Pg. 414 – 415 #1, 8, 11-15 odd, 20, 21-25 odd, 28

1. -3^4 is the negative of 3^4, so the base is 3, the exponent is 4, and its value is -81. $(-3)^4$ has a base of -3, an exponent of 4, and a value of 81.

8. $(-4)^3y^2$

11. 25

13. 1

15. $\frac{1}{144}$

20. $12 \cdot \left(\frac{7}{10}\right)^3$; 4.116 in.

21. 29

23. 5

25. 66

28. **a.** about 99.95 g

b. 99.95%

Pg. 420 – 421 #3-27 odd, 31, 32

3. 3^4

5. $(-4)^{12}$

7. h^7

9. $\left(-\frac{5}{7}\right)^{17}$

11. 5^{12}

13. 3.8^{12}

15. The bases should not be multiplied.

$$5^2 \cdot 5^9 = 5^{2+9}$$
$$= 5^{11}$$

17. $216g^3$

19. $\frac{1}{25}k^2$

21. $r^{12}\,t^{12}$

23. no; $3^2 + 3^3 = 9 + 27 = 36$ and $3^5 = 243$

25. 496

27. 78,125

31. See *Taking Math Deeper.*

32. **a.** 3

b. 4

Pg. 426 – 427 #3-27 odd, 32

3. 6^6

5. $(-3)^3$

7. 5^6

9. $(-17)^3$

11. $(-6.4)^2$

13. b^{13}

15. You should subtract the exponents instead of dividing them.

$$\frac{6^{15}}{6^5} = 6^{15-5}$$
$$= 6^{10}$$

17. 2^9

19. π^8

21. k^{14}

23. $64x$

25. $125a^3b^2$

27. x^7y^6

32. 10; The difference in the exponents needs to be 9. To find x, solve the equation
$3x - (2x + 1) = 9$.

Name_____ Date_____

Properties of Exponents Review

Section 10.1- Exponents

Write the product using exponents.

1) $4 \bullet 4 \bullet 4 \bullet 4 \bullet 4$

4^5

2) $\left(-\frac{1}{8}\right) \bullet \left(-\frac{1}{8}\right) \bullet \left(-\frac{1}{8}\right)$

$\left(-\frac{1}{8}\right)^3$

3) $5 \bullet 5 \bullet (-x) \bullet (-x) \bullet (-x) \bullet (-x)$

$5^2(-x)^4$

4) $9 \bullet 9 \bullet y \bullet y \bullet y \bullet y \bullet y \bullet y$

$9^2 y^6$

Evaluate the expression.

5) $(-7)^4$ $= 2401$

6) $-\left(\frac{1}{6}\right)^5$ $= -\frac{1}{7776}$

7) $3 + 6 \bullet (-5)^2$

$= 3 + 6 \cdot 25$

$= 3 + 150$

$= 153$

8) $\left|-\frac{1}{3}(1^{10} + 9 - 2^3)\right|$

$= \left|-\frac{1}{3}(1 + 9 - 8)\right|$

$= \left|-\frac{1}{3}(2)\right|$

$= \left|-\frac{2}{3}\right|$

$= \frac{2}{3}$

Section 10.2- Product of Powers

Simplify the expression. Write your answer as a power.

9) $(-6)^5 \bullet (-6)^4$

$= (-6)^9$

10) $\left(\frac{4}{5}\right)^3 \bullet \left(\frac{4}{5}\right)^{12}$

$\left(\frac{4}{5}\right)^{15}$

11) $(y^{10})^{20} = y^{200}$

12) $\left(\left(-\frac{2}{9}\right)^{8}\right)^{7} = \left(-\frac{2}{9}\right)^{56}$

Simplify the expression.

