



Republic of the Philippines  
**Department of Education**  
Region IX, Zamboanga Peninsula  
DIVISION OF ZAMBOANGA CITY



## STRATEGIC INTERVENTION MATERIAL

# **SIMPLIFYING RADICAL EXPRESSIONS USING THE LAWS OF RADICALS**

Mathematics - Grade 9  
Second Quarter  
Week 7

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### **Content Standards**

Demonstrate understanding of key concept of variation and radicals

### **Performance Standards**

Is able to investigate thoroughly mathematical relationships in various situations, formulate real – life problems involving quadratic equations , inequalities and functions and rational algebraic equations and solve them using a variety of strategies.

### **Learning Competencies**

Simplifies radical expressions using the laws of radicals. (M9AL-IIg-1)

\*K to 12 Mathematics Curriculum Guide August , 2016

### **Learning Objectives**

Simplify radical expressions using the laws of radicals.

**Title Card**

**SIMPLIFYING RADICAL EXPRESSIONS  
USING THE LAWS OF RADICALS**

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## Guide Card

### Simplifying Radical Expressions Using The Laws Of Radicals

#### A. Removing perfect nth powers

Break down the radicand into perfect non-perfect and nth powers and apply the property.

$$\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$$

Example :

$$\begin{aligned} 1. \sqrt{12} &= \sqrt{4 \cdot 3} \\ &= \sqrt{4} \cdot \sqrt{3} \\ &= \sqrt{2^2} \cdot \sqrt{3} \\ &= 2\sqrt{3} \end{aligned}$$

Factor the radicand with the greatest perfect square factor

$$\begin{aligned} 2. \sqrt[3]{250} &= \sqrt[3]{125 \cdot 2} \\ &= \sqrt[3]{125} \cdot \sqrt[3]{2} \\ &= \sqrt[3]{5^3} \cdot \sqrt[3]{2} \\ &= 5\sqrt[3]{2} \end{aligned}$$

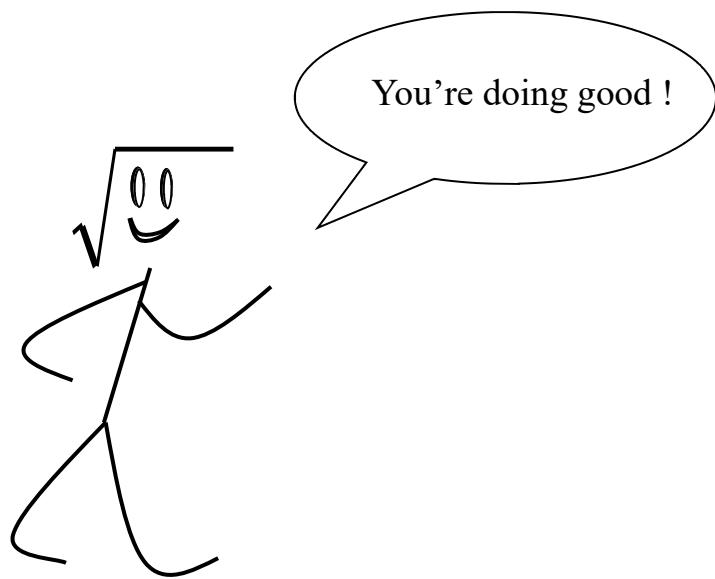
Factor the radicand with the greatest perfect cube factor

$$\begin{aligned} 3. \sqrt[3]{x^{17}} &= \sqrt[3]{x^{15} \cdot x^2} \\ &= \sqrt[3]{x^{15}} \cdot \sqrt[3]{x^2} \\ &= \sqrt[3]{(x^5)^3} \cdot \sqrt[3]{x^2} \\ &= x^5 \sqrt[3]{x^2} \end{aligned}$$

Factor the radicand wherein the exponent is divisible by 3

$$\begin{aligned}
 4.\sqrt{100m^9} &= \sqrt{100m^8 \cdot m} && \text{Factor the radicand with the greatest perfect square factor} \\
 &= \sqrt{100m^8} \cdot \sqrt{m} \\
 &= \sqrt{(10x^4)^2} \cdot \sqrt{m} \\
 &= 10x^4 \sqrt{m}
 \end{aligned}$$

$$\begin{aligned}
 5.\sqrt[3]{40x^4} &= \sqrt[3]{8 \cdot 5 \cdot x^3 \cdot x} && \text{Factor the radicand with the greatest perfect cube factor} \\
 &= \sqrt[3]{8 \cdot x^3 \cdot 5 \cdot x} && \text{Combine the factors that are perfect cube} \\
 &= \sqrt[3]{2^3 \cdot x^3 \cdot 5 \cdot x} \\
 &= \sqrt[3]{2^3 x^3} \cdot \sqrt[3]{5x} \\
 &= \sqrt[3]{(2x)^3} \cdot \sqrt[3]{5x} \\
 &= 2x\sqrt[3]{5x}
 \end{aligned}$$



