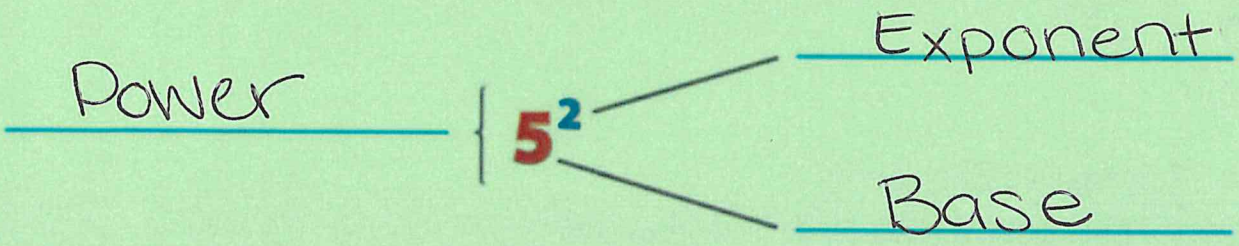
7A - CHAPTER 4: POWERS AND ROOTS - NOTE SHEET

NAME: Miss Cramer HOUR: _____

Lesson 4.1: Powers and Exponents

Vocabulary		
		
Exponent	**Power**	**Base**
tells how many times to multiply the factor	A number that is expressed using an exponent	the number being multiplied, or the factor

Write each expression using exponents.

1a. $\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)$ $\left(\frac{1}{2}\right)^3$

1b. $x \cdot x \cdot x \cdot x \cdot x$ x^5

1c. $(c-d)(c-d)$ c^2-d^2 $(c-d)^2$

1d. $9 \cdot f \cdot f \cdot f \cdot f \cdot g$ $9 \cdot g \cdot f^4$ $9 \cdot f^4 \cdot g$

Order of Operations	
Step 1:	Grouping Symbols ( ) [ ] | |
Step 2:	Exponents
Step 3:	Multiplication and Division Left → Right
Step 4:	Addition and Subtraction Left → Right

2. A tennis ball is dropped from the top of a building. After 8 seconds, the tennis ball hits the ground. The distance in meters the ball traveled is represented by $4.9(8)^2$. How far did the ball drop?

576

313.6

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Evaluate each expression if $a = 5, b = -2,$ and $c = \frac{3}{4}$.

3a. $10 + b^2$ 3b. $(a + b)^3$ 3c. $2 - c^2$

$10 + (-2)^2$

$10 +$

Lesson 4.2: Negative Exponents

Vocabulary							
Term	Definition						
Negative Exponent	$a^{-n} = \frac{1}{a^n}$ $\frac{1}{a^n} = a^n$						
Exponential Form	10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}
Standard Form	1,000	100	10	1	0.1	0.01	0.001
Zero Exponent	Any number with a zero exponent equals 1.						

Write each expression using a positive exponent.

1a. $\frac{3^{-5}}{1}$ $\frac{1}{3^5}$ 1b. $\frac{y^{-3}}{1}$ $\frac{1}{y^3}$ 1c. 2^0 1

Write each fraction as an expression using a negative exponent other than -1.

2a. $\frac{1}{6^3}$ 6^{-3} 2b. $\frac{1}{25} = \frac{1}{5^2} = 5^{-2}$ 2c. $\frac{1}{27} = \frac{1}{3^3} = 3^{-3}$

3a. the slowest-moving fish is a sea horse. It swims at a maximum speed of 0.0001 mile per minute. Write the decimal as a fraction and as a power of ten.

$\frac{1}{10{,}000} = \frac{1}{10^4} = 10^{-4}$

3b. The smallest species of ant has a mass of 0.00001 gram. Write the decimal as a fraction and as a power of ten.

$\frac{1}{100{,}000} = \frac{1}{10^5} = 10^{-5}$

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Evaluate each expression if $m = 4$ and $n = 3$.

4a. m^{-2}

$\frac{1}{16} = 0.0625$

4b. $6mn^{-4}$

$\frac{8}{27} = 0.\overline{296}$

4c. $-n^{-3}$

$-\frac{1}{27} = -0.\overline{037}$

4d. $-4m^{-2}$

$-\frac{25}{99} = -0.\overline{25}$

$-\frac{1}{4} = -0.25$

Lesson 4.3: Multiplying and Dividing Monomials

Product of Powers Property
To multiply powers with the same base, add the exponents. $x^5 \cdot x^3 = x^{5+3} = x^8$

Vocabulary		
Term	Definition	
Monomials	a number, a variable, or a product of number and/or variables.	
	Example	Non-Example
	1 a 2mn	$5x + 7$

Find each product. Express using positive exponents

1a. $5^2 \cdot 5^3$

$5^5 = 3,125$

1b. $12^3 \cdot 12^{-2}$

$12^1 = 12$

2a. $y^6 \cdot y^3$

y^9

2b. $r^6 \cdot r^{-5}$

r^1

2c. $a^7 \cdot a^6$

a^{13}

2d. $x^{-6} \cdot x^2$

$\frac{1}{x^4}$

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Rearrange expressions...

