EXPONENTS

FINAL REVIEW

Name_____

Exponents and Division

Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $\dfrac{5^4}{5}$

2) $\dfrac{3}{3^3}$

3) $\dfrac{2^2}{2^3}$

4) $\dfrac{2^4}{2^2}$

5) $\dfrac{3r^3}{2r}$

6) $\dfrac{7k^2}{4k^3}$

7) $\dfrac{10p^4}{6p}$

8) $\dfrac{3b}{10b^3}$

9) $\dfrac{8m^3}{10m^3}$

10) $\dfrac{7n^3}{2n^5}$

11) $\dfrac{2n^2}{n}$

12) $\dfrac{8x^3}{10x^5}$

13) $\dfrac{12x^3}{9y^8}$

14) $\dfrac{14x^4y^7}{6x^5y^4}$

15) $\dfrac{11u^4}{17u^7v^9}$

16) $\dfrac{4y^4}{14yx^8}$

17) $\dfrac{12yx^4}{10yx^8}$

18) $\dfrac{18x^8y^8}{10x^3}$

19) $\dfrac{5n^8}{20n^8}$

20) $\dfrac{16yx^4}{9x^8y^2}$

Name_____

Exponents and Division

Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $\dfrac{5^4}{5}$

5^3

2) $\dfrac{3}{3^3}$

$\dfrac{1}{3^2}$

3) $\dfrac{2^2}{2^3}$

$\dfrac{1}{2}$

4) $\dfrac{2^4}{2^2}$

2^2

5) $\dfrac{3r^3}{2r}$

$\dfrac{3r^2}{2}$

6) $\dfrac{7k^2}{4k^3}$

$\dfrac{7}{4k}$

7) $\dfrac{10p^4}{6p}$

$\dfrac{5p^3}{3}$

8) $\dfrac{3b}{10b^3}$

$\dfrac{3}{10b^2}$

9) $\dfrac{8m^3}{10m^3}$

$\dfrac{4}{5}$

10) $\dfrac{7n^3}{2n^5}$

$\dfrac{7}{2n^2}$

11) $\dfrac{2n^2}{n}$

$2n$

12) $\dfrac{8x^3}{10x^5}$

$\dfrac{4}{5x^2}$

13) $\dfrac{12x^3}{9y^8}$

$\dfrac{4x^3}{3y^8}$

14) $\dfrac{14x^4y^7}{6x^5y^4}$

$\dfrac{7y^3}{3x}$

15) $\dfrac{11u^4}{17u^7v^9}$

$\dfrac{11}{17u^3v^9}$

16) $\dfrac{4y^4}{14yx^8}$

$\dfrac{2y^3}{7x^8}$

17) $\dfrac{12yx^4}{10yx^8}$

$\dfrac{6}{5x^4}$

18) $\dfrac{18x^8y^8}{10x^3}$

$\dfrac{9x^5y^8}{5}$

19) $\dfrac{5n^8}{20n^8}$

$\dfrac{1}{4}$

20) $\dfrac{16yx^4}{9x^8y^2}$

$\dfrac{16}{9x^4y}$

Kuta Software - Infinite Pre-Algebra

Name_____

Exponents and Multiplication

Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $4^2 \cdot 4^2$