## B. Reducing the index to the lowest possible order

Express the radical into an expression with a rational exponent then simplify the exponent or apply the property

$$\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a} = \sqrt[n]{\sqrt[m]{a}}$$

Example :  $1. \sqrt[6]{25} = \sqrt[3]{\sqrt{25}}$  Factor the index wherein the radicand becomes perfect nth power

$$= \sqrt[3]{5} \quad \text{Since } \sqrt{25} = 5$$

or :  $\sqrt[6]{25} = (5^2)^{\frac{1}{6}}$  Express in rational exponent

$$= 5^{\frac{2}{6}} \quad \text{Express in rational exponent}$$

$$= 5^{\frac{1}{3}} \quad \text{The exponent } \frac{2}{6} = \frac{1}{3}$$

$$= \sqrt[3]{5}$$

$$2. \sqrt[20]{x^{25}} = \sqrt[4]{\sqrt[5]{x^{25}}}$$

$$= \sqrt[4]{x^5}$$

or :  $\sqrt[20]{x^{25}} = (x^{25})^{\frac{1}{20}}$

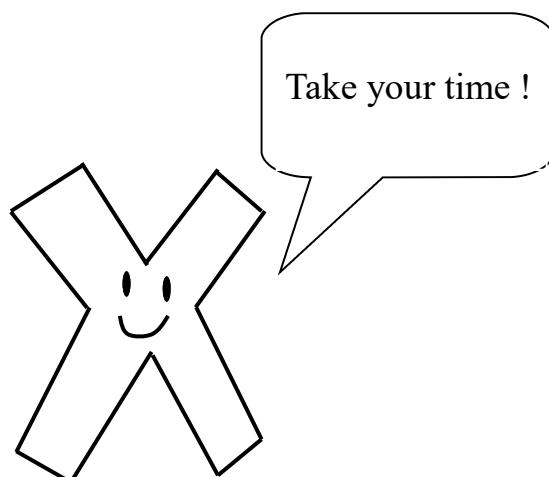
$$= (x^{25})^{\frac{1}{5} \cdot \frac{1}{4}}$$

$$= (x^{25})^{\frac{1}{5} \cdot \frac{1}{4}}$$

$$= (x^{\frac{25}{5}})^{\frac{1}{4}}$$

$$= (x^5)^{\frac{1}{4}}$$

$$= \sqrt[4]{x^5}$$



$$3\sqrt[15]{1000x^{12}} = \sqrt[5]{\sqrt[3]{10^3(x^4)^3}}$$

Factor the index into indices 5 and 3  
since the radicand is a perfect cube

$$= \sqrt[5]{\sqrt[3]{(10x^4)^3}} \quad \text{Express in exponential form}$$

$$= \sqrt[5]{10x^4} \quad \text{Extract the cube root}$$

or :  $\sqrt[15]{1000x^{12}} = (1000x^{12})^{\frac{1}{15}} \quad \text{Express in rational exponent}$

$$= (10^3 x^{12})^{\frac{1}{15}}$$

$$= (10^{\frac{3}{15}} x^{\frac{12}{15}})$$

$$= (10^{\frac{1}{5}} x^{\frac{4}{5}})$$

$$= (10x^4)^{\frac{1}{5}}$$

$$= (10x^4)^{\frac{1}{5}}$$

$$= \sqrt[5]{10x^4}$$

Bravo !



### C. Rationalizing the denominator of the radicand

Rationalization is the process of removing the radical sign in the denominator.