13) $(2a)^{6} = 64a^{6}$

14) $(-4b)^{4} = 256b^{4}$

15) $\left(-\frac{9}{10}p\right)^{2} = \frac{81}{100}p^{2}$

16) $(xy)^{15} = x^{15}y^{15}$

17) $10^{5} \cdot 10^{3} - (10^{1})^{8}$

$= 10^{8} - 10^{8}$

$= 0$

18) $7^{2}(7^{4} \cdot 7^{4})$

$= 7^{2}(7^{8})$

$= 7^{10}$

$= 282,475,249$

Section 10.3- Quotient of Powers

Simplify the expression. Write your answer as a power.

19) $\frac{7^{6}}{7^{5}} = 7$

20) $\frac{(-21)^{15}}{(-21)^{9}} = (-21)^{6}$

21) $\frac{(3.9)^{20}}{(3.9)^{10}} = (3.9)^{10}$

22) $\frac{8^{7} \cdot 8^{4}}{8^{9}} = \frac{8^{11}}{8^{9}} = 8^{2}$

Simplify the expression.

23) $\frac{k \bullet 3^9}{3^5}$ $= k \cdot 3^4$

$= 81k$

24) $\frac{x^4 \bullet y^{10} \bullet 2^{11}}{y^8 \bullet 2^7}$ $= x^4 \cdot y^2 \cdot 2^4$

$= 16x^4y^2$

Section 10.4 – Introduction to Negative and Zero Powers

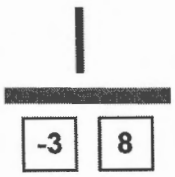
As we did in class, draw the resulting figure or image that is a result of the following:

25) $\frac{\triangle\triangle\triangle}{\triangle\triangle\triangle} = \frac{1}{1}$

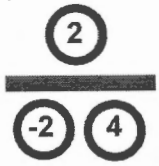
26) $\frac{\boxed{8}\ \boxed{-8}}{\quad} = \frac{1}{\quad}$

27) $\frac{\textcircled{4}}{\textcircled{-2}} = \frac{\textcircled{6}}{1}$

28) $\frac{\triangle_{-3}\ \triangle_{-2}}{\quad} = \frac{1}{\triangle_{5}}$

29) 

$= \frac{1}{15}$

30) 

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

Pg. 432-433 ##1-4, 5-27 odd

1. no; Any nonzero base raised to the zero power is always 1.
2. Use the definition of negative exponents to rewrite it as $\frac{1}{10^3}$. Then evaluate the power to get $\frac{1}{1000}$.
3. $5^{-5}, 5^0, 5^4$
4. Write $(-3) \cdot (-3) \cdot (-3)$ as a power.; $(-3)^3$; 3^{-3}
5. 1
7. 1
9. $\frac{1}{36}$
11. $\frac{1}{16}$
13. $5\frac{1}{4}$
15. $\frac{1}{125}$
17. The negative sign goes with the exponent, not the base. $(4)^{-3} = \frac{1}{4^3} = \frac{1}{64}$
19. 2^0; 10^0

21. $\frac{a^7}{64}$

23. $5b$

25. 12

27. $\frac{w^6}{9}$

Pg. 435 #1-18

1. $(-5)^4$
2. 7^2m^3
3. 625
4. 64
5. 1
6. $\frac{1}{125}$
7. 3^9
8. a^{15}
9. $81c^4$
10. $\frac{4}{49}p^2$
11. 8^3
12. 6^8
13. π^3
14. t^{10}
15. $\frac{8}{d^6}$
16. $\frac{3}{x^2}$
17. **a** 10^{-3} m

    b. 1 millimeter; The length is less than 1 meter and a millimeter is smaller than a meter.
18. 10^5 times

Name:_____ **Answer Key** _____Period_____

Laws of Exponents!

What are the rules?

Rule	Property	Example
Zero Exponent	$x^0 = 1$	$7^0 = 1$
Negative Exponent	$x^{-1} = 1/x$	$4^{-1} = 1/4$
Product of Powers	$x^m x^n = x^{m+n}$	$x^2x^3 = x^{2+3} = x^5$
Quotient of Powers	$\frac{x^m}{x^n} = x^{m-n}$	$x^6/x^2 = x^{6-2} = x^4$

How do I use them?

