

Name: _____

Date: _____

Chapter 2 Review

For each type of question, the achievement level is indicated. Showing work is an important strategy in communicating your knowledge and ideas so please be thorough.

Learning Goal 2.1	I can identify the base and exponent of a power and understand the relationship between powers and repeated multiplication.
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Developing

1. Identify the base, exponent and power of each expression.

	a. 3^{52}	b. $(-7)^{23}$	c. 2^{-18}	d. -4^{67}	e. 5^{25}	f. $(-12)^0$	g. 1^{-100}
Base	3	-7	2	4	5	-12	1
Exponent	52	23	-18	67	25	0	-100
Power	3^{52}	$(-7)^{23}$	2^{-18}	4^{67}	5^{25}	$(-12)^0$	1^{-100}

Developing

2. Write the following numbers as repeated multiplication, then evaluate. Do not leave answers as decimals, only as fractions where appropriate.

a. 3^5	b. 7^3	c. 2^8	
$= 3 \times 3 \times 3 \times 3 \times 3$ $= 243$	$= 7 \times 7 \times 7$ $= 343$	$= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$ $= 256$	
d. 4^6	e. 5^2	f. 12^0	g. 1^{10}
$= 4 \times 4 \times 4 \times 4 \times 4 \times 4$ $= 4096$	$= 5 \times 5$ $= 25$	$= 1$	$= 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1$ $= 1$

Proficient

a. $(-3)^3$	b. -3^3	c. -6^2
$= (-3) \times (-3) \times (-3)$ $= -27$	$= -3 \times 3 \times 3$ $= -27$	$= -6 \times 6$ $= -36$
d. $(-6)^2$	e. -5^4	f. $(-5)^4$
$= (-6) \times (-6)$ $= 36$	$= -5 \times 5 \times 5 \times 5$ $= -625$	$= (-5) \times (-5) \times (-5) \times (-5)$ $= 625$

Name: _____

Date: _____

Chapter 2 Review

Extending

a. $(-4)^{-3}$	b. -4^{-3}	c. -2^{-4}
$= \frac{1}{(-4) \times (-4) \times (-4)}$ $= \frac{-1}{64}$	$= \frac{-1}{4 \times 4 \times 4}$ $= \frac{-1}{64}$	$= \frac{-1}{2 \times 2 \times 2 \times 2}$ $= \frac{-1}{16}$
d. $(-2)^{-4}$	e. -10^{-5}	f. $(-10)^{-5}$
$= \frac{1}{(-2) \times (-2) \times (-2) \times (-2)}$ $= \frac{1}{16}$	$= \frac{-1}{10 \times 10 \times 10 \times 10 \times 10}$ $= \frac{-1}{100000}$	$= \frac{1}{(-10) \times (-10) \times (-10) \times (-10) \times (-10)}$ $= \frac{1}{100000}$

Extending

3. A text message tree is used to send messages. The person at the top texts 2 people. Each person texts 2 more people. Suppose it takes 1 minute to call someone. A message is relayed until the bottom row of the tree has 256 people. How long does it take? How do you know?

$$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$$

8 minutes

Name: _____

Date: _____

Chapter 2 Review

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Learning Goal 2.2	I can apply exponent laws to expressions.
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1. Simplify the following expressions to a single power (if possible). Show all your work.

Developing			
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a. $5^2 \times 5^9 = 5^{11}$	b. $7^{10} \times 7^{12} = 7^{22}$	c. $4^8 \times 3^9 = 4^8 \times 3^9$	d. $a^{14} \times a^{18} = a^{32}$
e. $\frac{4^{14}}{4^8} = 4^6$	f. $\frac{8^8}{5^3} = \frac{8^8}{5^3}$	g. $\frac{2^{23}}{2^6} = 2^{17}$	h. $\frac{f^{19}}{f^{13}} = f^6$
i. $(3^6)^{10} = 3^{60}$	j. $(6^{14})^3 = 6^{42}$	k. $(t^5)^{12} = t^{60}$	l. $(8^9)^4 = 8^{36}$

Proficient			
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a. $(5^6 \times 5^2)^4 = 5^{32}$	b. $(7^0 \times 7^{15})^2 = 7^{30}$	c. $(3^8 \times 3^9)^0 = 3^0$	d. $(a^4 \times a^8)^{12} = a^{144}$
e. $\frac{4^8}{4^{14}} = \frac{1}{4^6}$	f. $\frac{8^8}{8^{17}} = \frac{1}{8^9}$	g. $\frac{2^2}{2^{16}} = \frac{1}{2^{14}}$	h. $\frac{f^{11}}{f^{24}} = \frac{1}{f^{13}}$
i. $\left(\frac{3^6}{3^3}\right)^{12} = 3^{36}$	j. $\left(\frac{6^{14}}{6^{21}}\right)^3 = \frac{1}{6^{21}}$	k. $\left(\frac{t^5}{t^{11}}\right)^8 = \frac{1}{t^{48}}$	l. $\frac{a^4}{a^5} \times a^{-6} = \frac{1}{a^7}$
m. $\left(\frac{x^5 \times x^8}{x^3}\right)^9 = x^{90}$	n. $\left(\frac{x^5}{x^3} \times x^8\right)^9 = x^{90}$	o. $\left(\frac{x^5}{x^3}\right)^9 \times x^8 = x^{26}$	p. $\frac{(x^5 \times x^8)^9}{x^3} = x^{114}$

