EXPONENT RULES & PRACTICE

1. **PRODUCT RULE:** To multiply when two bases are the same, write the base and ADD the exponents.

$$x^m \cdot x^n = x^{m+n}$$

Examples:

A. $x^3 \cdot x^8 = x^{11}$ B. $2^4 \cdot 2^2 = 2^6$ C. $(x^2y)(x^3y^4) = x^5y^5$

2. **QUOTIENT RULE:** To divide when two bases are the same, write the base and SUBTRACT the exponents.

$$\frac{x^m}{x^n} = x^{m-n}$$

Examples:

A. $\frac{x^5}{x^2} = x^3$ B. $\frac{3^5}{3^3} = 3^2$ C. $\frac{x^2y^5}{xy^3} = xy^2$

3. **ZERO EXPONENT RULE:** Any base (except 0) raised to the zero power is equal to one.

$$x^0 = 1$$

Examples:

A. $y^0 = 1$ B. $6^0 = 1$ C. $(7a^3b^{-1})^0 = 1$

4. **POWER RULE:** To raise a power to another power, write the base and MULTIPLY the exponents.

$$(x^m)^n = x^{m \cdot n}$$

Examples:

A. $(x^3)^2 = x^6$ B. $(3^2)^4 = 3^8$ C. $(z^5)^2 = z^{10}$

FOIL

$(x+y)^2 = x^2 + 2xy + y^2$

5. EXPANDED POWER RULE:

$$(xy)^m = x^m y^n \qquad \left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$$

Examples:

A. $(2a)^3 = 2^3a^3 = 8a^3$

B. $(6x^3)^2 = 6^2(x^3)^2 = 36x^6$

C. $\left(\frac{x^2}{y}\right)^4 = \frac{(x^2)^4}{y^4} = \frac{x^8}{y^4}$

D. $\left(\frac{2x}{3y^2}\right)^3 = \frac{(2x)^3}{(3y^2)^3} = \frac{2^3x^3}{3^3(y^2)^3} = \frac{8x^3}{27y^6}$

E. $(x+3)^2 =$
$(x+3)(x+3) = x^2 + 6x + 9$

6. NEGATIVE EXPONENTS: If a factor in the numerator or denominator is moved across the fraction bar, the sign of the exponent is changed.

$$x^{-m} = \frac{1}{x^m} \qquad \frac{1}{x^{-m}} = x^m \qquad \left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$$

Examples:

A. $x^{-3} = \frac{1}{x^3}$

B. $4^{-2} = \frac{1}{4^2} = \frac{1}{16}$

C. $-4x^5y^{-2} = \frac{-4x^5}{y^2}$

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

E. $(3x^{-2}y)(-2xy^{-3}) = -6x^{-1}y^{-2} = \frac{-6}{xy^2}$

F. $\frac{a^{-2}b^3}{c^{-4}d^{-1}} = \frac{b^3c^4d}{a^2}$

G. $(-2x^2y^{-4})^{-2} = \left(\frac{-2x^2}{y^4}\right)^{-2} = \left(\frac{y^4}{-2x^2}\right)^2 = \frac{y^8}{4x^4}$

CAUTION: $-x \neq \frac{1}{x}$ For example: $-3 \neq \frac{1}{3}$

REMEMBER: An exponent applies to only the factor it is directly next to *unless* parentheses enclose other factors.

Examples:

A. $(-3)^2 = (-3)(-3) = 9$

B. $-3^2 = -9$

Name________________________________ Period __________

EXPONENTS PRACTICE

Simplify:

1. $3 \cdot 4^3$ $= 192$
2. $4x^3 \cdot 2x^3$ $8x^6$
3. $x^5 \cdot x^3$
4. $2x^3 \cdot 2x^2$
5. $\frac{6^5}{6^3}$
6. $\frac{x^4}{x^7}$

15. $\frac{x^5y^6}{xy^2}$

16. $\frac{x^2y^5}{xy^4}$

17. $\left(\frac{4x^5y}{16xy^4}\right)^3$ $\left(\frac{1x^4}{4y^3}\right)^3 = \frac{1x^{12}}{4^3y^9}$

