Welcome Back MYP Math 9!

	Assignment Effort Grade (Circle One)	Comments (What was interesting or challenging?)
Monday Date: 12/11 Topic: Unit 3 test Friday - no HW!	0 1 2	
Tuesday Date: _____ Topic:_____	0 1 2	
Wednesday Date: _____ Topic:_____	0 1 2	
Thursday Date: _____ Topic:_____	0 1 2	
Friday Date: _____ Topic:_____	0 1 2	

Class Plan:

1. Warm-up

2. Radicals and Surds

A RADICALS AND SURDS

3. Investigate and Examples

INVESTIGATION 1 PROPERTIES OF RADICALS

B SIMPLIFYING RADICALS

4. Practice

Warm-up: Radicals

Find exact or approximated values of the radicals. (Try not use a calculator!)

$\sqrt{4} = 2$

$\sqrt{8} \approx 2.7$ closest to 9 = 3

$\sqrt{64} = 8$

$\sqrt{169} = 13$

$\sqrt{200} \approx 14.14$ closest to $\sqrt{196} = 14$

$\sqrt{225} = 15$

Square roots

Here are the square roots of all the perfect squares from 1 to 100.

$\sqrt{1} = 1$ since $1^2 = 1$

$\sqrt{4} = 2$ since $2^2 = 4$

$\sqrt{9} = 3$ since $3^2 = 9$

$\sqrt{16} = 4$ since $4^2 = 16$

$\sqrt{25} = 5$ since $5^2 = 25$

$\sqrt{36} = 6$ since $6^2 = 36$

$\sqrt{49} = 7$ since $7^2 = 49$

$\sqrt{64} = 8$ since $8^2 = 64$

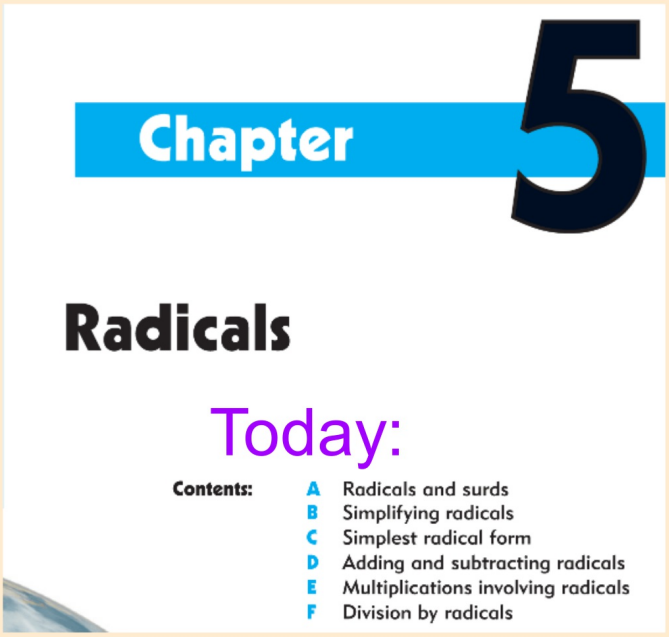
$\sqrt{81} = 9$ since $9^2 = 81$

$\sqrt{100} = 10$ since $10^2 = 100$

Estimating is very important for all square roots that are not the square roots of perfect squares.

Estimate $\sqrt{10}$ by finding which two whole numbers it lies between

Unit 4: Radicals, Special Rights, & Unit Circle



A RADICALS AND SURDS

A **radical** is a number that is written using the radical sign $\sqrt{\ }$.

An irrational radical is called a **surd**.

Examples of rational radicals include:

$$\sqrt{9} = 3 = \frac{3}{1}$$

$$\sqrt{\frac{1}{25}} = \sqrt{\left(\frac{1}{5}\right)^2} = \frac{1}{5}$$

$$\sqrt{\frac{4}{9}} = \sqrt{\left(\frac{2}{3}\right)^2} = \frac{2}{3}$$

If the number under the radical sign can be written as the perfect square of a rational number, then the radical is rational.

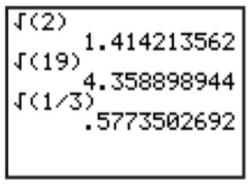
Examples of surds include:

$$\sqrt{2} \approx 1.414\,213\,56\ldots.$$

$$\sqrt{19} \approx 4.358\,898\,94\ldots.$$

$$\sqrt{\frac{1}{3}} \approx 0.577\,350\,269\ldots.$$

√3 √11 √17



Purpose:

A RADICALS AND SURDS

B SIMPLIFYING RADICALS

C SIMPLEST RADICAL FORM

Why do we simplify radicals?

