



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

Prepared by:

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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 :

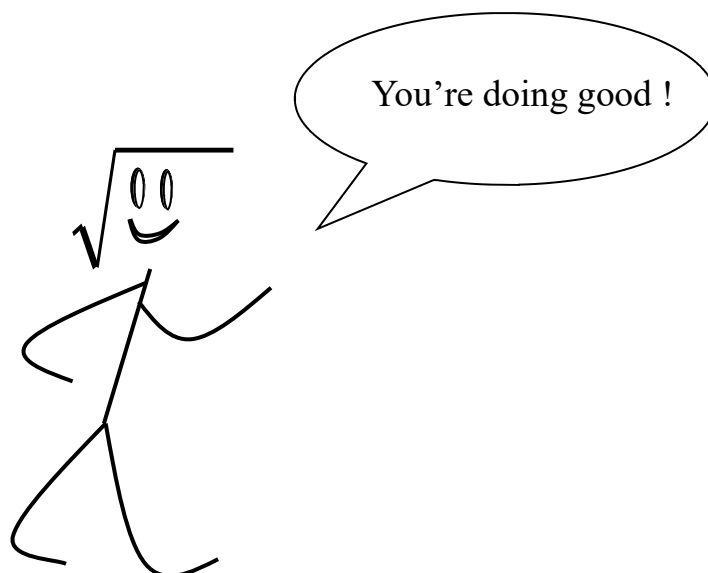
$$\begin{aligned} 1. \sqrt{12} &= \sqrt{4 \cdot 3} && \text{Factor the radicand with the greatest perfect square factor} \\ &= \sqrt{4} \cdot \sqrt{3} \\ &= \sqrt{2^2} \cdot \sqrt{3} && \text{Write 4 in exponential form} \\ &= 2\sqrt{3} \end{aligned}$$

$$\begin{aligned} 2. \sqrt[3]{250} &= \sqrt[3]{125 \cdot 2} && \text{Factor the radicand with the greatest perfect cube factor} \\ &= \sqrt[3]{125} \cdot \sqrt[3]{2} \\ &= \sqrt[3]{5^3} \cdot \sqrt[3]{2} \\ &= 5\sqrt[3]{2} \end{aligned}$$

$$\begin{aligned} 3. \sqrt[3]{x^{17}} &= \sqrt[3]{x^{15} \cdot x^2} && \text{Factor the radicand wherein the exponent is divisible by 3} \\ &= \sqrt[3]{x^{15}} \cdot \sqrt[3]{x^2} \\ &= \sqrt[3]{(x^5)^3} \cdot \sqrt[3]{x^2} \\ &= x^5 \sqrt[3]{x^2} \end{aligned}$$

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

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



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

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

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

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

Since $\sqrt{25} = 5$

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

$$= 5^{\frac{2}{6}}$$

Express in rational exponent

$$= 5^{\frac{1}{3}}$$

The exponent $\frac{2}{6} = \frac{1}{3}$

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

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

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

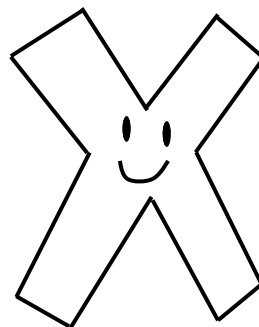
$$= (x^{25})^{\frac{1}{5} \cdot \frac{1}{4}}$$

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

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

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

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



Take your time !

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

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

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

Express in exponential form

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

Extract the cube root

or :

$$\sqrt[15]{1000x^{12}} = (1000x^{12})^{\frac{1}{15}}$$

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.

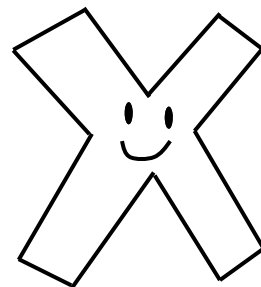
Example :

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

$$\begin{aligned} &= \sqrt{\frac{3x}{x^2}} \\ &= \frac{\sqrt{3x}}{\sqrt{x^2}} \\ &= \frac{\sqrt{3x}}{x} \end{aligned}$$