Example :

$$1. \sqrt{\frac{3}{x}} = \sqrt{\frac{3}{x} \cdot \frac{x}{x}}$$

Multiply the radicand by  $\frac{x}{x}$  to make the denominator a perfect square

$$= \sqrt{\frac{3x}{x^2}}$$
$$= \frac{\sqrt{3x}}{\sqrt{x^2}}$$
$$= \frac{\sqrt{3x}}{x}$$

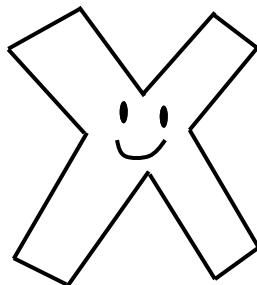
$$2. \sqrt{\frac{x}{7}} = \sqrt{\frac{x}{7} \cdot \frac{7}{7}}$$

Multiply the numerator and denominator of the radicand by 7 to make the denominator a perfect square

$$= \sqrt{\frac{7x}{49}}$$

$$= \frac{\sqrt{7x}}{\sqrt{49}}$$

$$= \frac{\sqrt{7x}}{7}$$



3.  $\sqrt{\frac{5}{x^5}} = \sqrt{\frac{5}{x^5} \cdot \frac{x}{x}}$  Multiply the radicand by  $\frac{x}{x}$  to make the denominator a perfect square

$$= \sqrt{\frac{5x}{x^6}}$$

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

$$= \frac{\sqrt{5x}}{x^3}$$

4.  $\sqrt{\frac{2m}{5n}} = \sqrt{\frac{2m}{5n} \cdot \frac{5n}{5n}}$  Multiply the numerator and denominator of the radicand by 5n to make the denominator a perfect square

$$= \sqrt{\frac{10mn}{25n^2}}$$

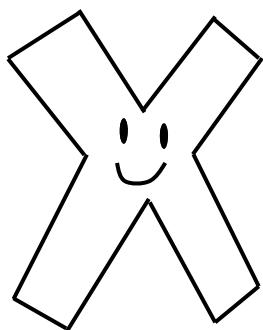
$$= \frac{\sqrt{10mn}}{\sqrt{25n^2}}$$

$$= \frac{\sqrt{10mn}}{\sqrt{5^2 n^2}}$$

$$= \frac{\sqrt{10mn}}{\sqrt{(5n)^2}}$$

$$= \frac{\sqrt{10mn}}{5n}$$

Great !



$$5. \sqrt[3]{\frac{3a}{4b}} = \sqrt[3]{\frac{3a}{4b} \cdot \frac{2b^2}{2b^2}}$$

Multiply the numerator and denominator of the radicand by  $2b^2$  to make the denominator a perfect cube

$$= \sqrt[3]{\frac{6ab^2}{8b^3}}$$

$$= \frac{\sqrt[3]{6ab^2}}{\sqrt[3]{8b^3}}$$

$$= \frac{\sqrt[3]{6ab^2}}{\sqrt[3]{2^3 b^3}}$$

$$= \frac{\sqrt[3]{6ab^2}}{\sqrt[3]{2^3 b^3}}$$

$$= \frac{\sqrt[3]{6ab^2}}{\sqrt[3]{(2b)^3}}$$

$$= \frac{\sqrt[3]{6ab^2}}{2b}$$

The radical expression is in the simplest form if:

1. No prime factors of a radicand that has an exponent equal to or greater than the index.
2. No radicand contains a fraction.
3. No denominator contains a radical sign.

#### Students' Notes (Pls. check the box)

After reading this guide card ;.....

I still do not understand the lesson.  Now I understand the lesson.

#### What I think about the things I do.

Easy       Moderate       Difficult

#### For this lesson I want to study

Alone     With my classmate     With the group



## Activity Card 1



### Estrellas !

Directions: Circle the star that contains a radical in simplest form . If not, write the simplified form of the given radical below the star.

$$\begin{array}{c} \star \\ \sqrt{20} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{30} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{50} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{18} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{200} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{65} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{15} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{45} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{72} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{28} \\ \hline \end{array}$$

