Warm Up

Express each as a radical then evaluate:

a) $(32)^{\frac{3}{5}}$

$(\sqrt[5]{32})^3$

$(2)^3$

8

b) $(729)^{\frac{2}{3}}$

$\sqrt[3]{729}^2$

9^2

81

Express each as a power:

a) $\sqrt[5]{184}$

$184^{\frac{1}{5}}$

b) $(\sqrt[3]{54})^4$

index exponent

$54^{\frac{4}{3}}$

c) $(\sqrt[4]{8^2})$

$8^{\frac{2}{4}}$

Express each in simplest radical form:(Entire to Mixed)

a) $\sqrt{112}$

$= \sqrt{16 \times 7}$

$= \sqrt{16}\,\sqrt{7}$

$4\sqrt{7}$

b) $\sqrt[3]{1536}$

$\sqrt[3]{512 \times 3}$

$\sqrt[3]{512} \times \sqrt[3]{3}$

$8\sqrt[3]{3}$

Write the radical for the power and evaluate: (Use calculator but show work)

a) $64^{\frac{2}{3}}$

$= (\sqrt[3]{64})^2$

$= (4)^2$

$= 16$

b) **$7776^{\frac{3}{5}}$** ex, index

$(\sqrt[5]{7776})^3$

$= 6^3$

$= 216$

Worksheet Exponent Laws

1) $2v^4 \cdot 3u^4v^3 \cdot 3u^2v^2$

$2 \cdot 3 \cdot 3 \; v^4v^3v^2 \; u^4u^2$

$18 \quad v^9 \quad u^6$

2) $4y^3 \cdot 4y^2$

$4 \cdot 4 \; y^3y^2$

$16 \; y^5$

3) $2x^2(2yx^3)^2$

$2x^2 \; 2^2y^2 \; x^6$

$2 \cdot 2^2 \; x^2 \; y^2 \; x^6$

$8 \; x^8y^2$

4) $y^4 \cdot (2x^3y^2)^4$

$= y^4 \; 2^4x^{12}y^{16}$

$= 2^4 y^4 y^{16} x^{12}$

$= 16 \; y^{20} x^{12}$

5) $\frac{3m^{-1}n^2}{m^{-3}n^{-1}}$ watch signs

$3 \; m^{-1--3} \; n^{2--1}$

$3 \; m^{-1+3} \; n^{2+1}$

$3 \; m^2 \; n^3$

6) $\frac{4u^4v^2}{4v^{-2}}$ watch signs

$= \frac{4}{4} \; u^4 \; v^{2--2}$

$= 1 \; u^4 \; v^{2+2}$

$= 1 \; u^4v^4$

7) $\left(\frac{b^2 \cdot b^1}{b^{-2}}\right)^2$

$= \left(\frac{b^3}{b^{-2}}\right)^2$

$= \left(b^{3--2}\right)^2$

$= \left(b^{3+2}\right)^2$

$= \left(b^5\right)^2$

$= b^{10}$

8) $\frac{(a^{-2}b^3)^{-1} \cdot 2a^4b^3}{2a}$

$= \frac{a^2b^{-3} \; 2a^4b^3}{2a}$

$= \frac{2a^2a^4 \; b^{-3}b^3}{2a}$

$= \frac{2a^6 \; b^0}{2a^1}$

$= \frac{2}{2} \; a^{6-1} \; b^0$

$= 1 \; a^5 \; 1$

$= a^5$

9) $\left(\frac{m^3n^1 \cdot m^2n^3}{m^4n^{-1}}\right)^2$

$= \left(\frac{m^5 \; n^4}{m^4 \; n^{-1}}\right)^2$

$= \left(m^{5-4} \; n^{4--1}\right)^2$ watch signs

$= \left(m^1 \; n^5\right)^2$

$= m^2 \; n^{10}$

10) $\frac{x^4y^{-2}}{(2y^4)^{-2}yx^0}$ labeled

$= \frac{x^4y^{-2}}{(2y^4)^{-2}y}$

$= \frac{x^4y^{-2}}{2^{-2}y^{-8}y^1}$

$= \frac{x^4y^{-2}}{2^{-2}y^{-7}}$

$= \frac{x^4 \; y^{-2--7}}{2^{-2}}$ add opp

$= \frac{x^4 \; y^{-2+7}}{2^{-2}}$

$= \frac{x^4 \; y^5}{2^{-2}}$ leave for now but we will talk about (-) exponents today

Any Homework Questions?

page 227

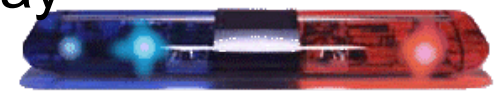
3(adf),4(acd), 5(abc), 6ac), 8a,b,c, 9, 12(a,b,c), 15