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

$$\begin{aligned} &= \sqrt{\frac{7x}{49}} \\ &= \frac{\sqrt{7x}}{\sqrt{49}} \\ &= \frac{\sqrt{7x}}{7} \end{aligned}$$



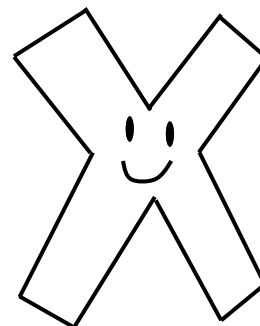
$$\begin{aligned}
 3. \quad \sqrt{\frac{5}{x^5}} &= \sqrt{\frac{5}{x^5} \cdot \frac{x}{x}} \\
 &= \sqrt{\frac{5x}{x^6}} \\
 &= \frac{\sqrt{5x}}{\sqrt{(x^3)^2}} \\
 &= \frac{\sqrt{5x}}{x^3}
 \end{aligned}$$

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

$$\begin{aligned}
 4. \quad \sqrt{\frac{2m}{5n}} &= \sqrt{\frac{2m}{5n} \cdot \frac{5n}{5n}} \\
 &= \sqrt{\frac{10mn}{25n^2}} \\
 &= \frac{\sqrt{10mn}}{\sqrt{25n^2}} \\
 &= \frac{\sqrt{10mn}}{\sqrt{5^2 n^2}} \\
 &= \frac{\sqrt{10mn}}{\sqrt{(5n)^2}} \\
 &= \frac{\sqrt{10mn}}{5n}
 \end{aligned}$$

Multiply the numerator and denominator of the radicand by $5n$ to make the denominator a perfect square

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

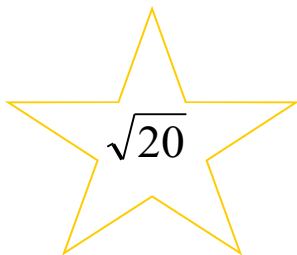


Activity Card 1

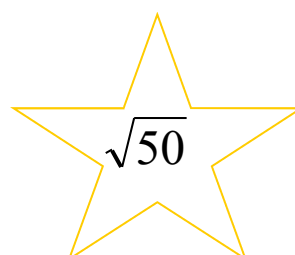


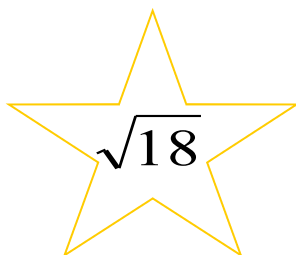
Estrellas !

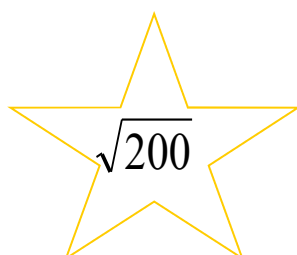
Directions: Circle the star that contains a radical in simplest form . If not, write the simplified form of the given radical below the star.