- explore geometric patterns (special rights)
- better, ***exact*** values to work with

RESEARCH

- Where did the names *radical* and *surd* come from?
- Why do we use the word *irrational* to describe some numbers?

B SIMPLIFYING RADICALS

1. Do:

INVESTIGATION 1 PROPERTIES OF RADICALS

What patterns do you see?
How can we use perfect squares to simplify radicals?

1) Explore radical patterns and simplify each radical:

a) $\sqrt{4}\cdot\sqrt{4} = \_\_\_\cdot\_\_\_ = \_\_\_\_$

b) $\sqrt{36}\cdot\sqrt{36} = \sqrt{36^2} = \_\_\_\_$

c) $\sqrt{9}\cdot\sqrt{25} = \_\_\_\cdot\_\_\_ = \_\_\_\_ = \sqrt{\_\_\_}$

d) $\sqrt{\frac{36}{4}} = \frac{\sqrt{\_\_\_}}{\sqrt{\_\_\_}} = \_\_\_\_ = \_\_\_\_$

2. Generalize Patterns:

- $\sqrt{a}\sqrt{a} = (\sqrt{a})^2 =$?
- $\sqrt{a}\sqrt{b} =$?
- $\frac{\sqrt{a}}{\sqrt{b}} =$?

3. Practice simplifying radicals

1 Simplify:

a $(\sqrt{3})^2$ b $(\sqrt{3})^3$ c $(\sqrt{3})^5$ d $\left(\frac{1}{\sqrt{3}}\right)^2$

4. Write an algorithm (rule) to find Simplest Radical Form

C SIMPLEST RADICAL FORM

Done: How could we prove these patterns?

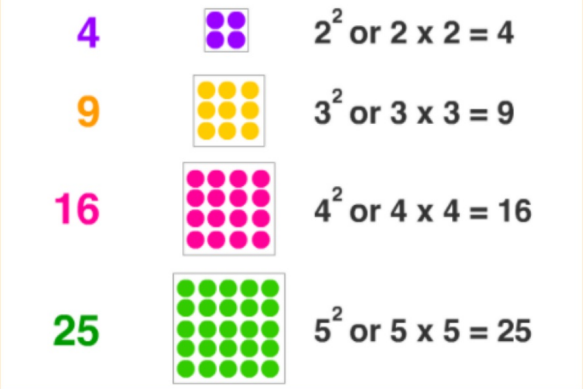
Perfect Squares (Square Numbers)

1) Complete the table to show the first few perfect squares of natural numbers.

Value	1	2	3	4	5	6	7	8	9	10	11	12	13
Value^2	1	4	9	16	25	36	49	64	81	100	121	144	169

square numbers

A square number can end only with digits 0, 1, 4, 6, 9, or 25.



14|15
196 225

Know perfect squares to simplify radicals!

INVESTIGATION 1 PROPERTIES OF RADICALS

1) Explore radical patterns and simplify each radical:

a) $\sqrt{4} \cdot \sqrt{4} = \_\_\_\_ \cdot \_\_\_\_ = \_\_\_\_\_$

b) $\sqrt{36} \cdot \sqrt{36} = \sqrt{36^2} = \_\_\_\_\_$

c) $\sqrt{9} \cdot \sqrt{25} = \_\_\_\_ \cdot \_\_\_\_ = \_\_\_\_\_ = \sqrt{\_\_\_\_}$

d) $\sqrt{\frac{36}{4}} = \frac{\sqrt{\_\_\_\_}}{\sqrt{\_\_\_\_}} = \frac{\_\_\_\_}{\_\_\_\_} = \_\_\_\_\_$

INVESTIGATION 1 PROPERTIES OF RADICALS

2) Generalize the radical patterns you observed:

$\sqrt{n} \cdot \sqrt{n} = \sqrt{n^2} =$ n [Reference a) and b)]

$\sqrt{a} \cdot \sqrt{b} = \sqrt{a \cdot b}$ [Reference c)]

[Reference d)]