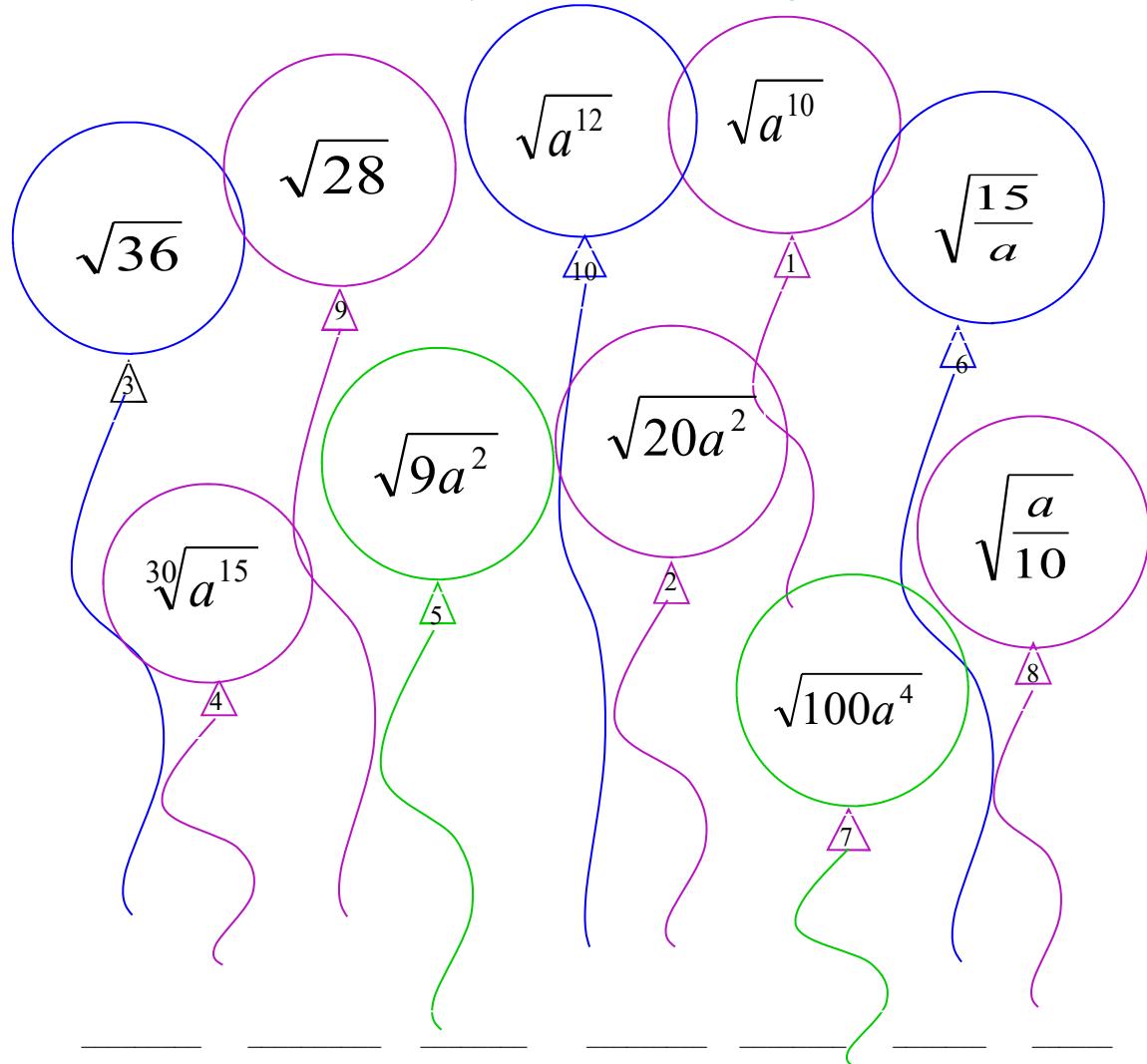
$$\begin{array}{c} \star \\ \sqrt{105} \\ \hline \end{array}$$

$$\begin{array}{c} \star \\ \sqrt{46} \\ \hline \end{array}$$

## Activity Card 2

**Lobo**

Directions : Simplify the radicals inside the balloon then write the word that corresponds to the answer on the blank to find out the reason why Ana doesn't like to give Elsa a balloon.



\_\_\_\_\_   \_\_\_\_\_   \_\_\_\_\_   \_\_\_\_\_   \_\_\_\_\_   \_\_\_\_\_   \_\_\_\_\_