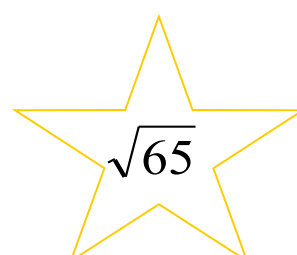


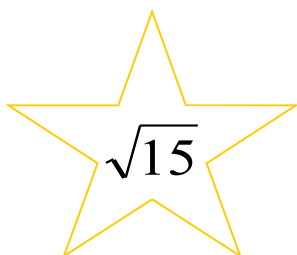




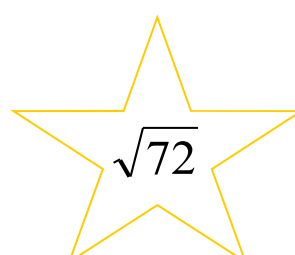


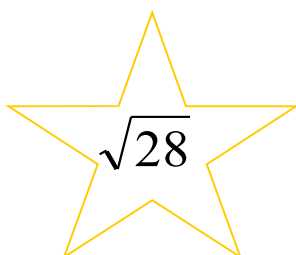


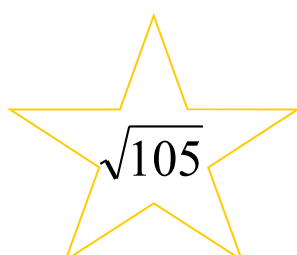


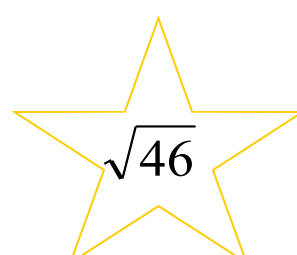








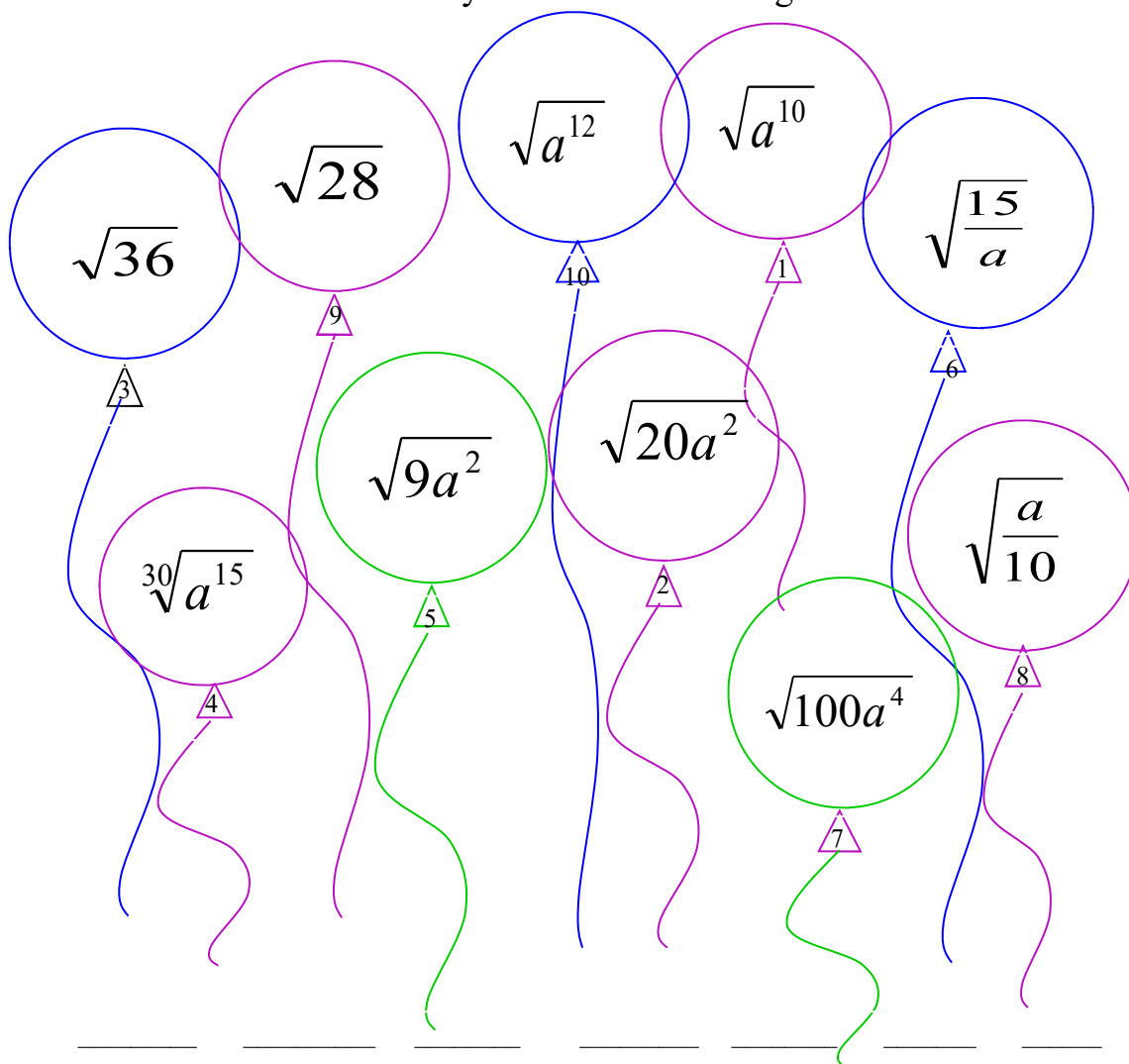




Activity Card 2

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

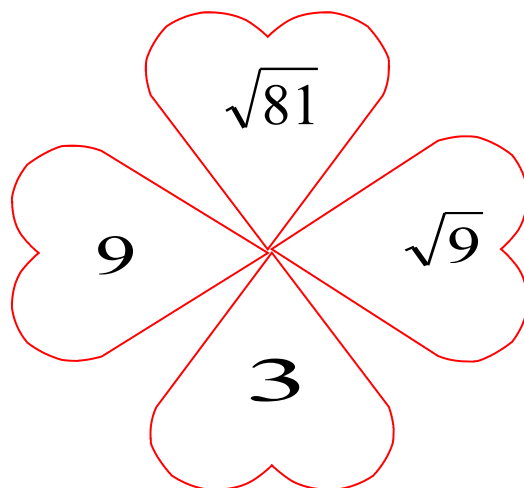
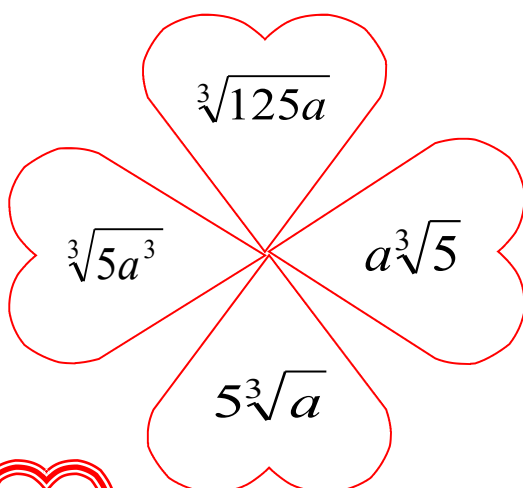
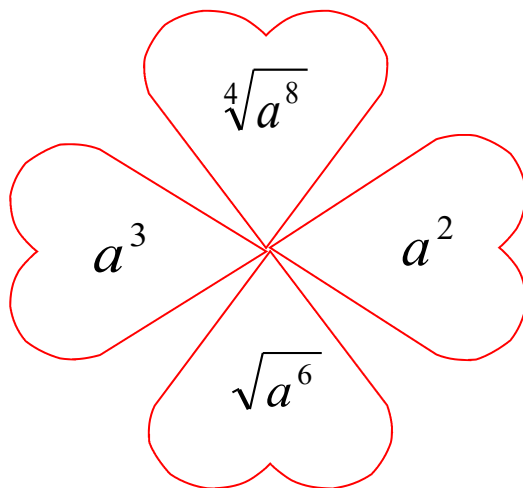
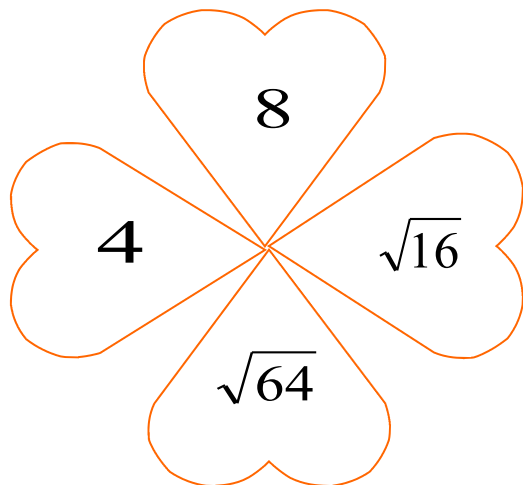
a^5	$2a\sqrt{5}$	6	\sqrt{a}	$3a$
Go	No	Because	Fly	Just
$\frac{\sqrt{15a}}{a}$	$10a^2$	$\frac{\sqrt{10a}}{10}$	$2\sqrt{7}$	a^6
Will	It	Don't	She	Let

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.

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

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

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

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

$$5. \sqrt[50]{x^{35}} = (x^{\frac{35}{50}})^{\frac{1}{10}} = x^{\frac{7}{10}} = x^{\frac{14}{20}} = \sqrt[10]{x^{14}}$$

Students' Notes (Pls. check the box)

What I think about the things I do.

