

Name: _____

UNIT 2 LEARNING GUIDE – EXPONENTS

INSTRUCTIONS:

Using a pencil, complete the following questions as you work through the related lessons. Show ALL of your work as is explained in the lessons. Do your best and always ask questions if there is anything that you don't understand.

2.1 EXPONENTS

1. Rewrite the following using digits.

Ex. Base: 3 Exponent: 5 3^5

e. Twenty squared

a. Base: 7 Exponent: 4

f. Two cubed

b. Base: 9 Exponent: 3

g. Base: 12 Exponent: 6

c. Four to the power of one

h. Base: 45 Exponent: 2

d. Base: 5 Exponent: 10

i. Seven to the power of eight

2. Expand.

Ex. 5^6

$5 \times 5 \times 5 \times 5 \times 5 \times 5$

c. 9^8

a. 2^4

d. 25^1

b. 7^2

e. 3^5

3. Evaluate the following using your calculator.

Ex. 4^6

4096

b. 5^5

d. 25^4

a. 2^8

c. 9^3

e. 3^4

4. Insert $>$, $<$, or $=$ to make each statement true.

Ex. $2^6 > 6^2$

c. $20^3 \underline{\hspace{1cm}} 10^4$

f. $8^3 \underline{\hspace{1cm}} 500$

a. $3^3 \underline{\hspace{1cm}} 27$

d. $4^2 \underline{\hspace{1cm}} 2^4$

g. $50 \underline{\hspace{1cm}} 25^2$

b. $7^3 \underline{\hspace{1cm}} 12^2$

e. $10^1 \underline{\hspace{1cm}} 5^2$

h. $2^6 \underline{\hspace{1cm}} 8^2$

5. Complete the table.

Perfect Squares		
Exponent	Expanded	Perfect Square
1^2		
	2×2	4
		9
	4×4	
5^2		
		36
	7×7	
		64
9^2		
	10×10	
		121
12^2		

6. Circle the perfect squares.

-9

30^2

400

10

2.5^2

64

3

11^2

$\frac{1^2}{2}$

-100

625

36.1

2.2 BEDMAS

1. Solve. *Reminder: Always use the Order of Operations (BEDMAS) when solving a problem.*

Ex. $8^2 - 2^5$

$64 - 32$

32

c. $3^3 + \frac{18}{2}$

a. $3^4 - 2^3$

d. $(17 + 6) - 5^2$

b. 4×7^2

e. $\frac{10^2}{2^2}$

2. Follow the steps to solve each problem. *Reminder: After each operation that you complete, rewrite what remains in the problem.*

	Ex. $4 \times (12 - 9)^3 - 7^2$	a. $(31 - 23)^2 - 5^3 \times 3$	b. $\frac{15}{3} \times \frac{(44-9)}{-5} + 2^4$
Step 1: Brackets	$4 \times 3^3 - 7^2$		
Step 2: Exponents	$4 \times 27 - 49$		
Step 3: Division & Multiplication	$108 - 49$		
Step 4: Addition & Subtraction	59		

3. Solve.

a. $(9 - 2)^2 + \frac{16}{8}$

c. $(8 + 5 \times 5) - \left(\frac{36}{6}\right)^2$

b. $\frac{81}{9} \times (3 - 2)^5$

d. $4 \times \frac{95}{5} - 8 \times (9 - 2)^2$

4. Solve. Reminder: Treat numbers that are in the numerator and denominator of a fraction as though they are in brackets.

a. $\frac{5^3 - 25}{2 \times 5}$

c. $\frac{100 - 4^3}{6} \times (8 - 3)$

b. $\frac{18 + (4 + 2)^2}{11 - 2}$

d. $(49 - 57) \times \frac{4^2}{17 - 8 \times 2}$

e. $(63 \div 9)^2 + \frac{5^2}{16 - 11} \times 4$

f. $2 + [9 + (9 - 4)^2] \times 2$

2.3 SQUARE ROOTS OF PERFECT SQUARES

1. Follow the steps to find the square root of each number.

	Question: “What is the square root of ____?”	Step 1: Find 2 identical numbers that have a product equal to the number in the square root sign.	Step 2: Use one of the numbers from Step 1. Answer	How to say the answer.
Ex.	$\sqrt{121}$	11×11	11	<i>“11 is the square root of 121.”</i>
a.	$\sqrt{49}$			
b.	$\sqrt{100}$			
c.	$\sqrt{4}$			
d.	$\sqrt{144}$			
e.	$\sqrt{81}$			