3

9

6

5

10

7

1

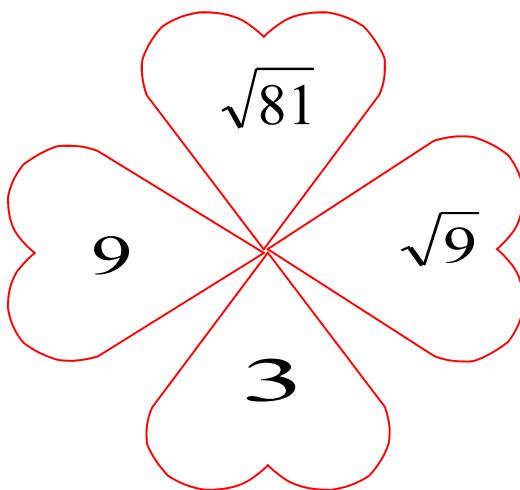
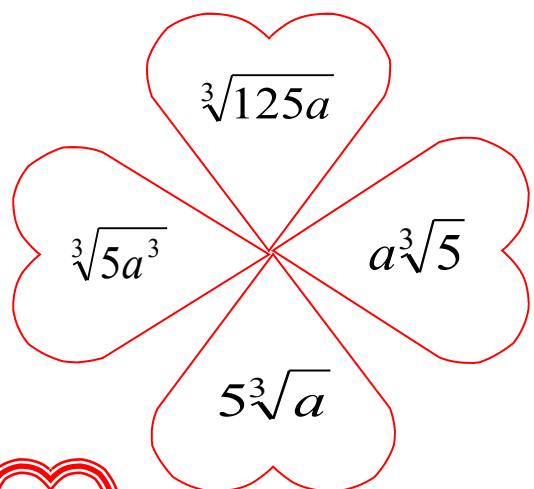
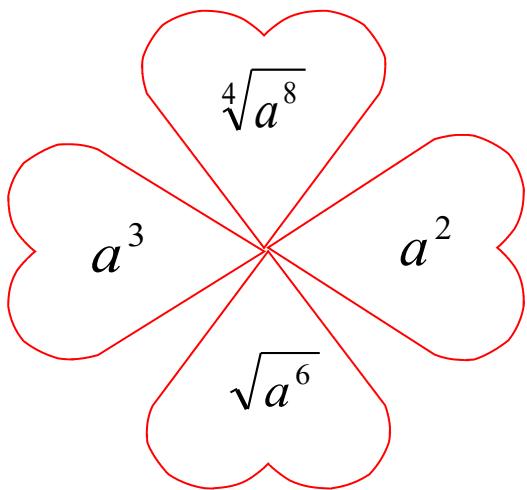
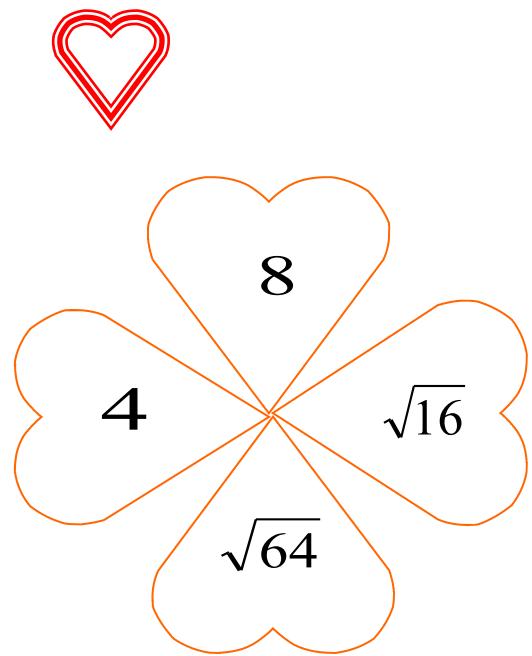
$a^5$	$2a\sqrt{5}$	6	$\sqrt{a}$	$3a$
Go	No	Because	Fly	Just
$\frac{\sqrt{15a}}{a}$	$10a^2$	$\frac{\sqrt{10a}}{10}$	$2\sqrt{7}$	$a^6$
Will	It	Don't	She	Let

### Activity Card 3



## Mi Corazon

Directions : Color the pair of hearts that contain a radicals that are equal.  
(Use the same color for each pair)



## Assessment Card 1

Directions : Simplify the given radicals.

A. Removing perfect nth powers

1.  $\sqrt{20}$  = \_\_\_\_\_

2.  $\sqrt{54}$  = \_\_\_\_\_

3.  $\sqrt{x^{11}}$  = \_\_\_\_\_

4.  $\sqrt[3]{16}$  = \_\_\_\_\_

B. Reducing the index to the lowest possible order

5.  $\sqrt[6]{4}$  = \_\_\_\_\_

6.  $\sqrt[9]{125}$  = \_\_\_\_\_

7.  $\sqrt[40]{x^{20}}$  = \_\_\_\_\_

C. Rationalizing the denominator of the radicand

8.  $\sqrt{\frac{2}{x}}$  = \_\_\_\_\_

9.  $\sqrt{\frac{m}{11}}$  = \_\_\_\_\_

10.  $\sqrt[3]{\frac{s}{t}}$  = \_\_\_\_\_

## Assessment Card 2

Directions: Fill in the blank to reduce the index of the following radical expressions to the lowest possible order.