Expression	Which Rule?	Simplified
x^7x^2	Product of Powers	x^9
$\frac{y^9}{y^5}$	Quotient of Powers	y^4
x^0	Zero Exponent	1
x^{-5}	Negative Exponent	$\frac{1}{x^5}$

You Try!

Expression	Which Rule?	Simplified
z^8z^9	Product of Powers	z^{17}
$\frac{x^{11}}{x^{10}}$	Quotient of Powers	$x^1 = x$
7^{-2}	Negative Exponent	$\frac{1}{7^2} = \frac{1}{49}$
y^0	Zero Exponent	$y^0 = 1$
w^3w^3	Product of Powers	w^6

Name:_____ **Answer Key** _____Period_____

Laws of Exponents - Practice

Expression	Simplified
1. a^5a^4	a^9
2. $\frac{c^{14}}{c^9}$	c^5
3. 4^{-3}	$\frac{1}{64}$
4. y^0	1
5. d^9d^8	d^{17}
6. $\frac{b^{13}}{b^{12}}$	b
7. $\frac{h^5}{h^5}$	1
8. $x^{11}x^{13}$	x^{24}
9. g^7g^{-4}	g^3
10. $\frac{m^{15}}{m^8}$	m^7
Challenge Problems:	
11. $c^5c^9c^6$	c^{20}
12. $\frac{x^5y^4}{x^2}$	x^3y^4
13. $\frac{x^9y^7}{x^4y^3}$	x^5y^4
14. $xy^4 \bullet x^6y^5$	x^7y^9
15. $x^3x^9x^{11}x^{-4}$	x^{19}

Name:_____ **Answer Key** _____Period_____

More Laws of Exponents!

Rule	Laws of Exponents	Example
Power of a Product	$(xy)^n = x^n y^n$	$(xy)^3 = x^3y^3$
Power of a Quotient	$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$	$\left(\frac{x}{y}\right)^2 = \frac{x^2}{y^2}$
Power of a Power	$(x^m)^n = x^{mn}$	$(x^2)^3 = x^{2*3} = x^6$

Practice! Name the rule that applies to each expression below and simplify.

Expression	Rule	Simplified
$\left(\frac{2}{p}\right)^3$	Power of a Quotient	$\frac{8}{p^3}$
$(x^5)^2$	Power of a Power	x^{10}
$(xy)^4$	Power of a Product	x^4y^4
$(ab)^8$	Power of a Product	a^8b^8
$\left(\frac{t}{3}\right)^2$	Power of a Quotient	$\frac{t^2}{8}$
$(y^8)^8$	Power of a Power	y^{64}
$(4^1)^3$	Power of a Power	64
$(yz)^6$	Power of a Product	y^6z^6
$\left(\frac{x}{y}\right)^0$	Power of a Quotient	1
$(3m)^3$	Power of a Product	$27m^3$

Name:_____**Answer Key**_____Period_____

More Laws of Exponents - Practice

Directions: Simplify each expression.

1. $(x^4x^7)^2 = x^{22}$

2. $(xy)^9 = x^9y^9$

3. $(b^{11}b^8)^3 = b^{57}$

4. $\left(\frac{a}{b}\right)^5 = \frac{a^5}{b^5}$

5. $(c^6c^3)^6 = c^{54}$

6. $\left(\frac{x^5}{y^2}\right)^3 = \frac{x^{15}}{y^6}$

7. $\left(\frac{c}{7}\right)^2 = \frac{c^2}{49}$

8. $\left(\frac{x^5}{y^2}\right)^3 = \frac{x^{15}}{y^6}$

9. $(2b^4)^3 = 8b^{12}$

10. $(2^2)^3 = 64$

11. $(1 \bullet 3)^4 = 81$

12. $\left(\frac{3}{5}\right)^3 = \frac{27}{125}$

13. $(2^2 \bullet 3^2)^2 = 1296$

14. $\left(\frac{d^3}{c^4}\right)^2 = \frac{d^6}{c^8}$

15. $\left(\frac{a^5}{b^7}\right)^3 = \frac{a^{15}}{b^{21}}$

16. $(3^2 \bullet 1^7)^2 = 81$

17. $(2x^7)^4 = 16x^{28}$

18. $\left(\frac{x^5y^4}{x^2y}\right)^2 = x^6y^6$

Pg. 440 #3-8, 10, 12-27(x3)