2. Write out the following using mathematical symbols.

Ex. The square root of 36 is 6.

$$\sqrt{36} = 6$$

c. 8 squared is 64.

a. The square root of 9 is 3.

d. 12 squared is 144.

b. The square root of 64 is 8.

e. The square root of 196 is 14.

3. Evaluate without a calculator.

Ex. $\sqrt{25}$ 5

c. $\sqrt{81}$

f. $\sqrt{36}$

a. $\sqrt{16}$

d. $\sqrt{1}$

g. $\sqrt{100}$

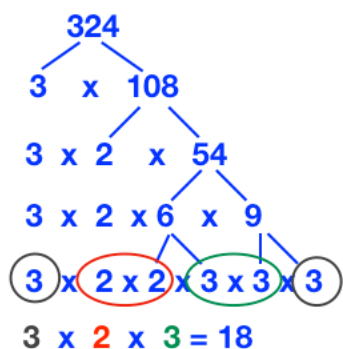
b. $\sqrt{64}$

e. $\sqrt{144}$

h. $\sqrt{121}$

4. Use prime factorization to find the square root of the perfect squares below.

Ex. $\sqrt{324} = 18$



b. $\sqrt{484}$

a. $\sqrt{256}$

c. $\sqrt{1225}$

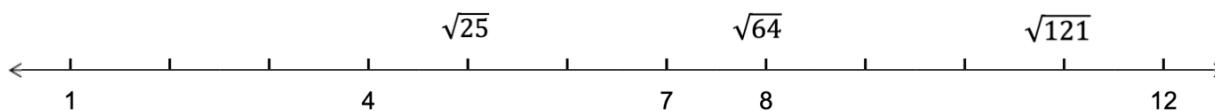
5. Look at the factors of each number to determine whether or not it is a perfect square. If the number is a perfect square, circle the factor that is its square root.

- | | |
|--|--------------------------------------|
| a. 128: 1, 2, 4, 8, 16, 32, 64, 128 | Perfect Square? Yes No |
| b. 332: 1, 2, 4, 83, 166, 332 | Perfect Square? Yes No |
| c. 625: 1, 5, 25, 125, 625 | Perfect Square? Yes No |
| d. 171: 1, 3, 9, 19, 57, 171 | Perfect Square? Yes No |
| e. 361: 1, 19, 361 | Perfect Square? Yes No |
| f. 729: 1, 3, 9, 27, 81, 243, 729 | Perfect Square? Yes No |

6. In your own words, explain why numbers that are perfect squares have an odd number of factors?

2.4 SQUARE ROOTS OF WHOLE NUMBERS

1. Fill in the missing information on the number line.



2. Determine between which two whole numbers each square root lies. *Hint: Use the number line above to help you.*

Ex. $\sqrt{105}$

Between 10 & 11

b. $\sqrt{20}$

d. $\sqrt{34}$

a. $\sqrt{57}$

c. $\sqrt{2}$

e. $\sqrt{139}$

3. Determine between which two square roots of perfect squares each number lies. *Hint: Use the number line above to help you.*

Ex. 6.6

b. 7.4

d. 4.9

Between the $\sqrt{36}$ & $\sqrt{49}$

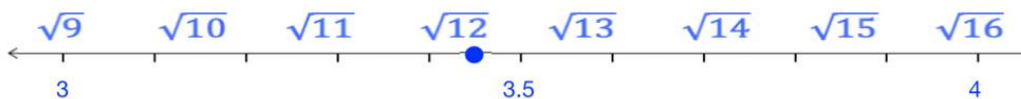
a. 2.1

c. 9.3

e. 1.5

4. Use a number line to estimate the value of each square root to the nearest tenth. Use the “approximately equals” sign (\approx) to show that the value is not exact. *Reminder: Place all of the square roots that are between the perfect squares on the number line (with equal spacing), then use this as a guide to estimate the value of the square root.*