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

(a - d)

a) $\sqrt{4} \cdot \sqrt{4} = 2 \cdot 2 = 4$

b) $\sqrt{36} \cdot \sqrt{36} = \sqrt{36^2} = 36$

c) $\sqrt{9} \cdot \sqrt{25} = 3 \cdot 5 = 15 = \sqrt{225}$

d) $\sqrt{\frac{36}{4}} = \frac{\sqrt{36}}{\sqrt{4}} = \frac{6}{2} = 3$

INVESTIGATION 1 PROPERTIES OF RADICALS

$$\sqrt{n} \cdot \sqrt{n} = \sqrt{n^2} = \_\_\_\_$$

1 Simplify:

a $(\sqrt{3})^2$ **b** $(\sqrt{3})^3$

3 $3\sqrt{3}$

$\sqrt{3} \cdot \sqrt{3} \cdot \sqrt{3}$

3

INVESTIGATION 1 PROPERTIES OF RADICALS

c $(\sqrt{3})^5$ **d** $\left(\frac{1}{\sqrt{3}}\right)^2$

INVESTIGATION 1 PROPERTIES OF RADICALS

2 Simplify:

a $\left(2\sqrt{2}\right)^2$

INVESTIGATION 1 PROPERTIES OF RADICALS

b $\left(4\sqrt{2}\right)^2$ **c** $\left(2\sqrt{3}\right)^2$

INVESTIGATION 1 PROPERTIES OF RADICALS

3) Practice:

1 Simplify:

a $(\sqrt{3})^2$ **b** $(\sqrt{3})^3$ **c** $(\sqrt{3})^5$ **d** $\left(\frac{1}{\sqrt{3}}\right)^2$

2 Simplify:

a $(2\sqrt{2})^2$ **b** $(4\sqrt{2})^2$ **c** $(2\sqrt{3})^2$

INVESTIGATION 1 PROPERTIES OF RADICALS

3) Practice:

Solutions

1 Simplify:

a $(\sqrt{3})^2 = 3$

b $(\sqrt{3})^3$

$\sqrt{3} \cdot \sqrt{3} \cdot \sqrt{3}$

$3\sqrt{3}$

c $(\sqrt{3})^5$

$\sqrt{3} \cdot \sqrt{3} \cdot \sqrt{3} \cdot \sqrt{3} \cdot \sqrt{3}$

$3 \cdot 3 \cdot \sqrt{3}$

$9\sqrt{3}$

d $\left(\frac{1}{\sqrt{3}}\right)^2$

$\frac{1}{3}$

2 Simplify:

a $(2\sqrt{2})^2$

$(2\sqrt{2})(2\sqrt{2})$

$= 4 \cdot 2$

$= 8$

b $(4\sqrt{2})^2$

$(4\sqrt{2})(4\sqrt{2})$

$= 16\sqrt{2} \cdot \sqrt{2}$

$= 32$

c $(2\sqrt{3})^2$

$(2\sqrt{3})(2\sqrt{3})$

$4\sqrt{3} \cdot \sqrt{3}$

$4 \cdot 3 = 12$

Preview for Tuesday...

C SIMPLEST RADICAL FORM

Challenge: Try to simplify each radical.

$\sqrt{12} = \sqrt{4 \cdot \_\_\_} = \sqrt{4} \cdot \sqrt{\_\_\_} = \_\_\_\sqrt{\_\_\_}$

$\sqrt{245} = \sqrt{\_\_\_ \cdot 5} = \sqrt{\_\_\_} \cdot \sqrt{\_\_\_} = \_\_\_\sqrt{\_\_\_}$

Solutions

Challenge: Try to simplify each radical.

$\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$ $= 2\sqrt{3}$

$\sqrt{245} = \sqrt{49 \cdot 5} = \sqrt{49} \cdot \sqrt{5} = 7\sqrt{5}$

B SIMPLIFYING RADICALS

Properties	Examples
• $\sqrt{a}\sqrt{a} = (\sqrt{a})^2 = a$	$\sqrt{278} \cdot \sqrt{278} = 278$
• $\sqrt{a}\sqrt{b} = \sqrt{ab}$	$\sqrt{8}\sqrt{32} = \sqrt{256} = 16$
• $\dfrac{\sqrt{a}}{\sqrt{b}} = \sqrt{\dfrac{a}{b}}$	$\dfrac{\sqrt{100}}{\sqrt{4}} = \sqrt{\dfrac{100}{4}} = \sqrt{25} = 5$

Example 1: Simplify the radicals.