$2x^3 \cdot 8x^4 = (2 \cdot 8) \cdot (x^3 \cdot x^4) = 16x^{3+4} = 16x^7$

3a. $(5a^2)(-3a^4)$

3b. $6b^{-4} \bullet 2b^2$

3c. $(6x^3)(-3x^5)$

3d. $10n^7 \bullet 5n^2$

Quotient of Powers Property

To divide powers with same base, subtract their exponents

$\frac{8^5}{8^3} = 8^{5-3} = 8^2$

$\frac{12|t^7}{3|t^4} = 4t^3$

Find each quotient. Express using positive exponents.

4a. $\frac{3^9}{3^2}$

4b. $\frac{b^7}{b^6}$

4c. $\frac{4^5}{4^{-2}}$

4d. $\frac{s^{-4}}{s^1}$

5a. About how many times as great is the diameter of Earth than the diameter of Mars?

$\frac{2^{13}}{2^{12}} = 2^1$

Planet	Approximate Diameter (mi)
Mars	2^{12}
Earth	2^{13}
Neptune	2^{15}

5b. The diamter of a small asteroid is 10^{-1} kilometer. The diameter of Ceres is 10^3 kilometers. About how many times as great is the diamtere of Ceres than the diamter of the smaller asteroid?

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Lesson 4.4: Scientific Notation

Vocabulary		
Term	**Definition**	**Example**
Standard Form	Numbers that do not include exponents	2,364 72
Scientific Notation	Its expressed using a factor and a power of 10 $a \times 10^n$ $1 \leq a < 10$	3.025×10^8 Non-Example 11.35×10^{-7} 0.72×10^{106}

Positive Exponent	Negative Exponent
The number is bigger than one. Move the decimal to the right. SN→SF	The number is between zero and one. SN→SF Move the decimal to the left.

Express each number in standard form.

1a. 4×10^2 → 400

1b. 5.94×10^7 → 59,409,000

1c. 1.3×10^{-3} → 0.0013

Express each number in scientific notation

2a. 900 → 9×10^2

2b. 18,900 → 1.89×10^4

2c. 0.000064 → 6.4×10^{-5}

Estimate each value using scientific notation.

3a. 3,612,500 cm

3b. 0.000000251 ft

3c. 4.215×10^{-3} kg

4. A dime is about 5.875×10^{-3} foot in diameter. Is it more appropriate to report that the diameter of a dime is 5.875×10^{-3} foot or 7.05×10^{-1}? Explain your reasoning.

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Comparing Scientific Notation	1) Compare the exponents 2) Compare the factors (a)

5. Approximately 1.372×10^7 square kilometers of Antarctica and about 1.834×10^6 square kilometers of Greenland are covered by an ice cap. Which land mass has a greater area covered by ice?

Antarctica

Lesson 4.5: Compute with Scientific Notation

Vocabulary	
Term	Definition
 Commutative Property	being able to rearrange a problem with multiplication and addition $ab = ba$ $a+b = b+a$
Associative Property	being able to regroup a problem with multiplication or addition $a(bc) = (ab)c$ $a+(b+c) = (a+b)+c$

Multiplication with Scientific Notation

$(7.2 \times 10^3)(1.6 \times 10^4)$

$(7.2 \times 1.6)(10^3 \times 10^4)$

11.52×10^7

$\boxed{1.152 \times 10^8}$

Division with Scientific Notation

$$\frac{7 \times 10^9}{3 \times 10^8}$$

$\left(\frac{7}{3}\right) \times \left(\frac{10^9}{10^8}\right)$

$\boxed{2.3 \times 10^1}$

Decimal moved to the right...	Decimal moved to the left...
Subtract from the exponent	add to the exponent

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Evaluate each expression. Express the result in scientific notation.

1a. $(4.62 \times 10^5)(8.15 \times 10^9)$

1b. $(7.53 \times 10^{-8})(2.93 \times 10^{-3})$

1c. $(1.2 \times 10^7)(1500)$

1d. $(6.4 \times 10^{-5})(12{,}000)$

2a. $\frac{4.62 \times 10^5}{1.4 \times 10^{-9}}$

2b. $\frac{2.5627 \times 10^{-9}}{5.23 \times 10^{-3}}$

3. Until 2008, the world's largest working cattle ranch was located in Australia. It was about 6×10^6 acres. The largest ranch in the United States is 825,000 acres. About how many times larger was the ranch in Australia than the largest ranch in the United States?