Ex. $\sqrt{12}$



$\sqrt{12} \approx 3.4$

a. $\sqrt{46}$



b. $\sqrt{21}$



c. $\sqrt{126}$



d. $\sqrt{29}$



5. Use your answers from Question 4 to find the square root of each number to 2 decimal places. Do not use a the square root function on the calculator. *Hint: Find this method in the Examples #1 page of the lesson Square Roots of Whole Numbers.*

Ex. $\sqrt{12}$

On the number line, the answer looks to be between 3.4 and 3.5.

$$3.4 \times 3.4 = 11.56$$

$$3.5 \times 3.5 = 12.25 \text{ The answer is between 3.4 and 3.5, but closer to 3.5}$$

$$3.46 \times 3.46 = 11.97$$

$$3.47 \times 3.47 = 12.04 \text{ The answer is between 3.46 and 3.47. but is closest to 3.46}$$

$$\sqrt{12} = 3.46$$

a. $\sqrt{46}$

b. $\sqrt{21}$

c. $\sqrt{126}$

6. Use your calculator to evaluate. Round your answer to **2 decimal places**.

Ex. $\sqrt{88} = 9.38$

b. $\sqrt{96}$

d. $\sqrt{75}$

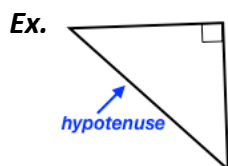
a. $\sqrt{2}$

c. $\sqrt{500}$

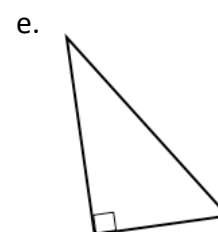
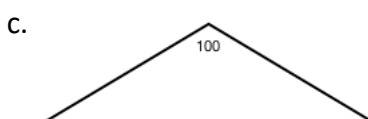
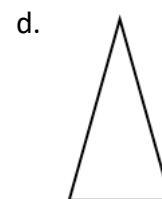
e. $\sqrt{20\,000}$

2.5 PYTHAGOREAN THEOREM

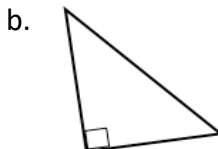
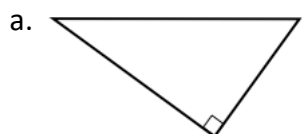
1. State whether each triangle is a right triangle or not. For each right triangle, identify the hypotenuse. *Reminder: The hypotenuse is the side opposite the right angle.*



This is a right triangle.



2. Label the sides of the triangles with the letters ***a***, ***b***, and ***c***. *Reminder: The hypotenuse must be labelled "***c***".*



3. Using numbers 1 – 5, order the steps used to determine the length of a side of a right triangle using Pythagoras' Theorem.

Write out the formula: $a^2 + b^2 = c^2$

Add the unit of measure to your answer

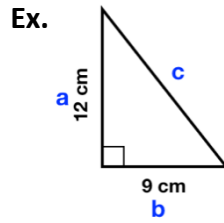
Replace the variables *a*, *b*, and/or *c* with known values

Step 1

Label the sides of the triangle *a*, *b*, and *c*

Calculate

4. Follow the steps to calculate the length of the hypotenuse.



Step 1: Label sides.

Step 2: $a^2 + b^2 = c^2$

Step 3: $12^2 + 9^2 = c^2$

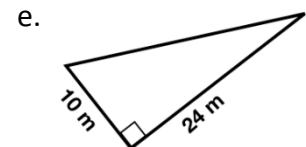
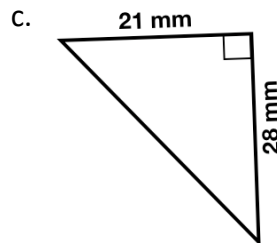
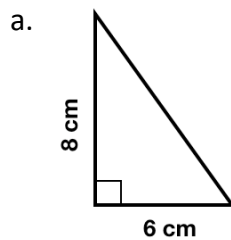
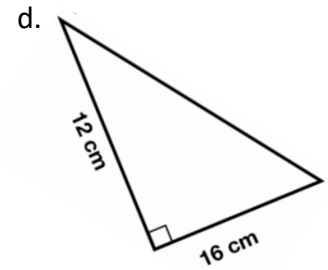
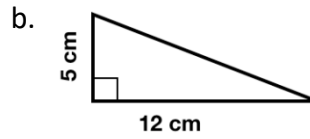
Step 4: $144 + 81 = c^2$