$$1. \sqrt[10]{25} = 25^{\frac{1}{-}} = (5^{-})^{\frac{1}{10}} = 5^{\frac{-}{10}} = 5^{\frac{1}{-}} = \sqrt[5]{-}$$

$$2. \sqrt[12]{343} = 343^{\frac{1}{-}} = (7^{-})^{\frac{1}{12}} = \underline{\hspace{2cm}}^{\frac{3}{-}} = 7^{\frac{-}{4}} = \sqrt[4]{7^{-}}$$

$$3. \sqrt[18]{16} = 16^{\frac{1}{-}} = (2^{-})^{\frac{1}{18}} = 2^{\frac{-}{18}} = 2^{\frac{4}{-}} = \sqrt[9]{2^{-}} = \sqrt[9]{\underline{\hspace{2cm}}}$$

$$4. \sqrt[16]{81} = 81^{\frac{1}{-}} = (\underline{\hspace{2cm}}^4)^{\frac{1}{16}} = \underline{\hspace{2cm}}^{\frac{4}{-}} = 3^{\frac{1}{-}} = \sqrt[4]{3^{-}}$$

$$5. \sqrt[50]{x^{35}} = (x^{-})^{\frac{1}{50}} = x^{\frac{-}{50}} = x^{\frac{-}{10-}} = \sqrt[10]{x^{-}}$$

**Students' Notes (Pls. check the box)**

**What I think about the things I do.**

Easy

Moderate

Difficult

## Enrichment Card

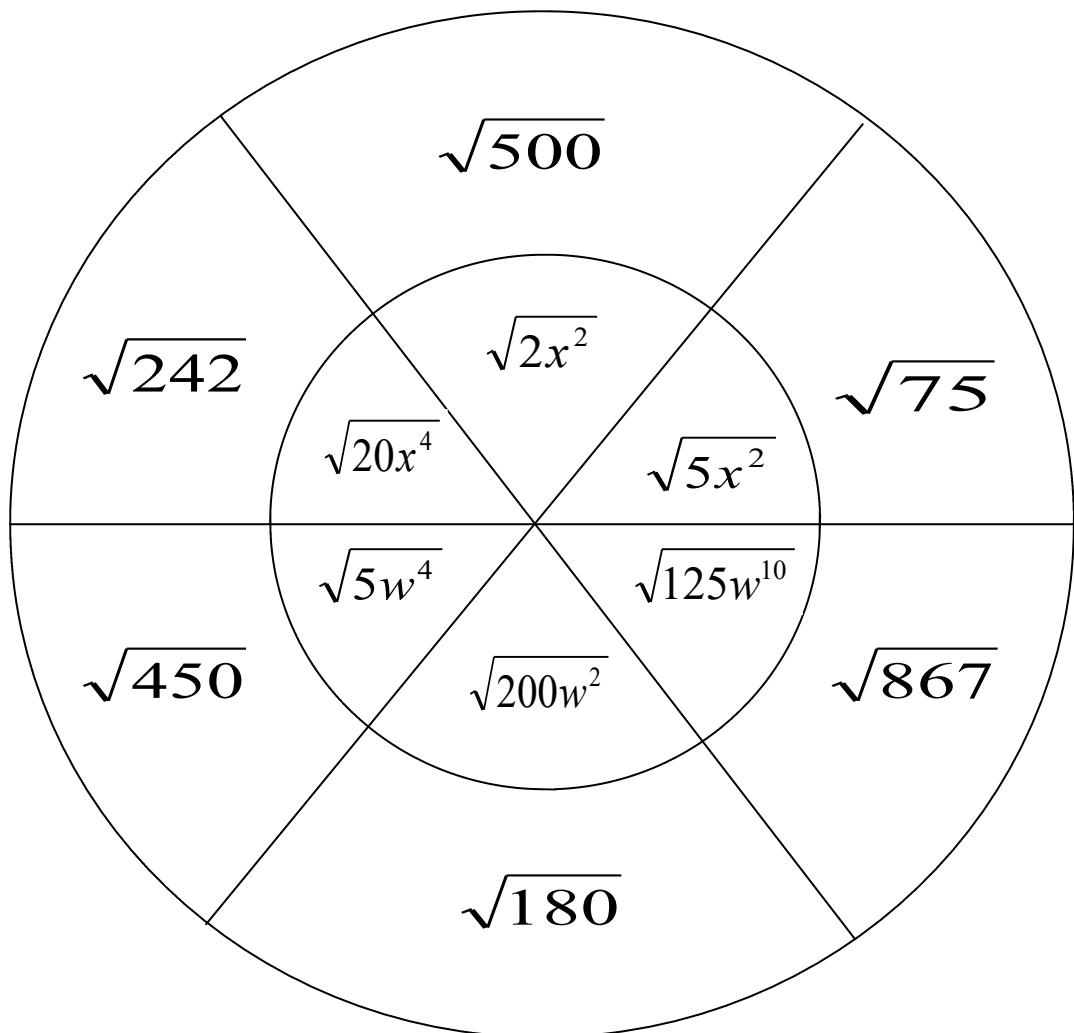
### **Color Wheel**

Directions: Simplify the radicals in the wheel then color it.