2) $4 \cdot 4^2$

3) $3^2 \cdot 3^2$

4) $2 \cdot 2^2 \cdot 2^2$

5) $2n^4 \cdot 5n^4$

6) $6r \cdot 5r^2$

7) $2n^4 \cdot 6n^4$

8) $6k^2 \cdot k$

9) $5b^2 \cdot 8b$

10) $4x^2 \cdot 3x$

11) $6x \cdot 2x^2$

12) $6x \cdot 6x^3$

13) $7v^3 \cdot 10u^3v^5 \cdot 8uv^3$

14) $9xy^2 \cdot 9x^5y^2$

15) $6m^3n^3 \cdot 8m^2n^3$

16) $6x^2 \cdot 6x^3y^4$

17) $7u^2v^5 \cdot 9uv^3$

18) $uv \cdot 4uv^5$

19) $10xy^3 \cdot 8x^5y^3$

20) $3u^4v^5 \cdot 7u^2v^3$

21) $\left(2x^2\right)^2$

22) $\left(p^4\right)^4$

23) $\left(k^3\right)^4$

24) $\left(7k\right)^2$

25) $\left(x^2\right)^3$

26) $\left(2b^2\right)^4$

Name_____

Exponents and Multiplication

Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $4^2 \cdot 4^2$

4^4

2) $4 \cdot 4^2$

4^3

3) $3^2 \cdot 3^2$

3^4

4) $2 \cdot 2^2 \cdot 2^2$

2^5

5) $2n^4 \cdot 5n^4$

$10n^8$

6) $6r \cdot 5r^2$

$30r^3$

7) $2n^4 \cdot 6n^4$

$12n^8$

8) $6k^2 \cdot k$

$6k^3$

9) $5b^2 \cdot 8b$

$40b^3$

10) $4x^2 \cdot 3x$

$12x^3$

11) $6x \cdot 2x^2$

$12x^3$

12) $6x \cdot 6x^3$

$36x^4$

13) $7v^3 \cdot 10u^3v^5 \cdot 8uv^3$

$560v^{11}u^4$

14) $9xy^2 \cdot 9x^5y^2$

$81x^6y^4$

15) $6m^3n^3 \cdot 8m^2n^3$

$48m^5n^6$

16) $6x^2 \cdot 6x^3y^4$

$36x^5y^4$

17) $7u^2v^5 \cdot 9uv^3$

$63u^3v^8$

18) $uv \cdot 4uv^5$

$4u^2v^6$

19) $10xy^3 \cdot 8x^5y^3$

$80x^6y^6$

20) $3u^4v^5 \cdot 7u^2v^3$

$21u^6v^8$

21) $\left(2x^2\right)^2$

$4x^4$

22) $\left(p^4\right)^4$

p^{16}

23) $\left(k^3\right)^4$

k^{12}

24) $(7k)^2$

$49k^2$

25) $\left(x^2\right)^3$

x^6

26) $\left(2b^2\right)^4$

$16b^8$

Name_____

Powers of Products and Quotients   Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $\left(3a^2\right)^3$