$$225 = c^2$$

$$\sqrt{225} = c$$

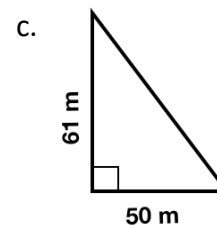
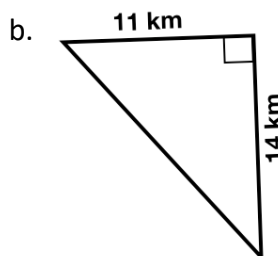
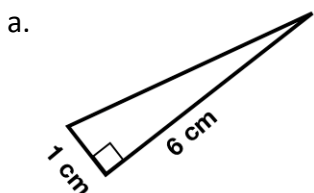
$$15 = c$$

Step 5: $c = 15 \text{ cm}$

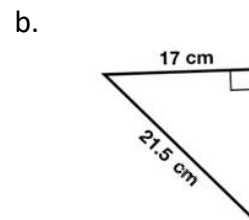
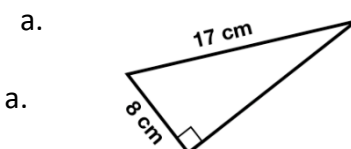
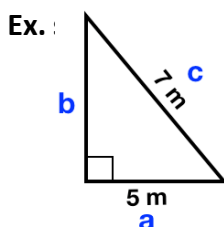


5. Calculate the length of the hypotenuse. Round your answer to the nearest hundredth.

Reminder: Always write out the formula at the start of your calculations. Don't forget to add the unit of measure to your answer.



6. Calculate the length of the unknown side. Round your answers to the nearest tenth.



Step 1: Label sides.

Step 2: $a^2 + b^2 = c^2$

Step 3: $5^2 + b^2 = 7^2$

Step 4: $25 + b^2 = 49$

$$\begin{array}{r} -25 \quad -25 \\ b^2 = 24 \end{array}$$

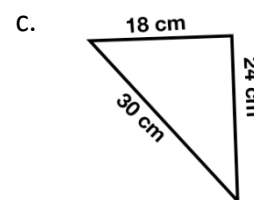
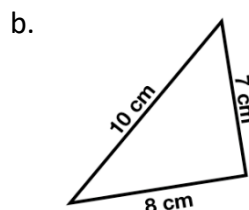
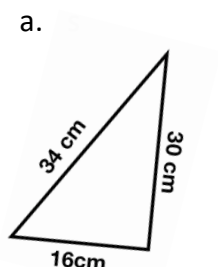
$$b^2 = 24$$

$$b = \sqrt{24}$$

$$b = 4.90$$

Step 5: $b = 4.9 \text{ m}$

7. Which triangle in Question #6 is a Pythagorean triple? Why?
8. Use the Pythagorean Theorem to determine whether each triangle is a right triangle.
Reminder: After substituting in the values for a , b , & c , if $a^2 + b^2 = c^2$, then you know that a triangle is a right triangle.



9. Use the Pythagorean Theorem to solve the problems below. Round your answers to the nearest tenth. Hint Draw a diagram of the problem as a first step to solving.
- What is the height of computer screen that has a diagonal measurement of 22 inches and a width of 12 inches?
 - A door jamb has a height of 2.08 m, a width of 1.05 m and a diagonal measurement of 2.33 m. Are the corners of the door jamb square (ie. 90°)?
 - After take-off from the airport, a plane travels for in a straight trajectory until it reaches its cruising altitude of 11 000 metres (11 km). At this point, it is directly over a town that is 200km from the airport. Calculate the actual distance traveled by the plane.