3. 5,600,000,000,000

4. 0.00000000021

5. 87,300,000,000,000,000

6. yes; The factor is greater than or equal to 1 and less than 10. The power of 10 has an integer exponent.

7. yes; The factor is greater than or equal to 1 and less than 10. The power of 10 has an integer exponent.

8. no; The factor is less than 1.

10. no; The factor is greater than 10.

12. yes; The factor is greater than or equal to 1 and less than 10. The power of 10 has an integer exponent.

15. 70,000,000

18. 0.00027

21. 1,660,000,000

24. The negative exponent means the decimal point will move left, not right, when the number is written in standard form. $4.1 \times 10^{-6} = 0.0000041$

27. **a.** Bellatrix

b. Betelgeuse

Pg. 446 #3-27 (x3)

3. 2.1×10^{-3}

6. 6.25×10^{-6}

9. 4.56×10^{10}

12. The decimal point moved 5 places to the right, so the exponent should be negative. 3.6×10^{-5}

15. 6.09×10^{-5}, 6.78×10^{-5}, 6.8×10^{-5}

18. 7.6×10^{-15}, 9.9×10^{-15}, 1.01×10^{-14}

21. 4.01×10^{7} m

24. 0.02, $\frac{5}{241}$, 2.1×10^{-2}

27. 1.99×10^{9} watts

Pg. 452 – 453 #23 –28, #3, 6, 7–27 odd, 28

3. 8.34×10^{7}

6. 2.79×10^{8}

7. 5.8×10^{5}

9. 5.2×10^{8}

11. 7.555×10^{7}

13. 1.037×10^{7}

15. You have to rewrite the numbers so they have the same power of 10 before adding; 3.03×10^{9}

17. 2.9×10^{-3}

19. 1.5×10^{0}

21. 2.88×10^{-7}

23. 1.12×10^{-2}

25. 4.006×10^{9}

27. 1.962×10^{8} cm

Name Key Date

CHAPTER 10 TEST Review- Exponents and Scientific Notation

Section 10.1- Exponents

Evaluate the expression.

1. $(-7)^4 = (-7)(-7)(-7)(-7)$ = 2,401

2. $-\left(\frac{1}{6}\right)^5$ (negative stays) = $-\frac{1}{7,776}$

3. $2 + 7 \times (-3)^2$
$2 + 7 \times 9$
$2 + 63$
65

4. Describe what is meant by the expression $(-3)^n$. (-3) is multiplied n times.

How is this different from the expression -3^n The opposite of 3^n, this answer will be the opposite it will be negative.

Section 10.2 and 10.3 – Product and Quotient of Powers Property

Simplify the expression. Write your answer as a power.

5. $(-6)^5 \cdot (-6)^4 = (-6)^{5+4} = (-6)^9$

6. $(y^{10})^{20} = y^{10 \times 20} = y^{200}$

Simplify the expression.

8. $(-4b)^4 = 256b^4$

9. $\left(\frac{9}{10p^4}\right)^2 = \frac{81}{10^2 p^{4 \times 2}} = \frac{81}{100p^8}$

10. $\left(-\frac{2}{9}\right)^2 = \frac{4}{81}$

11. $\frac{x^{12}y^8}{3^3x^5y^9}$ $\frac{x^{12-5}}{27\ y^{9-8}}$ $= \frac{x^7}{27y}$

Section 10.4- Zero and negative Exponents

Simplify. Write the expression using only positive exponents.