2) $\left(2n^4\right)^4$

3) $\left(3x^4\right)^4$

4) $\left(6b^2\right)^2$

5) $\left(7y^4\right)^2$

6) $\left(3ab^4\right)^4$

7) $\left(2x^4y^4\right)^3$

8) $\left(5mn^3\right)^3$

9) $\left(x^2y^2\right)^2$

10) $\left(6yx^4\right)^2$

11) $\left(u^4v^3\right)^2$

12) $\left(2x^4y^4\right)^4$

13) $\left(3x^2 \cdot 2x^2\right)^2$

14) $\left(2p^3 \cdot 2p\right)^2$

15) $\left(4n^3 \cdot n^2\right)^2$

16) $\left(3x \cdot 2x\right)^2$

17) $\left(4x^4 \cdot x^4\right)^3$

18) $\left(4n^4 \cdot n\right)^2$

Name_____

Powers of Products and Quotients

Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $\left(3a^2\right)^3$

   $27a^6$

2) $\left(2n^4\right)^4$

   $16n^{16}$

3) $\left(3x^4\right)^4$

   $81x^{16}$

4) $\left(6b^2\right)^2$

   $36b^4$

5) $\left(7y^4\right)^2$

   $49y^8$

6) $\left(3ab^4\right)^4$

   $81a^4b^{16}$

7) $\left(2x^4y^4\right)^3$

   $8x^{12}y^{12}$

8) $\left(5mn^3\right)^3$

   $125m^3n^9$

9) $\left(x^2y^2\right)^2$

   x^4y^4

10) $\left(6yx^4\right)^2$

   $36y^2x^8$

11) $\left(u^4v^3\right)^2$

   u^8v^6

12) $\left(2x^4y^4\right)^4$

   $16x^{16}y^{16}$

13) $\left(3x^2 \cdot 2x^2\right)^2$

   $36x^8$

14) $\left(2p^3 \cdot 2p\right)^2$

   $16p^8$

15) $\left(4n^3 \cdot n^2\right)^2$

   $16n^{10}$

16) $\left(3x \cdot 2x\right)^2$

   $36x^4$

17) $\left(4x^4 \cdot x^4\right)^3$

   $64x^{24}$

18) $\left(4n^4 \cdot n\right)^2$

   $16n^{10}$

DIVIDING EXPONENTS

Simplify

1. $\dfrac{12x^5}{3x^2}$

2. $\dfrac{-24cd^3}{-6cd}$

3. $\dfrac{36m^6}{4m^2}$

4. $\dfrac{28m^2n^5}{-7m^2n^3}$

5. $\dfrac{54a^8}{-6a^2}$

6. $\dfrac{-32a^3b^6}{-4a^3b^2}$

7. $\dfrac{30p^4q^5}{3p^2q^2}$

8. $\dfrac{-52b^3}{-13b^2}$

9. $\dfrac{36r^6s^4}{8r^2s^2}$

10. $\dfrac{-45x^8y^5}{15x^4y^2}$

11. $\dfrac{-35p^9q^6}{-14p^3q^2}$

Simplify. Show your work

12. $\dfrac{\left(3a^4b^2\right)\left(6ab^3\right)}{9a^3b^4}$

13. $\dfrac{\left(4m^4n^2\right)\left(6m^2n^4\right)}{-3m^6n^6}$

14. $\dfrac{\left(-9x^3y^6\right)\left(8x^7y^4\right)}{\left(2x^2y^3\right)\left(-6x^3y\right)}$

15. $\dfrac{\left(-7a^2b^4\right)\left(4a^3b^5\right)}{\left(-2ab^2\right)^3}$

16. $\dfrac{\left(2xy^2\right)^3\left(3x^5y^4\right)}{4x^2y^5}$

17. $\dfrac{\left(-3p^2q^5\right)\left(-4pq^3\right)^2}{8p^4q^4}$

18. $\dfrac{\left(-5x^4y^5\right)^2\left(2xy^2\right)^3}{\left(10x^3y^8\right)^2}$

19. $\dfrac{\left(-4m^2n^4\right)^3\left(-3m^3n\right)^2}{\left(-6m^2n^3\right)^2}$

20. $\dfrac{\left(3a^6b^2\right)^2\left(-2a^2b^4\right)^3}{\left(6ab\right)^2\left(-2a^4b\right)}$

Answers

1) $4x^3$	2) $4d^2$	3) $9m^4$	4) $-4n^2$	5) $-9a^6$	6) $8b^4$	7) $10p^2q^3$	8) $4b$	9) $\dfrac{9r^4s^2}{2}$	10) $-3x^4y^3$
11) $\dfrac{5p^6q^4}{2}$	12) $2a^2b$	13) -8	14) $6x^5y^6$	15) $\dfrac{7a^2b^3}{2}$	16) $6x^6y^5$	17) $-6q^7$	18) $2x^5$	19) $-16m^8n^8$	20) $a^{12}b^{13}$