2.6 CUBES & CUBE ROOTS

1. Circle the perfect cubes.

27 **30^3** **8****216****9****64****3** **$4 \cdot 1^3$** **$\frac{1^3}{2}$** **1000****125****36**

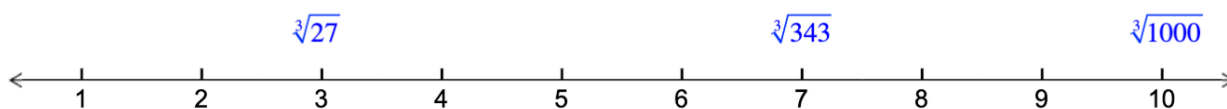
2. Complete the table.

Perfect Cubes		
Exponent	Expanded	Perfect Cube
1^3		
	$2 \times 2 \times 2$	8
		27
	$4 \times 4 \times 4$	
5^3		
		216
	$10 \times 10 \times 10$	

3. Follow the steps to find the cube root of each number.

	Question: “What is the cube root of ___?”	Step 1: Find 3 identical numbers that have a product equal to the number in the cube root sign.	Step 2: Use one of the numbers from Step 1. Answer	How to say the answer.
Ex.	$\sqrt[3]{125}$	$5 \times 5 \times 5$	5	<i>“5 is the cube root of 125.”</i>
a.	$\sqrt[3]{64}$			
b.	$\sqrt[3]{729}$			
c.	$\sqrt[3]{343}$			
d.	$\sqrt[3]{512}$			

4. Fill in the number line below.



5. Estimate the cube root of the following numbers. Write your answers using 1 decimal point. *Hint: Use the number line above to help with your estimations.*

Ex. $\sqrt[3]{24} \approx 2.9$

c. $\sqrt[3]{6}$

f. $\sqrt[3]{2}$

a. $\sqrt[3]{45}$

d. $\sqrt[3]{120}$

g. $\sqrt[3]{280}$

b. $\sqrt[3]{143}$

e. $\sqrt[3]{946}$

h. $\sqrt[3]{530}$

6. Evaluate using your calculator. Round your answers to the nearest hundredth.

Ex. $\sqrt[3]{50} \approx 3.68$

c. $\sqrt[3]{100}$

f. $\sqrt[3]{15\,625}$

a. $\sqrt[3]{400}$

d. $\sqrt[3]{1100}$

g. $\sqrt[3]{36}$

b. $\sqrt[3]{16}$

e. $\sqrt[3]{2}$

h. $\sqrt[3]{125\,000}$

UNIT 2 – ANSWER KEY

SECTION 2.1

1. a. 7^4 b. 9^3 c. 4^1 d. 5^{10} e. 20^2 f. 2^3 g. 12^6 h. 45^2 i. 7^8
2. a. $2 \times 2 \times 2 \times 2$ b. 7×7 c. $9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9$ d. 25 e. $3 \times 3 \times 3 \times 3 \times 3$
3. a. 256 b. 3125 c. 729 d. 390 625 e. 81
4. a. = b. > c. < d. = e. < f. > g. < h. =
- 5.

Perfect Squares		
Exponent	Expanded	Perfect Square
1^2	1×1	1
2^2	2×2	4
3^2	3×3	9
4^2	4×4	16
5^2	5×5	25
6^2	6×6	36
7^2	7×7	49
8^2	8×8	64
9^2	9×9	81
10^2	10×10	100
11^2	11×11	121
12^2	12×12	144

6. 30^2 , 400, 64, 11^2 , 625

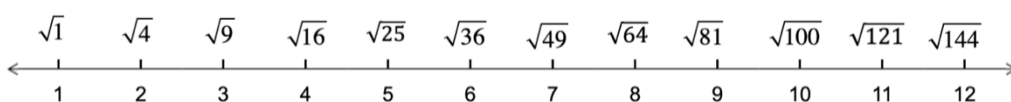
SECTION 2.2

1. a. 73 b. 196 c. 36 d. -2 e. 25
2. a. -311 b. -19
3. a. 51 b. 9 c. -3 d. -316
4. a. 10 b. 6 c. 30 d. -128 e. 69 f. 70

