w}$ | $\sqrt{w+x+y}$ | $\sqrt{3x+4y}$ | $\sqrt{5y-2x}$ |

**Class Notes –** If the radical expression has a perfect radicand, simplify it. If it does not contain a perfect radicand, write "not now".

| | | | |
|---|---|---|---|
| **LP#5** $\sqrt{x^2}$ | $\sqrt{m^2}$ | $\sqrt{p^3}$ | $\sqrt{w^2}$ |
| **LP#6** $\sqrt{n}$ | $\sqrt{k^2}$ | $\sqrt{d^2}$ | $\sqrt{y^3}$ |

**Review** – Evaluate or simplify each expression.

| | | |
|---|---|---|
| **R#1** $\sqrt{9}$ | $\sqrt{144}$ | $\sqrt{h^2}$ |
| **R#2** $\sqrt{64}$ | $\sqrt{196}$ | $\sqrt{b^2}$ |
| **R#3** $\sqrt{4}$ | $\sqrt{400}$ | $\sqrt{a^2}$ |

**Homework –**

Evaluate each expression.

**1)** $\sqrt{64}$ **2)** $\sqrt{121}$ **3)** $\sqrt{25}$ **4)** $\sqrt{225}$

**5)** $\sqrt{49}$ **6)** $\sqrt{81}$ **7)** $\sqrt{196}$ **8)** $\sqrt{144}$

**9)** $\sqrt{36}$ **10)** $\sqrt{4}$ **11)** $\sqrt{16}$ **12)** $\sqrt{9}$

Evaluate each expression. State whether the result is rational or irrational.
Let $w = 5$, $x = 1$, and $y = 8$.

**13)** $\sqrt{20w}$ **14)** $\sqrt{7x}$ **15)** $\sqrt{y+y}$ **16)** $\sqrt{x+y}$

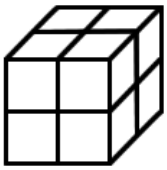
**17)** $\sqrt{10x-w}$ **18)** $\sqrt{2w+7x+y}$ **19)** $\sqrt{4x+4y}$ **20)** $\sqrt{4w-3x}$

**21)** $\sqrt{2y}$ **22)** $\sqrt{6w-5x}$ **23)** $\sqrt{10w-3y}$ **24)** $\sqrt{10y+8w+x}$

# 4.2 – Radical Expressions – Cube Root

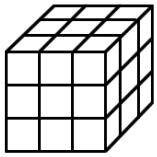
The concept for cube root is similar to square root, except we must think in terms of a cube instead of a square.

**Activity 1**



**Dimensions of cube**

**Total number of small cubes**



**Dimensions of large cube**

**Total number of small cubes**

$\sqrt[3]{8} =$ $\sqrt[3]{27} =$

In respect to the diagrams in the activity, what do the cube root of 8 and the cube root of 27 represent?

State the index and the radicands for the radical expressions above.

## List of perfect cubes

$4 \times 4 \times 4 =$
$5 \times 5 \times 5 =$
$6 \times 6 \times 6 =$
$7 \times 7 \times 7 =$

$8^3 =$
$9^3 =$
$10^3 =$

**Class Notes –** Evaluate each expression that has a perfect cube for its radicand. If an expression contains a radicand that is not a perfect cube, write "need calculator".

| | | | |
|---|---|---|---|
| **LP#1** $\sqrt[3]{125}$ | $\sqrt[3]{27}$ | $\sqrt[3]{49}$ | $\sqrt[3]{8}$ |
| **LP#2** $\sqrt[3]{81}$ | $\sqrt[3]{1}$ | $\sqrt[3]{36}$ | $\sqrt[3]{1000}$ |

**Class Notes –** If the radical expression has a perfect cube radicand, simplify it. If it does not contain a perfect cube radicand, write "not now".

| | | | |
|---|---|---|---|
| **LP#3** $\sqrt[3]{x^3}$ | $\sqrt[3]{m^3}$ | $\sqrt[3]{b^2}$ | $\sqrt[3]{w^3}$ |
| **LP#4** $\sqrt[3]{k^4}$ | $\sqrt[3]{f^3}$ | $\sqrt[3]{n^5}$ | $\sqrt[3]{p^3}$ |

**Review** – Evaluate or simplify each expression.

| | | |
|---|---|---|
| **R#1** $\sqrt[3]{8}$ | $\sqrt[3]{216}$ | $\sqrt[3]{p^3}$ |
| **R#2** $\sqrt[3]{64}$ | $\sqrt[3]{729}$ | $\sqrt[3]{p^3}$ |
| **R#3** $\sqrt[3]{27}$ | $\sqrt[3]{343}$ | $\sqrt[3]{h^3}$ |

**Homework –**

Evaluate each expression that has a perfect cube for its radicand. If an expression contains a radicand that is not a perfect cube, write "need calculator".