NEGATIVE EXPONENTS

1. 2^2

2. 2^1

3. 2^0

Rewrite with positive exponents then evaluate

4. 2^{-1}

5. 2^{-2}

6. 2^{-3}

7. $-2^0 \cdot 9$

8. $(-2)^1$

9. $(-2)^2$

10. $(-2)^{-1}$

11. $(-2)^{-2}$

12. $\dfrac{1}{5^{-2}}$

13. $\dfrac{1}{(-2)^{-3}}$

14. 4^{-2}

15. $(-6)^{-2}$

16. $(-10)^{-3}$

17. $\dfrac{1}{9^{-2}}$

18. $\dfrac{(-7)^{-2}}{1^{-3}}$

19. $\dfrac{(-3)^{-2}}{(-2)^{-3}}$

20. $\dfrac{2^{-5}}{4^{-2}}$

21. $\dfrac{(-9)^{-2}}{(-3)^{-3}}$

Rewrite with positive exponents

22. a^{-3}

23. $x^2 c^{-4}$

24. $\dfrac{1}{x^{-3}}$

25. $\dfrac{1}{b^{-2}c^3}$

26. $-4x^{-2}$

27. $a^{-3}c^0 x^4$

28. $\dfrac{8c^{-2}}{d}$

29. $\dfrac{-10a^{-1}}{c^{-2}}$

30. $\dfrac{(-2)^0 r^{-2}}{x^{-3}}$

31. $5^{-2}x^2$

32. $(-4)^2 a^{-2}$

33. $\dfrac{(-2)^{-3}a^4}{b^{-2}}$
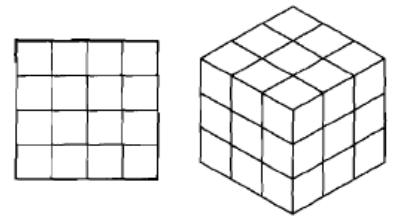
34. $\dfrac{x^4 b^{-1}}{3^{-2}a^2}$

35. $\dfrac{4^{-2}x^2 c^{-3}}{5^{-2}b^{-2}}$

36. $\dfrac{(-2)^{-3}a^{-4}c}{4^{-2}xe^{-3}}$

Answers

1) 4	2) 2	3) 1	4) $\dfrac{1}{2}$	5) $\dfrac{1}{4}$	6) $\dfrac{1}{8}$	7) -9	8) -2	9) 4	10) $-\dfrac{1}{2}$	11) $\dfrac{1}{4}$	12) 25
13) -8	14) $\dfrac{1}{16}$	15) $\dfrac{1}{36}$	16) $\dfrac{-1}{1000}$	17) 81	18) $\dfrac{1}{49}$	19) $\dfrac{-8}{9}$	20) $\dfrac{1}{2}$	21) $\dfrac{-1}{3}$	22) $\dfrac{1}{a^3}$	23) $\dfrac{x^2}{c^4}$	24) x^3
25) $\dfrac{b^2}{c^3}$	26) $\dfrac{-4}{x^2}$	27) $\dfrac{x^4}{a^3}$	28) $\dfrac{8}{c^2 d}$	29) $\dfrac{-10c^2}{a}$	30) $\dfrac{x^3}{r^2}$	31) $\dfrac{x^2}{25}$	32) $\dfrac{16}{a^2}$	33) $\dfrac{-a^4 b^2}{8}$	34) $\dfrac{9x^4}{a^2 b}$	35) $\dfrac{25x^2 b^2}{16c^3}$	36) $\dfrac{-2e^3 c}{a^4 x}$

Exponents and Powers

Investigation: Consider the figures.

1.   What are the names of these figures?

2.   How can we express the dimensions of these figures as repeated multiplication?

3.   How can we express the dimensions of these figures using powers?

4.   In the expression $-7\,x^6$, the base is _____, the exponent is _____ and the coefficient is _____.

5.   How are the expressions $(2x)^5$ and $2x^5$ different? Write each as repeated multiplication.

6.   Fill in the blanks.

Word Form	Repeated Multiplication	Exponential Form	Standard Form
two cubed			
	$5 \times 5 \times 5 \times 5$		
		$(1)^6$	
Fifth power of -1			
	$(-3) \times (-3)$		
Ten to the exponent five			

7) Use a calculator to determine which power is larger. Use the x^y key or the ^ key.

a. 0.5^3 or 0.3^5

b. $(-2.1)^2$ or -2.1^2

c. 4.6^7 or $(-5.1)^6$

8) Evaluate for $z = 3$. Remember to show the substitution step.

a. $6z^2 - 16$

b. $3z^3 \times 2z^2$

c. $3z^4 - 9$

9) Evaluate when $x = 5$ and $y = 4$. Remember to show the substitution step.

a. $4x^2 + y^2$

b. $(2xy)^3 - x^2 y$

c. $2xy^2 - x\sqrt{y}$

The Exponent Rules

To multiply powers with the same base, add the exponents. $\boxed{y^m \times y^n = y^{m+n}}$

To divide powers with the same base, subtract the exponents. $\boxed{y^m \div y^n =^{m-n}}$

To raise a power to a power, multiply the exponents. $\boxed{(y^m)^n = y^{m \times n}}$

1) Write as a single power, then evaluate.