13. $19x^{-6}$ $\frac{19}{x^6}$

14. $\frac{16m^{-5}}{m^{-8}}$ $16m^3$

15. $3t^6 \cdot 8t^{-6}$ 24

16. $m^{-2} \cdot n^3$ $\frac{n^3}{m^2}$

17. $\frac{9c^3}{c^{-6}}$ $9c^{3-6}$
$9c^{3+6}$
$9c^9$

18. $\frac{7x^3}{2x^{-9}}$ $\frac{7x^{3--9}}{2} = \frac{7x^{12}}{2}$

Section 10.5 and 10.6- Reading and Writing Scientific Notation

Tell whether the number is written in scientific notation. Explain.

19. 14×10^8

No. The factor should be between 1 and less than 10

20. 4.79×10^{-8}

Yes. It is a correct factor and exponent is an integer.

Write the number in standard form.

21. 2×10^{-5}

0.00002
1 2 3 4 5

22. 3.7×10^6

3,700,000
1 2 3 4 5 6

23. 4.12×10^{-3}

0.00412
1 2 3

24. 7.62×10^{10}

76,200,000,000

25. Light travels at 3×10^8 meters per second.

a. Write the speed of light in standard form.

300,000,000

b. How far has light traveled after 5 seconds?

$3 \times 10^8 \times 5$

$\boxed{15 \times 10^8}$

Write the number in scientific notation.

26. 9,600,000 9.6×10^6

27. 0.0027 2.7×10^{-3}

28. 0.0000404 4.04×10^{-5}

29. 75,010,000,000 7.501×10^{10}

30. A patient has 0.0000075 gram of iron in 1 liter of blood. The normal level is between 6×10^{-7} gram and 1.6×10^{-5} gram. Is the patient's iron level normal? Write the patient's amount of iron in scientific notation.

7.5×10^{-6} Yes, that is in the normal range.

Section 10.7- Operations in Scientific Notation

Evaluate and write your answer in scientific notation.

31. $(6.7 \times 10^5) - (4.3 \times 10^5)$

Base is the same

$10^5(6.7 - 4.3)$

$10^5(2.4) = \boxed{24 \times 10^5}$

32. $(8.9 \times 10^{-3}) - (1.9 \times 10^{-3})$

$(8.9 - 1.9) \times 10^{-3}$

$\boxed{7 \times 10^{-3}}$

33. $(2 \times 10^4) + (7.2 \times 10^5)$

*Base not the same

$(2 \times 10) + (72 \times 10)$

$\times 10$

34. $(3.2 \times 10^{-3}) + (9.4 \times 10^{-2})$

$(3.2 \times 10^{-3}) + (94 \times 10^{-3})$

97.2×10^{-3}

9.72×10^{-2}

35. $(6 \times 10^8) \times (4 \times 10^6)$

$(6 \times 4)(10^8 \times 10^6)$

24×10^{14}

2.4×10^{15}

36. $(9 \times 10^{-3}) \times (9 \times 10^{-3})$

81×10^{-6}

8.1×10^{-5}

37. $(8 \times 10^3) \div (2 \times 10^2)$

$(8 \div 2) \times (10^3 \div 10^2)$

4×10^1

38. $(2.34 \times 10^5) \div (7.8 \times 10^5)$

$(2.34 \div 7.8) \times (10^5 \div 10^5)$

$0.3 \times 10^0 = .3 \times 1$

3×10^{-1}

39. How many times greater is the radius of a basketball than the radius of a marble?

Radius = 1.143×10^1 cm

Radius = 5×10^{-1} cm

basketball / marble

$\frac{1.143 \times 10^1}{5 \times 10^{-1}}$

$.2286 \times 10^2$

about 22 times

Other helpful review for the Chapter 10 test:

40. 25% of 220

$.25 \times 220 = 55$

41. 5% of 20,000

$.05 \times 20{,}000 = 1{,}000$

42. 80% of 3.2×10^3

$.80 \times 3.2 \times 10^3$

2.56×10^3

43. 9% of 5×10^6

$.09 \times 5 \times 10^6$

$.45 \times 10^6$

4.5×10^5