18. $\left(\frac{5x^3y}{20xy^5}\right)^4$

19. y^{-7} $\frac{1}{y^7}$

20. 7^{-2}

27. $\frac{x^{-1}}{x^{-8}}$

28. $\frac{52x^6}{13x^{-7}}$ $4x^{13}$

29. $f^{-3}(f^3)(f^{-3})$

30. $\frac{x^{-4}}{x^{-9}}$ $\frac{x^9}{x^4} = x^5$

7. 8^0

8. $-(9x)^0$

9. $(y^4)^3$

10. $(x^2y)^4$

11. $\frac{6x^7}{2x^4}$

12. $\frac{8x^5}{4x^2}$

13. $(2cd^4)^2(cd)^5$

$2^2c^2d^8 \cdot c^5d^5 = \boxed{4c^7d^{13}}$

14. $(2fg^4)^4(fg)^6$

21. $\frac{1}{x^{-5}}$

22. $\frac{1}{2^{-4}}$

23. $x^5 \cdot x^{-1}$

24. x^{-6}

25. $x^9 \cdot x^{-7}$

26. $(j^{-13})(j^4)(j^6)$

$j^{-13+4+6} = j^{-3} = \boxed{\frac{1}{j^3}}$

31. $\frac{24x^6}{12x^{-8}}$

32. $\frac{3x^2y^{-3}}{12x^6y^3}$ $\frac{1}{4}$

$\boxed{\frac{1}{4x^4y^6}}$

33. $(2x^3y^{-3})^{-2}$

34. $\frac{2x^4y^{-4}}{8x^7y^3}$

35. $(4x^4y^{-4})^3$

36. $5x^2y(2x^4y^{-3})$ $\frac{y}{y^3}$

$\frac{10x^6}{y^2}$

37. $\left(\frac{-7a^2b^3\cancel{c^0}}{3a^3b^4c^3}\right)^{-4}$

$\left(\frac{-7}{3abc^3}\right)^{-4}$ $\frac{3^4a^4b^4c^{12}}{(-7)^4}$

38. $\left(\frac{-2a^3b^2c^0}{3a^2b^3c^7}\right)^{-2}$

SECONDARY MATH II // MODULE 3
SOLVING QUADRATICS & OTHER EQUATIONS - 3.2

3.2

READY, SET, GO! Name Period Date

READY

Topic: Simplifying Radicals

A very common radical expression is a square root. One way to think of a square root is the number that will multiply by itself to create a desired value. For example: $\sqrt{2}$ is the number that will multiply by itself to equal 2. And in like manner $\sqrt{16}$ is the number that will multiply by itself to equal 16, in this case the value is 4 because 4 x 4 = 16. (When the square root of a square number is taken you get a nice whole number value. Otherwise an irrational number is produced.)

This same pattern holds true for other radicals such as cube roots and fourth roots and so forth. For example: $\sqrt[3]{8}$ is the number that will multiply by itself three times to equal 8. In this case it is equal to the value of 2 because $2^3 = 2 \times 2 \times 2 = 8$.

$x^2 \rightarrow \sqrt[2]{\ }$
$x^3 \rightarrow \sqrt[3]{\ }$

With this in mind radicals can be simplified. See the examples below.

Example 1: Simplify $\sqrt{20}$ $\sqrt{20} = \sqrt{4 \cdot 5} = \sqrt{2 \cdot 2 \cdot 5} = \boxed{2\sqrt{5}}$	*Example 2*: Simplify $\sqrt[5]{96}$ $\sqrt[5]{96} = \sqrt[5]{2^5 \cdot 3} = 2\sqrt[5]{3}$ $\boxed{2\sqrt[5]{3}}$

20: 2, 10: 2, 5

96: 2, 48: 2, 8 ... 4: 2, 3; 2, 2

Simplify each of the radicals.

SHOW WORK

1. $\sqrt{40} = \boxed{2\sqrt{10}}$

40: 4, 10; 2, 2, 2, 5

2. $\sqrt{50}$

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

4. $\sqrt{72}$

5. $\sqrt[4]{81}$

6. $\sqrt{32}$

$2 \cdot 2\sqrt{2}$

$4\sqrt{2}$

32: 4, 8; 2, 2; 4, 2; 2, 2

check
$\sqrt{32} = 5.657$
$4\sqrt{2} = 5.657$ ✓

7. $\sqrt[5]{160}$

$\sqrt[5]{2^5 \cdot 5}$

$\boxed{2\sqrt[5]{5}}$

160: 2, 80: 2, 40: 2, 20: 2, 10: 2, 5

8. $\sqrt{45}$

9. $\sqrt[3]{54}$

SET

Topic: Finding arithmetic and geometric means and making meaning of rational exponents

You may have found arithmetic and geometric means in your prior work. Finding arithmetic and geometric means requires finding values of a sequence between given values from non-consecutive terms. In each of the sequences below determine the means and show how you found them.