☐ Easy

☐ Moderate

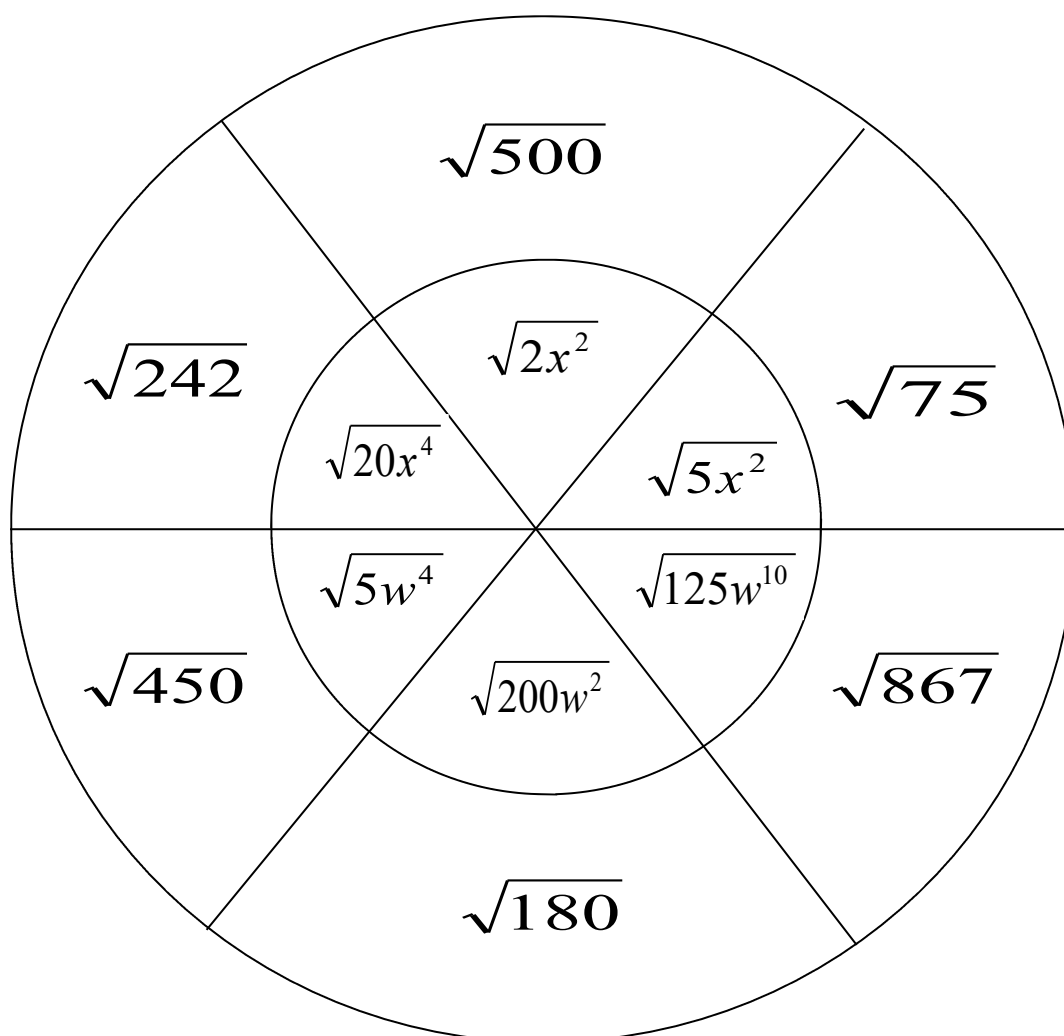
☐ Difficult

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:

What I still want to learn from this topic:

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=gF5AAAd025Dk>

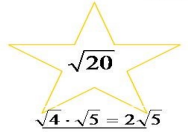
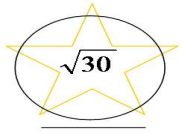
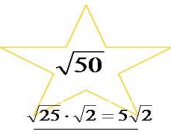
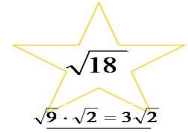
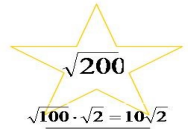
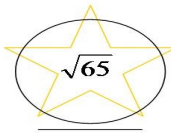