a. $4^7 \div 4 =$

b. $\frac{7^5}{7^2} =$

c. $3^8 \div (3^2)^3 =$

d. $9^5 \times \frac{9^3}{9} =$

2) Find the value of x.

a. $3^5 \times 3^x = 3^{10}$

b. $5^8 \div 5^x = 5$

c. $(6^4)^x = 6^{12}$

d. $2^x \times 2^4 = 2^5$

3) Which is true? Do not use a calculator.

a. $3^4 + 3^5 = 3^9$

b. $3^3 \times 3^4 = 3^{12}$

c. $3^{10} \div 3^2 = 3^5$

d. $3^5 \div 3^3 = 3^2$

Working with Exponents

4) Complete the chart.

Exponential Form	Repeated Multiplication	Standard Form
$(-3)^5 \div (-3)^2$		
		-125
	$\dfrac{(-4) \times (-4) \times (-4)}{(-4)}$	

5) The standard forms of $(-2)^4$ and -2^4 are not the same. Use repeated multiplication to explain why this is true.

6) Write as a single power then evaluate:

a. $((-4.5)^2)^3$

b. $(3.2)^3(3.2)^6$

c. $\dfrac{(-7)^9}{(-7)^7}$

d. $\dfrac{1.8^5}{(1.8^2)^2}$

7) Is each statement true or false? Correct the false statements. Do not use calculators.

a. $6(-2)^3 = 48$

b. $(-a)^4 \div (-a)^2 = a^2$

c. $(-5)^3 \div (-5)^2 = 5$

d. $y^2 \times y^4 = y^6$
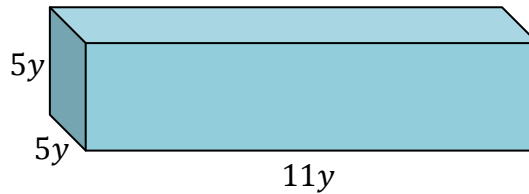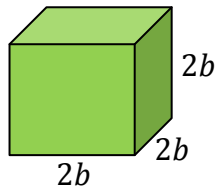
8) Evaluate for $s = -2$ and $t = -4$.

a. $-3st$

b. $-2s^2 - 5t$

c. $\sqrt{-t} + s^3$

d. $3s^4 + \dfrac{8}{t^2}$

Investigate:

2b   5y

2b

2b

5y

11y

1. Write the volume of each prism in expanded form as $V = l \times w \times h$.

     a. $V =$ _____ $\times$ _____ $\times$ _____   b. $V =$ _____ $\times$ _____ $\times$ _____

2. Write the volume of each prism using exponents instead of repeated multiplication.

     a. $V =$ _____   b. $V =$ _____

3. Use exponent laws to simplify your answers.

     a. $V =$ _____   b. $V =$ _____

To simplify powers with coefficients & variables, find the power of the coefficient and of each variable.

For example: $\begin{aligned}(2x^2y^3)^4 &= (2)^4(x^2)^4(y^3)^4 \\ &= 2^4 \times x^8 \times y^{12} \\ &= 16x^8y^{12}\end{aligned}$ In general: $(x^m y^n)^a = x^{am} y^{an}$

$\left(\dfrac{x^m}{y^n}\right)^a = \dfrac{x^{am}}{y^{an}}, \; y \neq 0$

9) Simplify.

a. $(5k^3m^5)^2$

b. $(-4x^4yz^8)^3$

c. $\left(\dfrac{4m^2n^7}{3}\right)^4$

d. $(-p^5q^2)^6$

10) Multiple Choice: Simplify the expression $(-7p^4q^3)^2$.

A. $-7p^6q^5$ B. $14p^8q^6$ C. $-49p^6q^5$ D. $49p^8q^6$ E. $-14p^6q^5$

11) Simplify.

a. $(-2ab)(-a^3b)^2$ b. $(5s^2t^2)^4(-st)$ c. $\left(\frac{4mp}{3}\right)^3\left(-\frac{p^2}{6}\right)$ d. $(-xy)^2(3xz^2)^2(-6x^3y)$

12) Explain the error in each case and correct it.

a. $(-8x^2y^2)^2 = -64x^4y^4$

b. $(5a)(3a) = 15a$

c. $(3p^2q^5)^6 = 9p^8q^{11}$

13) Complete the chart.