+ −

Find the *arithmetic* means for the following. Show your work.

10.

x	1	2	3
y	5		11

+3 +3

+6 /2

11.

x	1	2	3	4	5
y	18				-10

12.

x	1	2	3	4	5	6	7
y	12						-6

Find the *geometric* means for the following. Show your work.

13.

x	1	2	3
y	3		12

14.

x	1	2	3	4
y	7			875

$875 \div 7 = 125$

$\sqrt[3]{125} = 5$

15.

x	1	2	3	4	5	6
y	4					972

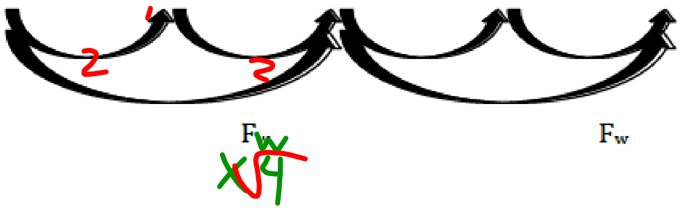
Fill in the tables of values and find the factor used to move between whole number values, F_w, as well as the factor, F_c used to move between each column of the table.

16.

x	0	½	1	3⁄2	2
y	4		16		

d. $F_w = 4$

e. $F_c = 2$



SECONDARY MATH II // MODULE 3

SOLVING QUADRATICS & OTHER EQUATIONS – 3.2

3.2

$4\cdot 2^{1/2}$ $\quad$ $4\cdot(\sqrt{2})^3$ $\quad$ $4\cdot 2^{3/2}$

17.

x	0	½	1	3/2	2
y	4	$4\sqrt{2}$	8	$8\sqrt{2}$	

d. $F_w = 2$

e. $F_c = \sqrt{2}$

$\sqrt{2}$ $\quad$ $\sqrt{2}$ $\quad$ $\sqrt{2}$

$2^{1/2} = \sqrt{2}$ $\quad$ $\sqrt{2}$

2 F_w $\qquad$ F_w

18.

x	0	½	1	3/2	2
y	5	$5\sqrt{3}$	15	$15\sqrt{3}$	45

d. $F_w =$

e. $F_c =$

$\sqrt{3}$ $\quad$ $\sqrt{3}$

3 F_w $\qquad$ 3 F_w

GO

GO

Topic: Simplifying Exponents

Estimating exponents

Find the desired values for each function below.

19. $f(x) = 2x - 7$ Find $f(-3)$ $5^0=1$ Find $f(x) = 21$ Find $f\left(\frac{1}{2}\right)$	20. $g(x) = 3^x(2)$ Find $g(-4)$ Find $g(x) = 162 = 3^x(2)$ $81 = 3^x$ $\boxed{x=4}$ $3 \cdot 3 \cdot 3 \cdot 3$ Find $g\left(\frac{1}{2}\right)$	21. $I(t) = 210(1.08^t)$ Find $I(12) = 210(1.08)^{12}$ $= 528.82$ Find $I(t) = 420$ $420 = 210(1.08)^t$ $2 = 1.08^t$ $t \sim 9$ Find $I\left(\frac{1}{2}\right)$
22. $h(x) = x^2 + x - 6$ Find $h(-5)$ Find $h(x) = 0$ Find $h\left(\frac{1}{2}\right)$	23. $k(x) = -5x + 9$ Find $k(-7)$ Find $k(x) = 0$ Find $k\left(\frac{1}{2}\right)$	24. $m(x) = (5^x)2$ Find $m(-2) = (5^{-2})2 = \boxed{\frac{2}{25}}$ Find $m(x) = \frac{1}{2}$ $= 5^x(2)$ $\frac{1}{2}$ $5^x = \frac{1}{4}$ $\sim -.43$ Find $m\left(\frac{1}{2}\right) = (5^{\frac{1}{2}})2$

$5^{-1}=.2$
between -1 -- 0
$5^0=1$
$5^1=5$
$5^2=25$

Interim 1