Use Green = if the radicand is two after simplifying it

Red = if the radicand is three after simplifying it.

Yellow = if the radicand is five after simplifying it.



## **End Card**

What I learned from this topic:

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What I still want to learn from this topic:

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## **Reference Card**

There are other books / sources that you can use about  
“ Laws Of Radicals “

You can also refer to the following :

### **BOOKS:**

Merden L. Bryant et.al., Mathematics Learners Material 9. Pasig: Sunshine Interlinks Publishing House, 2016, 256-258

Gladys C. Nivera and Minie Rose C. Lapinid, Grade 9 Mathematics. Makati: Don Bosco Press, 196-201

### **WEBSITE**

Simplifying Radicals  
<https://www.youtube.com/watch?v=Ef2gOQbDv7M>

Simplifying Radicals  
<https://www.youtube.com/watch?v=gF5AAd025Dk>

Simplifying Radicals  
<https://www.youtube.com/watch?v=tZwJU4wDWYs>

## Answer Card 1



### Activity Card 1



#### **Estrellas !**

Directions : Circle the star that contains a radical in simplest form .If not ,write the simplified form of the given radical below the star.

$$\star \sqrt{20}$$

$$\underline{\sqrt{4} \cdot \sqrt{5} = 2\sqrt{5}}$$

$$\circlearrowleft \star \sqrt{30}$$

$$\underline{\quad}$$

$$\star \sqrt{50}$$

$$\underline{\sqrt{25} \cdot \sqrt{2} = 5\sqrt{2}}$$

$$\star \sqrt{18}$$

$$\underline{\sqrt{9} \cdot \sqrt{2} = 3\sqrt{2}}$$

$$\star \sqrt{200}$$

$$\underline{\sqrt{100} \cdot \sqrt{2} = 10\sqrt{2}}$$

$$\circlearrowleft \star \sqrt{65}$$

$$\underline{\quad}$$

$$\circlearrowleft \star \sqrt{15}$$

$$\underline{\quad}$$

$$\star \sqrt{45}$$

$$\underline{\sqrt{9} \cdot \sqrt{5} = 3\sqrt{5}}$$

$$\star \sqrt{72}$$

$$\underline{\sqrt{36} \cdot \sqrt{2} = 6\sqrt{2}}$$

$$\star \sqrt{28}$$

$$\underline{\sqrt{4} \cdot \sqrt{7} = 2\sqrt{7}}$$

$$\circlearrowleft \star \sqrt{105}$$

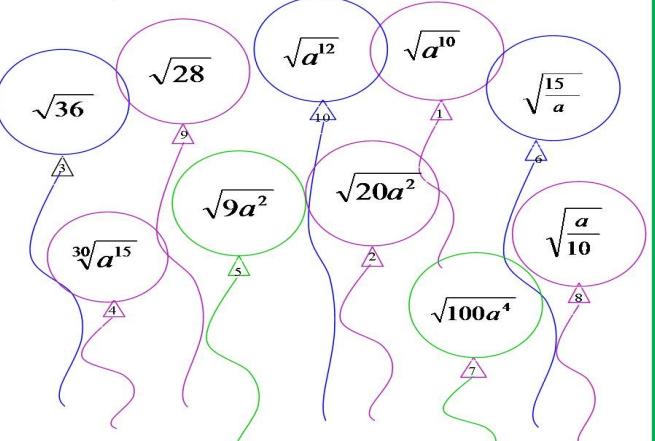
$$\underline{\quad}$$

$$\circlearrowleft \star \sqrt{46}$$

$$\underline{\quad}$$

#### **Lobo**

Directions : Simplify the radicals inside the balloon then write the word that corresponds to the answer on the blank to find out the reason why Ana doesn't like to give Elsa a balloon.