Division	Expand and Divide	Exponent Rule
$2^4 \div 2^4$	$\frac{2\times2\times2\times2}{2\times2\times2\times2} = ?$	$\frac{2^4}{2^4} = 2^{4-4} = ?$
$3^2 \div 3^2$		
$4^3 \div 4^3$		
$10^4 \div 10^4$		
$x^5 \div x^5$		

a) How do the two answers in each row compare? _____

b) What is the value of 5^0? 7^0? y^0? _____

c) What is the value of any (non-zero) number raised to the exponent 0? _____

d) What is the value of 0^0? _____

Rule: Any base (except zero) raised to the exponent 0 equals 1. $\boxed{x^0 = 1, \ x \neq 0}$

14) Evaluate without calculators. Hint: the answers are not all 1!

a. $\left(\frac{1}{2}\right)^0$ 　　　　　　b. $\frac{3^0}{9}$ 　　　　　　c. $(-5)^0$ 　　　　　　d. -5^0

15) Complete the chart.

Division	Expand and Reduce	Exponent Rule
$2^3 \div 2^5$	$\dfrac{2 \times 2 \times 2}{2 \times 2 \times 2 \times 2 \times 2} = \dfrac{1}{2^2}$	$\dfrac{2^3}{2^5} = 2^{3-5} = 2^{-2}$
$3^2 \div 3^6$		
$5 \div 5^3$		
$10^4 \div 10^5$		
$x^5 \div x^9$		

a) How do the two answers in each row compare? _____

b) State another way to write 3^{-2}, 4^{-3} and 1^{-4} _____

c) Write a rule for writing a number with a negative exponent. _____

_____

16) Evaluate without a calculator. Show your work. Leave answers in fraction form.

　a. 2^{-4} 　　　　b. 5^{-2} 　　　　c. 3^{-3} 　　　　d. 4^{-2} 　　　　e. 1^{-7}

Rule: Any base (except zero) raised to a negative exponent equals $\boxed{x^{-m} = \dfrac{1}{x^m}, \ x \neq 0}$

　　　the reciprocal of that power but with a positive exponent.

17) Evaluate without calculators. Give exact answers as reduced fractions or integers.

a. 4^{-3} 　　　　b. $(-3)^{-2}$ 　　　　c. $2^0 - 2^{-2}$ 　　　　d. $8^4 \div 8^6 \times 8$

18) Simplify. Write as a single power with a positive exponent.

a. $t^3 \times t^{-5}$ 　　　　b. $(c^2)^{-2} \div c$ 　　　　c. $y^{-5} \times y^3 \div y^{-8}$ 　　　　d. $a^{-2} \div (a^{-4})^{-1}$

19) Find the missing value of y.

a. $5^y \times 5^9 \div 5^2 = 1$

b. $(-y)^{-3} = -\dfrac{1}{1000}$

c. $-5^2 \times 5^{-2} = y$

d. $\dfrac{(-5)^y}{(-2)^2} = \dfrac{1}{4}$

20) Evaluate. Leave answers as reduced fractions. Hint: write fractions as division!

a. $\dfrac{1}{4^{-1}} + \dfrac{1}{2^{-1}}$

b. $\dfrac{3^{-1}}{6^{-1}}$

c. $-\dfrac{2^{-3}}{7^{-1}}$

d. $\dfrac{-2^3}{3^{-2}}$

Rule: Any fractional base raised to a negative exponent equals

$$\left(\frac{x}{y}\right)^{-m} = \left(\frac{y}{x}\right)^{m}, \; x \neq 0, \; y \neq 0$$

the **reciprocal** of the fraction but with a positive exponent.

Verify: Show that $\left(\dfrac{2}{3}\right)^{-2} = \left(\dfrac{3}{2}\right)^{2}$ using a calculator and also using exponent rules.