SECTION 2.3

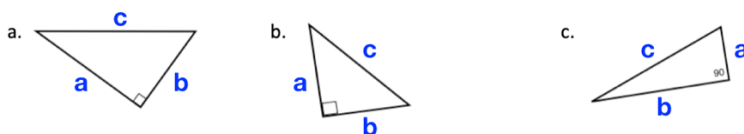
1. a. 7 b. 10 c. 2 d. 12 e. 9
2. a. $\sqrt{9} = 3$ b. $\sqrt{64} = 8$ c. $8^2 = 64$ d. $12^2 = 144$ e. $\sqrt{196} = 14$
3. a. 4 b. 8 c. 9 d. 1 e. 12 f. 6 g. 10 h. 11
4. a. 16 b. 22 c. 35
5. a. No b. No c. Yes, 25 d. No e. Yes, 19 f. Yes, 27
6. Because the factor pair of a perfect square is a repeat of itself, therefore you only see one of that number in the list of factors, turning the list of factors pairs into a odd number.

SECTION 2.4

1. 
2. a. 7 & 8 b. 4 & 5 c. 1 & 2 d. 5 & 6 e. 11 & 12
3. a. $\sqrt{4} \text{ \& } \sqrt{9}$ b. $\sqrt{49} \text{ \& } \sqrt{64}$ c. $\sqrt{81} \text{ \& } \sqrt{100}$ d. $\sqrt{16} \text{ \& } \sqrt{25}$ e. $\sqrt{1} \text{ \& } \sqrt{4}$
4. a. ≈ 6.8 b. ≈ 4.6 c. ≈ 11.2 d. ≈ 5.4
5. a. 6.78 b. 4.58 c. 11.22
6. a. 1.41 b. 9.8 c. 22.36 d. 8.66 e. 141.42

SECTION 2.5

1. a. Yes b. Yes c. No d. No e. Yes
2. Note: **a** & **b** can be switched places, but **c** must always be the longest side.



3. 2, 5, 3, 1, 4
4. a. 10 cm b. 13 cm c. 35 mm d. 20 cm e. 26 m
5. a. 6.08 cm b. 17.80 km c. 78.87 m
6. a. 15 cm b. 13.2 cm
7. 6.a. Because all of its sides are positive integers.

8. a. Yes b. No c. Yes
9. a. 18.4 in b. Yes, the corners are square. This is because the triangles formed by the diagonal are right triangles (as proven by Pythagoras' Theorem), which means the angles in the corners of the door jamb are 90° . c. 200.3 km

SECTION 2.6

1. 27, 30^3 , 8, 216, 64, 1000, 125

2.

Perfect Cubes		
Exponent	Expanded	Perfect Cube
1^3	$1 \times 1 \times 1$	1
2^3	$2 \times 2 \times 2$	8
3^3	$3 \times 3 \times 3$	27
4^3	$4 \times 4 \times 4$	64
5^3	$5 \times 5 \times 5$	125
6^3	$6 \times 6 \times 6$	216
10^3	$10 \times 10 \times 10$	1000

3. a. 4 b. 9 c. 7 d. 8
4. $\sqrt[3]{1}$, $\sqrt[3]{8}$, $\sqrt[3]{27}$, $\sqrt[3]{64}$, $\sqrt[3]{125}$, $\sqrt[3]{216}$, $\sqrt[3]{343}$, $\sqrt[3]{512}$, $\sqrt[3]{729}$, $\sqrt[3]{1000}$
5. Note: Answers +/- 0.1 from the stated answer are considered accurate estimations.
a. ≈ 3.6 b. ≈ 5.2 c. ≈ 1.8 d. ≈ 4.9 e. ≈ 9.8 f. ≈ 1.3 g. ≈ 6.5 h. ≈ 8.1
6. a. 7.37 b. 2.52 c. 4.64 d. 10.32 e. 1.26 f. 25 g. 3.3 h. 50