Because      she      will      just      let      it      go

$a^5$	$2a\sqrt{5}$	6	$\sqrt{a}$	$3a$
$\frac{\sqrt{15a}}{a}$	$10a^2$	$\frac{\sqrt{10a}}{10}$	$2\sqrt{7}$	$a^6$
Will	It	Don't	She	Let

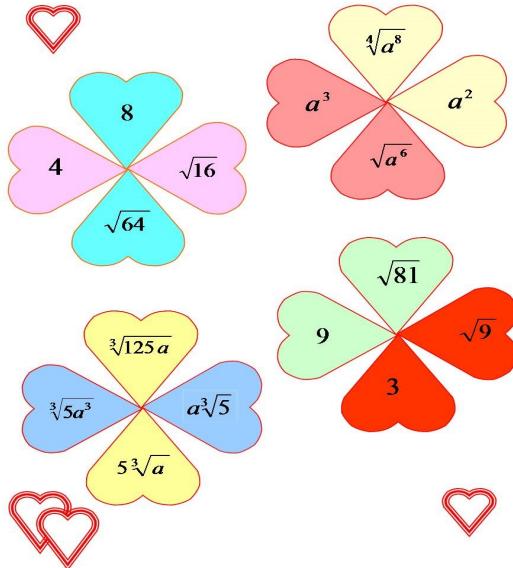
## Answer Card 2

### Activity Card 3



#### Mi Corazon

Directions : Color the pair of hearts that contain a radicals that are equal.  
( Use the same color for each pair)



### Assessment Card 1

Directions : Simplify the given radicals.

A. Removing perfect nth powers.

1.  $\sqrt{20} = \underline{\hspace{2cm}} 2\sqrt{5}$
2.  $\sqrt[3]{54} = \underline{\hspace{2cm}} 3\sqrt{6}$
3.  $\sqrt{x^{11}} = \underline{\hspace{2cm}} x^5\sqrt{x}$
4.  $\sqrt[3]{16} = \underline{\hspace{2cm}} 2\sqrt[3]{2}$

B. Reducing the index to the lowest possible order.

5.  $\sqrt[6]{4} = \underline{\hspace{2cm}} \sqrt[3]{2}$
6.  $\sqrt[9]{125} = \underline{\hspace{2cm}} \sqrt[3]{5}$
7.  $\sqrt[10]{x^{20}} = \underline{\hspace{2cm}} \sqrt{x}$

C. Rationalizing the denominator of the radicand.

8.  $\sqrt{\frac{2}{x}} = \underline{\hspace{2cm}} \frac{\sqrt{2}x}{x}$
9.  $\sqrt{\frac{m}{11}} = \underline{\hspace{2cm}} \frac{\sqrt{11}m}{11}$
10.  $\sqrt[3]{\frac{s}{t}} = \underline{\hspace{2cm}} \frac{\sqrt[3]{st^2}}{t}$

## Answer Card 3

### Assessment Card 2

Directions : Fill in the blank to reduce the index of the following radical expressions to the lowest possible order.

$$1. \sqrt[10]{25} = 25^{\frac{1}{10}} = (5^2)^{\frac{1}{10}} = 5^{\frac{2}{10}} = 5^{\frac{1}{5}} = \sqrt[5]{5}$$

$$2. \sqrt[12]{343} = 343^{\frac{1}{12}} = (7^3)^{\frac{1}{12}} = 7^{\frac{3}{12}} = 7^{\frac{1}{4}} = \sqrt[4]{7}$$

$$3. \sqrt[18]{16} = 16^{\frac{1}{18}} = (2^4)^{\frac{1}{18}} = 2^{\frac{4}{18}} = 2^{\frac{2}{9}} = \sqrt[9]{2^2} = \sqrt[9]{4}$$

$$4. \sqrt[16]{81} = 81^{\frac{1}{16}} = (3^4)^{\frac{1}{16}} = 3^{\frac{4}{16}} = 3^{\frac{1}{4}} = \sqrt[4]{3}$$

$$5. \sqrt[50]{x^{35}} = (x^{35})^{\frac{1}{50}} = x^{\frac{35}{50}} = x^{\frac{7}{10}} = \sqrt[10]{x^7}$$

**Students' Notes** (Pls. check the box)

**What I think about the things I do.**

Easy

Moderate

Difficult

### Enrichment Card

#### **Color Wheel**

Directions: Simplify the radicals in the wheel then color it.

Use Green = if the radicand is two after simplifying it.  
 Red = if the radicand is three after simplifying it.  
 Yellow = if the radicand is five after simplifying it.