**1)** $\sqrt[3]{125}$ **2)** $\sqrt[3]{27}$ **3)** $\sqrt[3]{49}$ **4)** $\sqrt[3]{8}$

**5)** $\sqrt[3]{65}$ **6)** $\sqrt[3]{1}$ **7)** $\sqrt[3]{36}$ **8)** $\sqrt[3]{1000}$

**9)** $\sqrt[3]{64}$ **10)** $\sqrt[3]{343}$ **11)** $\sqrt[3]{216}$ **12)** $\sqrt[3]{17}$

Evaluate each expression. State whether the result is rational or irrational. Let $w = 2$, $x = 3$, and $y = 4$.

**13)** $\sqrt[3]{6y + x}$ **14)** $\sqrt[3]{11w + 25y + x}$ **15)** $\sqrt[3]{2y}$ **16)** $\sqrt[3]{x - w}$

**17)** $\sqrt[3]{4y + 100w}$ **18)** $\sqrt[3]{y^3}$ **19)** $\sqrt[3]{2x + w}$ **20)** $\sqrt[3]{20y - 8w}$

# 4.3 – Solving a Second-Degree Equation

In this lesson we will be solving second-degree equations. Second-degree equations contain a variable that has an exponent of two.

**Class Notes –** State the degree of each equation. Identify the equation as a first-degree equation or a second-degree equation.

| | | | |
|---|---|---|---|
| **LP#1** $x^2 = 16$ | $w + 3 = 15$ | $y^2 = 36$ | $3z = 42$ |
| **LP#2** $x^2 + 10 = 35$ | $100 = 4w^2$ | $10z = 120$ | $4x^2 = 400$ |
| **LP#3** $w^2 + w = 6$ | $y^4 = 16$ | $x^2 = 4$ | $x^2 - x = 12$ |

**Class Notes –** A solution to each equation is given. Check to see if the solution is correct or incorrect.

| | | | |
|---|---|---|---|
| **LP#4** | $x^2 = 16$<br>$x = 4$ | $y^2 = 36$<br>$y = 6$ | $m^2 = 400$<br>$m = 15$ |
| **LP#5** | $x^2 + 10 = 35$<br>$x = 5$ | $4x^2 = 400$<br>$x = 9$ | $100 = 4w^2$<br>$w = 5$ |

Go to http://en.wikipedia.org/wiki/Equations#Properties. Read the section titled "Properties". Which of the five properties must we use when solving the equation $x^2 = 49$?

| State which property to use here. | Solve the equation here. |
|---|---|
| | |

**Class Notes –** Solve each second-degree equation and check. If you do not solve an equation, explain why.

| | | |
|---|---|---|
| **LP#6**<br>$x^2 = 121$ | $m^2 = 64$ | $x = 49$ |
| **LP#7**<br>$x^2 = 144$ | $x = 169$ | $p^2 = 25$ |
| **LP#8**<br>$x^2 + 9 = 13$ | $x - 5 = 20$ | $x^2 - 20 = 61$ |

**Review** – Solve each second-degree equation and check. If an equation is not a second-degree equation write "not a second-degree equation".

| | |
|---|---|
| **R#1** $x^2 = 49$ | $x^2 = 169$ |
| **R#2** $x^2 = 4$ | $x + 2 = 38$ |
| **R#3** $x^2 + 10 = 26$ | $2x^2 = 50$ |

**Homework**

Evaluate.

**1)** $3^2 =$ **2)** $8^2 =$ **3)** $12^2 =$ **4)** $5^2 =$ **5)** $2^2 =$

**6)** $9^2 =$ **7)** $4^2 =$ **8)** $7^2 =$ **9)** $1^2 =$ **10)** $11^2 =$

**11)** $10^2 =$ **12)** $6^2 =$ **13)** $13^2 =$ **14)** $20^2 =$ **15)** $15^2 =$

Solve each second-degree equation and check.

**16)** $x^2 = 100$ **17)** $m^2 = 81$ **18)** $p^2 = 100 + 21$ **19)** $p^2 = 16$

**20)** $x^2 = 30 - 5$ **21)** $m^2 = 9$ **22)** $x^2 = 30 - 5$ **23)** $m^2 = 30 + 19$

**24)** $x^2 + 10 = 74$ **25)** $x^2 - 4 = 32$ **26)** $2x^2 = 200$ **27)** $3x^2 = 12$

**Synthesis**

The area of a square is 9 $in^2$. Let *m* represent the measure of one of the sides in inches. Create a second-degree equation that you could solve to determine the length of the side *m*. Solve the equation and state the dimensions of the square.

# 4.4 – Solving a Third-Degree Equation

In this unit we will be solving third-degree equations. Third-degree equations contain a variable that has an exponent of three.