2. Simplify the following expressions. Show all your work.

Proficient			
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a. $\left(\frac{6}{12a}\right)^3 = \frac{1}{8a^3}$	b. $(2b^2c^5)^3 = 8b^6c^{15}$	c. $\frac{(4m^4n^{-3})^{-3}}{n^9} = \frac{1}{64m^{12}}$	d. $\frac{(-3a^{-4}b^{-5})^{-3}}{-a^{12}b^{15}} = \frac{1}{27}$
e. $\frac{4q^2r^5}{12q^7r^2} = \frac{r^3}{3q^5}$	f. $\left(\frac{f^5}{fg^3}\right)^{-4} = \frac{g^{12}}{f^{16}}$	g. $\frac{2xy^2z^3}{x^3y^2z} = \frac{2z^2}{x^2}$	h. $\left(\frac{14f^{11}}{7f^{24}}\right)^4 = \frac{16}{f^{52}}$

Name: _____

Date: _____

Chapter 2 Review

i.	$\frac{x^9y^5}{x^6y^{-2}} = x^3y^7$	j.	$\left(\frac{c^5d^{-3}}{c^{-2}d^3}\right)^{-4} = \frac{d^{24}}{c^{28}}$	k.	$\frac{\left(\frac{-r^5s^3}{2t^{-11}}\right)^8}{r^{40}s^{24}t^{88}} = \frac{1}{256}$	l.	$\left(\frac{16g^7}{8g^5h^{-4}}\right)^{15} = 32768g^{30}h^{60}$
m.	$\left(-\frac{x^5y^8}{6y^3}\right)^3 = -\frac{x^{15}y^{15}}{216}$	n.	$\left(\frac{j^5}{k^3} \times j^8k^{-4}\right)^9 = \frac{j^{117}}{k^{63}}$	o.	$\left(\frac{c^{-2}d}{a^{-3}b^{-4}}\right)^{-9} = \frac{c^{18}}{a^{27}b^{36}d^9}$	p.	$\left(-3p^{-4}q^3\right)^{-3} = \frac{-p^{12}}{27q^9}$

Extending

a.	$(3p^4q^5)^{-2} \times (2p^{-3})^4 = \frac{16}{9p^{20}q^{10}}$	b.	$(15r^6s^2t^{-4})^3 \times (3r^3s^{-6}t^{-8})^{-4} = \frac{125r^6s^{30}t^{20}}{3}$
c.	$\left(\frac{-12a^7b^{-6}}{20a^{-3}c^4}\right)^{-3} = \frac{125b^{18}c^{12}}{27a^{30}}$	d.	$\left(\frac{60x^9y^{-12}}{12x^{-3}y^4z^{-2}}\right)^{-2} = \frac{y^{32}}{25x^{24}z^4}$

Extending

3. The tallest tree in the world, Hyperion in California, is about 10^2 m tall. The highest mountain, Mount Everest, is about 10^4 m high. About how many times as high as the tree is the mountain?			
10^2			
4. Scientists grow bacteria. This table shows how the number of bacteria doubles every hour. How many bacteria are there at noon? At 3:00 PM? If the pattern continues, how many bacteria would you expect by midnight?	Time	Elapsed Time After Noon (h)	Number of Bacteria
	noon	0	1000×2^0
	1:00 P.M.	1	1000×2^1
	2:00 P.M.	2	1000×2^2
	3:00 P.M.	3	1000×2^3
Noon: 1000 bacteria	3:00 PM: 8000 bacteria	Midnight: 4 096 000 bacteria	

Name: _____

Date: _____

Chapter 2 Review

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Learning Goal 2.3	I can evaluate an expression using order of operations with powers and applying exponent laws.
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1. The following equations are true. Show each step, using order of operations how the answer is achieved.