- $\sqrt{a}\sqrt{a} = (\sqrt{a})^2 = a$

a	b	c
$(\sqrt{2})^2$	$(\sqrt{2})^3$	$\left(\frac{4}{\sqrt{2}}\right)^2$
2	$2\sqrt{2}$	$\left(\frac{4}{\sqrt{2}}\right)\left(\frac{4}{\sqrt{2}}\right) = \frac{16}{2}$ 8

a

$$\begin{aligned}(\sqrt{2})^2 &= \sqrt{2} \times \sqrt{2} \\ &= 2\end{aligned}$$

b

$$\begin{aligned}(\sqrt{2})^3 &= \sqrt{2} \times \sqrt{2} \times \sqrt{2} \\ &= 2\sqrt{2}\end{aligned}$$

c

$$\begin{aligned}\left(\frac{4}{\sqrt{2}}\right)^2 &= \frac{4^2}{(\sqrt{2})^2} \\ &= \frac{16}{2} \\ &= 8\end{aligned}$$

Example 2: Simplify the radicals.

a $(3\sqrt{2})^2$

$(3\sqrt{2})(3\sqrt{2})$

$9 \cdot 2 = 18$

b $3\sqrt{3} \times (-2\sqrt{3})$

$-6\sqrt{3} \cdot \sqrt{3}$

-18

a

$$\begin{aligned}&\left(3\sqrt{2}\right)^2\\&= 3\sqrt{2} \times 3\sqrt{2}\\&= 9 \times 2\\&= 18\end{aligned}$$

b

$$\begin{aligned}&3\sqrt{3} \times \left(-2\sqrt{3}\right)\\&= 3 \times -2 \times \sqrt{3} \times \sqrt{3}\\&= -6 \times 3\\&= -18\end{aligned}$$

Example 3: Simplify the radicals.

- $\sqrt{a}\sqrt{b} = \sqrt{ab}$

Write in simplest form:

a $\sqrt{2} \times \sqrt{5}$

$\sqrt{10}$

b $3\sqrt{2} \times 4\sqrt{11}$

$12\sqrt{22}$

a

$$\begin{aligned}&\sqrt{2} \times \sqrt{5}\\ &= \sqrt{2 \times 5}\\ &= \sqrt{10}\end{aligned}$$

b

$$\begin{aligned}&3\sqrt{2} \times 4\sqrt{11}\\ &= 3 \times 4 \times \sqrt{2} \times \sqrt{11}\\ &= 12 \times \sqrt{2 \times 11}\\ &= 12\sqrt{22}\end{aligned}$$

Example 4:

Simplify the radicals.

- $\dfrac{\sqrt{a}}{\sqrt{b}} = \sqrt{\dfrac{a}{b}}$

Simplify: **a** $\dfrac{\sqrt{75}}{\sqrt{3}}$ **b** $\sqrt{\dfrac{9}{49}}$

$\sqrt{\frac{75}{3}} = \sqrt{25} = 5$

$\frac{\sqrt{9}}{\sqrt{49}} = \frac{3}{7}$

a

$$\frac{\sqrt{75}}{\sqrt{3}}$$
$$= \sqrt{\frac{75}{3}}$$
$$= \sqrt{25}$$
$$= 5$$

b

$$\sqrt{\frac{9}{49}}$$
$$= \frac{\sqrt{9}}{\sqrt{49}}$$
$$= \frac{3}{7}$$

Exercises...

EXERCISE 5B 5B Simplifying Radicals

(p.81) #2-6

(choose 4 from each problem)

2 Simplify:

a $(2\sqrt{2})^2$ **b** $(4\sqrt{2})^2$ **c** $(2\sqrt{3})^2$

d $(3\sqrt{3})^2$ **e** $(2\sqrt{5})^2$ **f** $(3\sqrt{5})^2$

3 Simplify:

a $3\sqrt{2} \times 4\sqrt{2}$ **b** $5\sqrt{3} \times 2\sqrt{3}$ **c** $7\sqrt{2} \times 5\sqrt{2}$

d $(-4\sqrt{2})^2$ **e** $(-7\sqrt{3})^2$ **f** $\sqrt{2} \times (-3\sqrt{2})$

$70 = 35\sqrt{2}\sqrt{2} = 35 \cdot 2$

Exercises...