**Class Notes –** State the degree of each equation. Identify the equation as a first-degree equation, second-degree equation, or a third degree equation.

| | | | |
|---|---|---|---|
| **LP#1** $x^3 = 8$ | $w + 3 = 15$ | $y^2 = 36$ | $3z^3 = 375$ |
| **LP#2** $x^3 + 1 = 28$ | $32 = 4w^3$ | $10z = 120$ | $4x^2 = 400$ |
| **LP#3** $w^3 + w^2 = w + 6$ | $y^3 = 216$ | $x^2 = 4x^3$ | $x^2 - x = 12$ |

**Class Notes –** A solution to each equation is given. Check to see if the solution is correct or incorrect.

| | | | |
|---|---|---|---|
| **LP#4** | $x^3 = 125$<br>$x = 5$ | $x^3 = 9$<br>$x = 3$ | $x^3 = 64$<br>$x = 4$ |
| **LP#5** | $x^3 + 1 = 28$<br>$x = 3$ | $32 = 4w^3$<br>$w = 4$ | $3z^3 = 375$<br>$z = 5$ |

**Class Notes –** Solve each third-degree equation and check. If you do not solve an equation, explain why.

| | | |
|---|---|---|
| **LP#6**<br>$x^3 = 216$ | $4x^2 = 400$ | $x^3 = 27$ |
| **LP#7**<br>$w + 20 = 3w - 15$ | $x^3 = 8$ | $x^3 = 1$ |
| **LP#8**<br>$x^3 = 64$ | $x^2 = 49$ | $x^3 = 1000$ |

**Review** – Solve each third-degree equation and check.

| | |
|---|---|
| **R#1** $x^3 = 125$ | $x^3 = 27$ |
| **R#2** $x^3 = 729$ | $x^3 = 8$ |
| **R#3** $x^3 = 512$ | $x^3 = 1000$ |

**Homework**

Evaluate.

**1)** $3^3 =$ **2)** $8^3 =$ **3)** $10^3 =$ **4)** $5^3 =$ **5)** $6^3 =$

**6)** $9^3 =$ **7)** $4^3 =$ **8)** $7^3 =$ **9)** $1^3 =$ **10)** $2^3 =$

Solve each third-degree equation and check.

**11)** $x^3 = 1000$ **12)** $x^3 = 512$ **13)** $x^3 = 216$

**14)** $x^3 = 729$ **15)** $x^3 = 125$ **16)** $x^3 = 8$

**17)** $x^3 = 343$ **18)** $x^3 = 27$ **19)** $x^3 = 64$

# 4.5 – Practice Solving Different Types of Equations

| | | |
|---|---|---|
| $x^2 + 20 = 45$ | $52 = 3x - 8$ | $x^3 = 125$ |
| Match the terms below with the equations that they describe above.<br><br>First-Degree Equation Second-Degree Equation Third-Degree Equations | | |

**Practice –** a) Label each equation as first, second, or third degree. There will be one of each type in each row. b) Solve each equation and check.

| | | |
|---|---|---|
| **LP#1**<br>$x + 18 = 22$ | $x^3 = 216$ | $y^2 = 196$ |
| **LP#2**<br>$m^3 = 8$ | $x^2 = 25$ | $6x = 42$ |

| | | |
|---|---|---|
| **LP#3**<br>$w^2 = 81$ | $9(y + 3) = 9$ | $d^3 = 1000$ |
| **LP#4**<br>$x^2 + 1 = 10$ | $x + 18 = 3x - 6$ | $x^3 - 7 = 20$ |
| **LP#5**<br>$2y - 4 = 7y - 19$ | $w^3 + 3 = 128$ | $x^2 - 10 = 6$ |

**Review** a) Label each equation as first, second, or third degree. There will be one of each type in each row. b) Solve each equation and check.

| | | |
|---|---|---|
| **R#1**<br>$x^2 = 9$ | $y^3 = 64$ | $y + 27 = 22$ |
| **R#2**<br>$6(x + 1) = 7x + 2$ | $n^2 + 12 = 16$ | $x^3 = 27$ |
| **R#3**<br>$x^3 - 5 = 3$ | $3y + 18 = 6y + 24$ | $x^2 = 121$ |

**Homework**

**1)** $x - 8 = 3$ **2)** $d^3 = 216$ **3)** $5m + 19 = 9$ **4)** $x^2 = 49$

**5)** $b^3 = 27$ **6)** $8m + 6 = 9m + 2$ **7)** $x^2 = 4$ **8)** $-15 = 3x - 30$

**9)** $y^2 = 144$ **10)** $2(3x - 10) = 4$ **11)** $k^3 = 1$ **12)** $5w + 18 = 9w - 8$

**13)** $6y = -54$ **14)** $18 = -3(x - 2)$ **15)** (8^2) = 64 **16)** (2^3) = 8

**17)** $10w - 15 = 7w$ **18)** $x^2 = 225$ **19)** $p^3 - 20 = 7$ **20)** $6x + 20 = -22$

**21)** $h^2 = 400$ **22)** $y + 1 = 2y + 10$ **23)** $x^3 + 10 = 18$ **24)** $3(x + 4) = 9x$