Developing		
a.	$4^3 - 2^3 = 56$	b. $(4 - 2)^3 = 8$
	3 steps	2 steps
c.	$(6^2 \times 7) \div 2^1 = 126$	
		4 steps
d.	$48 \div 3 \times 2^2 = 64$	e. $5 \times (2^3 - 2^4) = -40$
	3 steps	4 steps
f.	$5 \times 2^3 - 2^4 = 24$	
		4 steps
Proficient		
g.	$4^3 \div (8 \times (6^1 - 2^3)) = -4$	h. $(4^3 \div 8) \times (6^1 - 2^3) = -16$
	6 steps	6 steps
i.	$(2 \times 3) + 3^2 - 5 \times 3 = 0$	
		5 steps
j.	$\frac{5^3 \times (2^3 - 4^2)}{5^2} = -40$	k. $(10 - 7)^4 + 2 \times 3^2 = 99$
	7 steps	5 steps
l.	$\frac{2^3(3^2 - 5)}{4^2} = 2$	
		6 steps
Extending		
m.	$(10 - 2^3)^5 + 4 \times (5 - 24) + (21 - 5^2)^2 = -28$	n.
	10 steps	$\left(\left(\frac{3^3}{3^4} \right)^{-1} + \left(\frac{5 \times 9^1}{3^2} \right) \right) \times 2^{-2} = 2$
		11 steps
o.	$\left(\frac{5}{10} \right)^{-3} - 2 \times 5^2 \times 10^{-1} = 3$	p.
	9 steps	$6^2 \div (9 + (-2)^3) - 2(8 - (-2)^2)^3 = -92$
		9 steps

Name: _____

Date: _____

Chapter 2 Review

Name: _____

Date: _____

Chapter 2 Review

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Learning Goal 2.4	I can convert number between standard form and scientific notation.
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1. Write each number in scientific notation.

Developing			
a. 0.000 054 mg	b. 0.006 4 s	c. 0.000 32 mm	d. 0.012 345 mg
5.4×10^{-5} mg	6.4×10^{-3} s	3.2×10^{-4} mm	1.2345×10^{-2} mg
e. 0.000 000 000 1 mL	f. 0.987 mg	g. 1 500 g	h. 123 456 km
1.0×10^{-10} mL	9.87×10^{-1} mg	1.5×10^3 g	1.23456×10^5 km
i. 120 km	j. 975.05 km	k. 900 hours	l. 6.7 m
1.2×10^2 km	9.7505×10^2 km	9.0×10^2 hours	6.7×10^0 m
Proficient			
m. 1 one thousandth of a second	n. 12 million km	o. 17 hundredths of a mm	p. 7.9 mL
1.0×10^{-3} s	1.2×10^7 km	1.7×10^{-1} mm	7.9×10^0 mL
q. 3.7 million kg	r. 187 thousand years	s. 8.2 g	t. 15 hundred L
3.7×10^5 kg	1.87×10^5 years	8.2×10^0 g	1.5×10^3 L
Extending			
u. 0.00035×10^{-4} mL	v. 23×10^{-8} mm	w. 8×10^{-17} mg	x. 0.00678×10^{-6} s
3.5×10^{-8} mL	2.3×10^{-7} mm	8.0×10^{-17} mg	6.78×10^{-9} s
y. 5×10^{16} L	z. $123\,456 \times 10^{27}$ kg	aa. 38×10^2 m	bb. 495.8×10^6 km
5.0×10^{16} L	1.23456×10^{32} kg	3.8×10^3 m	4.958×10^8 km

Name: _____

Date: _____

Chapter 2 Review

2. Write each number in standard notation. Make note of which questions are written in scientific notation.

Developing			
a. 1.5×10^{-2} s	b. 7.75×10^{-1} mg	c. 1.71×10^{-8} mm	d. 9.24×10^{-4} mL
0.015 s	0.775 mg	0.000 000 017 1 mm	0.000 924 mL
e. 4.65×10^{-3} g	f. 3.14×10^{-5} mm	g. 2.5×10^1 kg	h. 3.14×10^5 km
0.004 65 g	0.000 031 4 mm	25 kg	314 000 km
i. 5.4×10^6 kg	j. 2.71×10^3 hours	k. 7.5×10^6 L	l. 5.234×10^2 kg
5 400 000 kg	2710 hours	7 500 000 L	523.4 kg
Proficient			
m. 4.32×10^0 s	n. 9.75×10^0 m	o. 4.63×10^0 g	p. 3.14×10^0 L
4.32 s	9.75 m	4.63 g	3.14 L
Extending			
q. 495.3×10^{-2} s	r. 0.0934×10^{-3} mg	s. 0.0067×10^{-5} mL	t. 0.54×10^{-7} mm
4.953 s	0.000 093 4 mg	0.000 000 067 mL	0.000 000 054 mm
u. 31415×10^5 kg	v. 0.00035×10^8 L	w. 234×10^3 hours	x. 75×10^4 km
3 141 500 000 kg	35 000 L	234 000 hours	750 000 km