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Addition with Scientific Notation	Subtraction with Scientific Notation
$(6.89 \times 10^4) + (9.24 \times 10^5)$ $+1$ $(6.89 \times 10^4) + (92.4 \times 10^4)$ $(6.89 + 92.4) \times 10^4$ $99.29 \times 10^{4+1}$ 9.929×10^5	$(7.83 \times 10^8) - 11{,}610{,}000$ $(7.83 \times 10^8) - (1.161 \times 10^7)$ $(78.3 \times 10^7) - (1.161 \times 10^7)$ $(78.3 - 1.161) \times 10^7$ $77.139 \times 10^{7+1}$ 7.7139×10^8

Evaluate each expression. Express the result in scientific notation.

4a. $(1.7 \times 10^7) + (6.25 \times 10^5)$

4b. $0.00864 + (5.67 \times 10^{-4})$

4c. $(2.84 \times 10^{11}) - (5.4 \times 10^9)$

4d. $0.0000321 - (4.9 \times 10^{-7})$

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Lesson 4.6: Square Roots and Cube Roots

Vocabulary			
Term	Definition		Perfect Squares
Square Roots	a number that is one of two equal factors		x | x^2 1 | 1 2 | 4
Positive $\sqrt{9} = 3$	Negative $-\sqrt{36} = -6$	Both $\pm\sqrt{81} = \pm 9$ $= 9$ or -9	3 | 9 4 | 16 5 | 25
Radical Signs	$\sqrt{\ }$ = is used to indicate a square root		6 | 36 7 | 49 8 | 64
Perfect Square	a number with a square root that is an integer		9 | 81 10 | 100

1a. $\sqrt{49}$

7

1b. $-\sqrt{16}$

-4

$\pm\sqrt{144}$

$+ = 1+$

12

1c. $\pm\sqrt{100}$

± 10

10 or -10

$10 \cdot 10 = 100$

$-10 \cdot -10 = 100$

1d. $\sqrt{-49}$

Non real

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2a. $\sqrt{60}$

2b. $-\sqrt{23}$

2c. $\sqrt{14}$

2d. $-\sqrt{79}$

3a. Spring Port Ledge Lighthouse in Maine is approximately 55 feet tall. Calculate about how far a person who is standing at the top of the lighthouse can see on a clear day. Round to the nearest tenth of a mile.

3b. The observation deck of the Washington Monument is 500 feet high. Calculate about how far a person on the observation deck can see on a clear day. Round to the nearest tenth of a mile.

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Vocabulary		
Term	Definition	Perfect Cubes

Term	Definition	x	x^3
Cube Roots	a number that is one of three equal factors	1	1
		2	8
Positive: $\sqrt[3]{27} = 3$	Negative: $\sqrt[3]{-1{,}000} = -10$	3	27
		4	64
		5	125
Estimate Cube Roots		6	216
		7	343
		8	512
		9	729
		10	1,000

4a. $\sqrt[3]{64}$

4

4b. $\sqrt[3]{-1331}$

-11

Estimate the cube root.

5a. $\sqrt[3]{72}$

≈ 4.2

5b. $\sqrt[3]{2024}$

≈ 12.6

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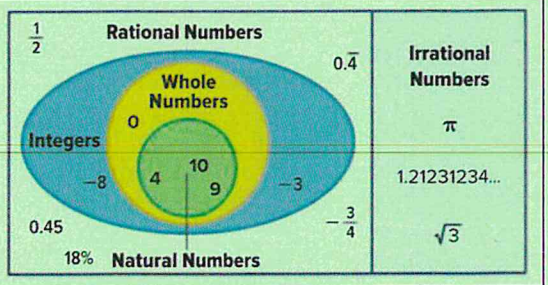
Lesson 4.7: The Real Number System

Vocabulary	
Term	Definition
Irrational Number	A number that can NOT be written as a fraction
Real Number	Rational + Irrational



Name all sets of numbers to which each real number belongs. Write *natural* $\mathbb{N}$, *whole* $\mathbb{W}$, *integers* $\mathbb{Z}$, *rational* $\mathbb{Q}$, and *irrational*.

1a. 0.7

1b. $\sqrt{100}$

1c. $\frac{9}{5}$

1d. -6

How to compare and order real numbers...

Convert all numbers into decimals

2. Replace ● with $<$, $>$, or $=$ to make $7\frac{2}{5}$ ● $\sqrt{57}$ a true statement.

3. Order the set $\left\{\sqrt{30}, 5.6, \frac{15}{3}, 5\frac{2}{3}\right\}$ from greatest to least.

4a. $363 = 3d^2$

4b. $729 = s^3$

4c. $100 = 4n^2$

4d. $512 = x^3$

5. A tsunami is caused by an earthquake on the ocean floor. The speed of a tsunami can be measured by the formula $\frac{s^2}{d} = 9.61$, where s is the speed of the wave in meters per second and d is the depth of the ocean in meters where the earthquake occurs. What is the speed of a tsunami if an earthquake occurs at a depth of 632 meters? Round to the nearest tenth.