21) Evaluate. Give exact answers as reduced fractions. Hint: watch for common bases!

a. $\left(\dfrac{3}{4}\right)^{-1}$

b. $\left(\dfrac{-4}{5}\right)^{-2}$

c. $\left(\dfrac{1}{2}\right)^{-3} \times 2^{-4}$

d. $\left(\dfrac{3}{7}\right)^{5} \left(\dfrac{3}{7}\right)^{-7}$

22) Decide whether each of the following statements is *always true*, *sometimes true*, or *never true*, and under what conditions.

a. Two powers in which the exponents are both -2 have equal values.

b. $(-x)^2 = (+x)^2$ for any x

c. $(y)^{-x} = (-y)^x$

Answers Page 1:

1) square & cube,

2) Square $= 4\times 4$, cube $= 3\times 3\times 3$,

3) . 4^2, 3^3

4) base is x, exponent is 6, coefficient is -7

5) $(2x)^5 = (2x)(2x)(2x)(2x)(2x) = 32x^5$

$2x^5 = 2\cdot x\cdot x\cdot x\cdot x\cdot x = 2x^5$

6)

Word Form	Repeated Multiplication	Exponential Form	Standard Form
two cubed	$2\times 2\times 2$	2^3	8
Fourth power of 5	$5\times 5\times 5\times 5$	5^4	625
Sixth power of 1	$1\times 1\times 1\times 1\times 1\times 1$	$(1)^6$	1
Fifth power of -1	$(-1)(-1)(-1)(-1)(-1)$	$(-1)^5$	-1
Negative 3 squared	$(-3)\times(-3)$	$(-3)^2$	9
Ten to the exponent five	$10\times 10\times 10\times 10\times 10$	10^5	100 000

7a) 0.5^3 b. $(-2.1)^2$ c. 4.6^7 8a) 38,   b) 1458   c) 234

9a) 116   b. 63 900   c. 150

Answers Page 2:

1a) $4^6 = 4096$ **b)** $7^3 = 343$ **c)** $3^2 = 9$ **d)** $9^7 = 4\,782\,969$

2a) $5 + x = 10$ b) $8 - x = 5$ c) $4x = 12$ d) $x + 4 = 5$

$x = 5$ $x = 3$ $x = 3$ $x = 1$

3a) False, there are no exponent rules for sums of powers, use BEDMAS instead

$81 + 243 = 324$

b) False, When multiplying powers ADD the exponents

$3^3 \times 3^4 = 3^7$

c) False, When dividing powers, SUBTRACT the exponents

$3^{10} \div 3^2 = 3^8$

d) True

4)

Exponential Form	Repeated Multiplication	Standard Form
$(-3)^5 \div (-3)^2$	$\dfrac{(-3)(-3)(-3)(-3)(-3)}{(-3)(-3)}$	$(-3)^3 = -27$
$(-5)^3$	$(-5)(-5)(-5)$	-125
$(-4)^3 \div (-4)$	$\dfrac{(-4)\times(-4)\times(-4)}{(-4)}$	$(-4)^2 = 16$

5) $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

$-2^4 = -1 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

Answers pg 3:

6a) $(-4.5)^6 = 8303.765625$ b) $(3.2)^9 = 35184.37209$ c) $(-7)^2 = 49$ d) $1.8^1 = 1.8$

7a) $6(-8) = -48$
$\therefore$ *False*

b) $(-a)^2 = a^2$
$\therefore$ *True*

c) $(-5)^1 = -5$
$\therefore$ *False*

d) $y^6 = y^6$
$\therefore$ *True*

8a) -24   b) 12   c) -6   d) 48.5

Investigate 1a) $V = 2b \times 2b \times 2b$,   b) $V = 11y \times 5y \times 5y$ 2a) $V = (2b)^3$ b) $V = 11 \times 5^2 \times y^3$

3a) $V = 8b^3$ b) $V = 275y^3$

9a) $25k^6m^{10}$ b) $-64x^{12}y^3z^{24}$ c) $\dfrac{256m^8n^{28}}{81}$ d) $p^{30}q^{12}$

Answers pg 4:

10) $D. \, 49p^8q^6$

11a) $-2a^7b^3$ b) $-625s^9t^9$ c) $\dfrac{-32m^3p^5}{81}$ d) $-54x^7y^3z^4$

12a) $(-8)(-8) = 64$ b) $(a)(a) = a^2$ c) $3^6p^{12}q^{30} = 729p^{12}q^{30}$

13)

Division	Expand and Divide	Exponent Rule
$2^4 \div 2^4$	$\frac{2\times2\times2\times2}{2\times2\times2\times2} = 1$	$\frac{2^4}{2^4} = 2^{4-4} = 2^0$
$3^2 \div 3^2$	$\frac{3\times3}{3\times3} = 1$	$3^{2-2} = 3^0$
$4^3 \div 4^3$	$\frac{4\times4\times4}{4\times4\times4} = 1$	$4^{3-3} = 4^0$
$10^4 \div 10^4$	$\frac{10\times10\times10\times10}{10\times10\times10\times10} = 1$	$10^{4-4} = 10^0$
$x^5 \div x^5$	$\frac{x\cdot x\cdot x\cdot x\cdot x}{x\cdot x\cdot x\cdot x\cdot x} = 1$	$x^{5-5} = x^0$

Page 5 answers:

14) 1   b) $\dfrac{1}{9}$ c) 1   d) -1

15)

Division	Expand and Reduce	Exponent Rule
$2^3 \div 2^5$	$\dfrac{2 \times 2 \times 2}{2 \times 2 \times 2 \times 2 \times 2} = \dfrac{1}{2^{\boxed{2}}}$	$\dfrac{2^3}{2^5} = 2^{3-5} = 2^{\boxed{-2}}$
$3^2 \div 3^6$	$\dfrac{3 \times 3}{3 \times 3 \times 3 \times 3 \times 3 \times 3} = \dfrac{1}{3^4}$	$3^{2-6} = 3^{-4}$
$5 \div 5^3$	$\dfrac{5}{5 \times 5 \times 5} = \dfrac{1}{5^2}$	$5^{1-3} = 5^{-2}$
$10^4 \div 10^5$	$\dfrac{10 \times 10 \times 10 \times 10}{10 \times 10 \times 10 \times 10 \times 10} = \dfrac{1}{10}$	$10^{4-5} = 10^{-1}$
$x^5 \div x^9$	$\dfrac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x} = \dfrac{1}{x^4}$	$x^{5-9} = x^{-4}$

a) The must be equal

b) $3^{-2} = \dfrac{1}{3^2}$, $4^{-3} = \dfrac{1}{4^3}$, $1^{-4} = \dfrac{1}{1^4}$

c) To make the exponent positive take the reciprocal of the BASE.

16) $2^{-4} = \dfrac{1}{2^4} = \dfrac{1}{16}$ b) $5^{-2} = \dfrac{1}{5^2} = \dfrac{1}{25}$ c) $3^{-3} = \dfrac{1}{3^3} = \dfrac{1}{27}$ d) $4^{-2} = \dfrac{1}{4^2} = \dfrac{1}{16}$ e) $1^{-7} = \dfrac{1}{1^7} = 1$

17) $\dfrac{1}{4^3} = \dfrac{1}{64}$ b) $\dfrac{1}{(-3)^2} = \dfrac{1}{9}$ c) $1 - \dfrac{1}{4} = \dfrac{3}{4}$ d) $8^{4-6+1} = 8^{-1} = \dfrac{1}{8}$

18) $\dfrac{1}{t^2}$ b) $\dfrac{1}{c^5}$ c) y^6 d) $\dfrac{1}{a^6}$

Page 6 answers:

19) $y = -7$ b) $y = 10$ c) $y = -1$ d) $y = 0$

20) 6   b) 2   c) $-\dfrac{7}{8}$ d) -72

21) $\dfrac{4}{3}$ b) $\dfrac{25}{16}$ c) $\dfrac{1}{2}$ d) $\dfrac{49}{9}$

22a) $3^{-2} \neq 4^{-2}$
$\therefore$ *False*
   b) $(-3)^2 = (3)^2$
$\therefore$ *True*
   c) $(y)^{-x} = \dfrac{1}{y^x}$
$\therefore$ *False*