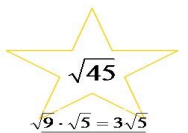
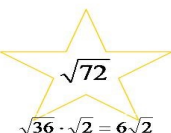
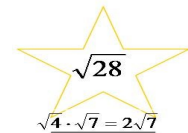
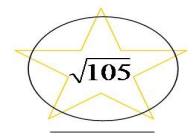
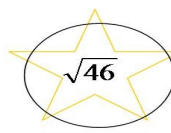
Simplifying Radicals
<https://www.youtube.com/watch?v=tZwJU4wDWYs>

Answer Card 1

Activity Card 1

Estrellas !

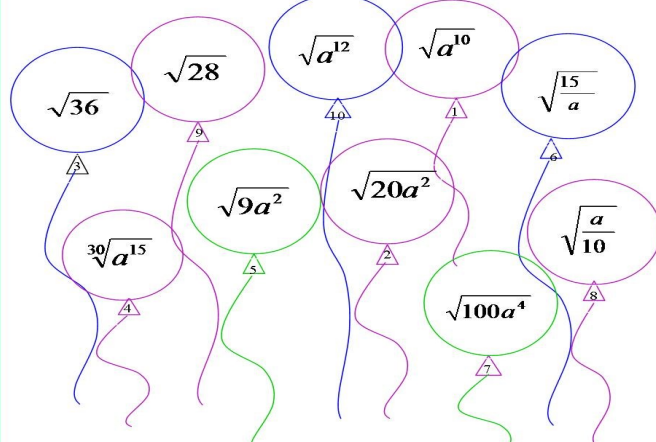
Directions : Circle the star that contains a radical in simplest form . If not ,write the simplified form of the given radical below the star.

 $\sqrt{20}$ $\sqrt{4 \cdot 5} = 2\sqrt{5}$	 $\sqrt{30}$ <u> </u>	 $\sqrt{50}$ $\sqrt{25 \cdot 2} = 5\sqrt{2}$
 $\sqrt{18}$ $\sqrt{9 \cdot 2} = 3\sqrt{2}$	 $\sqrt{200}$ $\sqrt{100 \cdot 2} = 10\sqrt{2}$	 $\sqrt{65}$ <u> </u>
 $\sqrt{15}$ <u> </u>	 $\sqrt{45}$ $\sqrt{9 \cdot 5} = 3\sqrt{5}$	 $\sqrt{72}$ $\sqrt{36 \cdot 2} = 6\sqrt{2}$
 $\sqrt{28}$ $\sqrt{4 \cdot 7} = 2\sqrt{7}$	 $\sqrt{105}$ <u> </u>	 $\sqrt{46}$ <u> </u>

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.



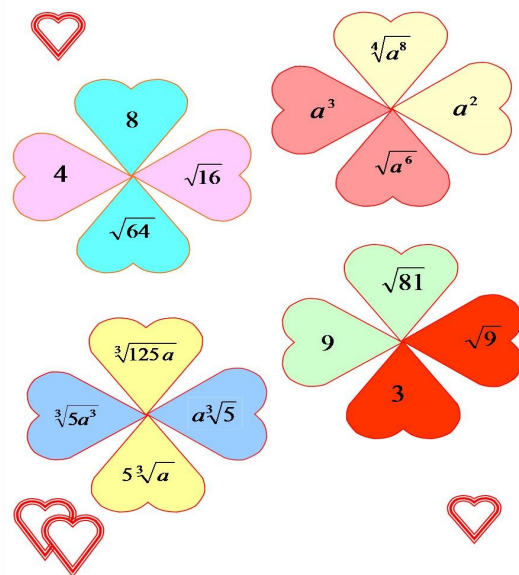
Because	she	will	just	let	it	go
3	9	6	5	10	7	1
a^5	$2a\sqrt{5}$	6	\sqrt{a}	$3a$		
Go	No	Because	Fly	Just		
$\frac{\sqrt{15a}}{a}$	$10a^2$	$\frac{\sqrt{10a}}{10}$	$2\sqrt{7}$	a^6		
Will	It	Don't	She	Let		

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

B. Reducing the index to the lowest possible order.

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

C. Rationalizing the denominator of the radicand.

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

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.