5 Simplify:

a $\frac{\sqrt{8}}{\sqrt{2}}$	**b** $\frac{\sqrt{3}}{\sqrt{27}}$	**c** $\frac{\sqrt{18}}{\sqrt{3}}$	**d** $\frac{\sqrt{2}}{\sqrt{50}}$
e $\frac{\sqrt{75}}{\sqrt{5}}$	**f** $\frac{\sqrt{5}}{\sqrt{75}}$	**g** $\frac{\sqrt{18}}{\sqrt{2}}$	**h** $\frac{\sqrt{3}}{\sqrt{48}}$

$\sqrt{\frac{3}{27}} = \sqrt{\frac{1}{9}} = \frac{\sqrt{1}}{\sqrt{9}} = \frac{1}{3}$

(g) $\sqrt{\frac{64}{25}} = \frac{\sqrt{64}}{\sqrt{25}} = \frac{8}{5}$

6 Simplify:

a $\sqrt{\frac{1}{16}}$	**b** $\sqrt{\frac{81}{144}}$	**c** $\sqrt{\frac{49}{64}}$	**d** $\sqrt{\frac{121}{9}}$
e $\sqrt{6\frac{1}{4}}$	**f** $\sqrt{1\frac{7}{9}}$	**g** $\sqrt{2\frac{14}{25}}$	**h** $\sqrt{7\frac{1}{9}}$

Exercises...

5 Simplify:

a $\frac{\sqrt{8}}{\sqrt{2}}$ **b** $\frac{\sqrt{3}}{\sqrt{27}}$ **c** $\frac{\sqrt{18}}{\sqrt{3}}$ **d** $\frac{\sqrt{2}}{\sqrt{50}}$

e $\frac{\sqrt{75}}{\sqrt{5}}$ **f** $\frac{\sqrt{5}}{\sqrt{75}}$ **g** $\frac{\sqrt{18}}{\sqrt{2}}$ **h** $\frac{\sqrt{3}}{\sqrt{48}}$

4 Simplify:

a $\sqrt{2} \times \sqrt{3}$ **b** $\sqrt{2} \times \sqrt{7}$ **c** $\sqrt{2} \times \sqrt{17}$

d $\sqrt{7} \times \sqrt{3}$ **e** $2\sqrt{2} \times 5\sqrt{3}$ **f** $(4\sqrt{3})^2$

g $5\sqrt{2} \times \sqrt{7}$ **h** $2\sqrt{6} \times 3\sqrt{5}$ **i** $-5\sqrt{2} \times 2\sqrt{7}$

j $(-\sqrt{7}) \times (-2\sqrt{3})$ **k** $(2\sqrt{3})^2 \times 2\sqrt{5}$ **l** $(2\sqrt{2})^3 \times 5\sqrt{3}$

6 Simplify:

a $\sqrt{\frac{1}{16}}$ **b** $\sqrt{\frac{81}{144}}$ **c** $\sqrt{\frac{49}{64}}$ **d** $\sqrt{\frac{121}{9}}$

e $\sqrt{6\frac{1}{4}}$ **f** $\sqrt{1\frac{7}{9}}$ **g** $\sqrt{2\frac{14}{25}}$ **h** $\sqrt{7\frac{1}{9}}$

EXERCISE 5B

1 **a** 3 **b** $3\sqrt{3}$ **c** $9\sqrt{3}$ **d** $\frac{1}{3}$ **e** 7 **f** $7\sqrt{7}$

g $\frac{1}{7}$ **h** $\frac{9}{7}$ **i** 5 **j** 25 **k** 5 **l** 20

2 **a** 8 **b** 32 **c** 12 **d** 27 **e** 20 **f** 45

g 28 **h** 40 **i** 490

3 **a** 24 **b** 30 **c** 70 **d** 32 **e** 147 **f** -6

g 30 **h** -42 **i** -22

4 **a** $\sqrt{6}$ **b** $\sqrt{14}$ **c** $\sqrt{34}$ **d** $\sqrt{21}$

e $10\sqrt{6}$ **f** 48 **g** $5\sqrt{14}$ **h** $6\sqrt{30}$

i $-10\sqrt{14}$ **j** $2\sqrt{21}$ **k** $24\sqrt{5}$ **l** $80\sqrt{6}$

5 **a** 2 **b** $\frac{1}{3}$ **c** $\sqrt{6}$ **d** $\frac{1}{5}$ **e** $\sqrt{15}$ **f** $\sqrt{\frac{1}{15}}$

g 3 **h** $\frac{1}{4}$

6 **a** $\frac{1}{4}$ **b** $\frac{3}{4}$ **c** $\frac{7}{8}$ **d** $\frac{11}{3}$ **e** $\frac{5}{2}$ **f** $\frac{4}{3}$ **g** $\frac{8}{5}$ **h** $\frac{8}{3}$