From Last Day

LAWS OF EXPONENTS

From Last Day

Laws Of Exponents



Law #1: Product Rule

$$b^m \times b^n = b^{m+n}$$

- when multiplying powers with the **same** base you add the exponents

Exercise:

Simplify the following using the laws of exponents

a) $3^2 \times 3^4$ **b)** $4^3 \times 3^4$ **c)** $(q^7)(q)$ **d)** $p \times p^3 \times p^2$

e) $(2x^3)(4x^2)$ **f)** $(3z^3)(6z^{12})$

From Last Day

Law #2: Quotient Rule

$$b^m \div b^n = b^{m-n}$$

- when dividing powers with the **same** base you subtract the exponents

Exercise:

Simplify the following using exponent laws

a) $5^{23} \div 5^{12}$

b) $\dfrac{x^{34}}{x^{19}}$

c) $c^3 \div e^2$

d) $\dfrac{12x^3}{4x}$

e) $\dfrac{25c^{30}}{5c^{23}}$

From Last Day

Law #3: Power Rule

when raising a power to another power...MULTIPLY the exponents."

$$(b^m)^n = b^{mn}$$

Law #4: Power of Product

When raising a product to a power ...each factor needs to have the exponent applied to them (remember to multiply their exponents)

$$(ab)^m = a^m b^m$$

- when brackets are involved you must multiply the exponents

Exercise:

Simplify the following using Laws of Exponents

a) $(m^3)^4$ b) $(x^2y^4)^3$ c) $(2d^3)^3$ d) $(2m^4n)^2(m^3n^2)$

Law #5: Power of Quotient Rule

From Last Day

When raising a quotient to an exponent....applied exponent to bot top and bottom (Remember to multiply exponents)

$$\left(\frac{a}{b}\right)^n = \left(\frac{a^n}{b^n}\right)$$

Law #6: Zero Rule

$$b^0 = 1$$

- any power raised to the exponent 0 (zero) is equal to 1

NEW

Law #7a: Negative Reciprocals

$$x^{-n} = \frac{1}{x^n}$$

Ex) $\frac{3x^4}{y^{-2}}$ ← write reciprocal (put on top)

$= 3x^4y^2$

Examples:

$\frac{6^{-2}}{1} = \frac{1}{6^2} = \frac{1}{36}$

remember the reciprocal of

$\frac{1}{2}$ is 2

so

2^{-1} is the reciprocal of 2^1

NEW

Law #7b: Negative Reciprocals

$$\frac{1}{x^{-n}} = x^n$$

Examples:

$$\frac{1}{5^{-3}} = 5^3 = 125$$

Ex) Simplify $\frac{12x^8y^{11}}{x^{13}y^2}$ Leave with positive exponents

$= 12x^{8-13}y^{11-2}$

$= 12x^{-5}y^9$

$= \frac{12y^9}{x^5}$

Law #7c: Negative Reciprocal Quotient NEW

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b^n}{a^n}\right)$$

$\left(\frac{a}{b}\right)^{-n} = \frac{a^{-n}}{b^{-n}} = \frac{b^n}{a^n}$

Flip fraction and exponent is now positive

- now apply exponent law for quotient

Examples:

$$\left(\frac{3}{4}\right)^{-3} = \left(\frac{4}{3}\right)^{3}$$

$\frac{3^{-3}}{4^{-3}}$ ← neg switch positions

$= \frac{4^3}{3^3}$

Example 1 Evaluating Powers with Negative Integer Exponents

Evaluate each power.

a) 3^{-2} b) $\left(-\frac{3}{4}\right)^{-3}$ c) 0.3^{-4}

b) $\left(-\frac{3}{4}\right)^{-3}$

Evaluate each power without using a calculator.

a) $8^{-\frac{2}{3}}$ b) $\left(\frac{9}{16}\right)^{-\frac{3}{2}}$

SOLUTION

a) $8^{-\frac{2}{3}} =$ Write with a positive exponent

$\left(\frac{8}{1}\right)^{-\frac{2}{3}} = \left(\frac{1}{8}\right)^{\frac{2}{3}}$

$= \frac{\left(\sqrt[3]{1}\right)^2}{\left(\sqrt[3]{8}\right)^2}$

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

$= \frac{1}{4}$

OR

neg exponent write reciprocal & make it pos

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

$= \frac{1}{8^{\frac{2}{3}}}$

$= \frac{1}{\left(\sqrt[3]{8}\right)^2}$

$= \frac{1}{2^2} = \frac{1}{4}$

$$\left(\frac{x^4}{y^{-2}}\right)^{-3} = \frac{x^{-12}}{y^6} = \frac{1}{x^{12}y^6}$$

Why it works

$$\frac{x^{-12}}{y^6}\,\frac{x^{12}}{x^{12}} = \frac{x^0}{y^6 x^{12}} = \frac{1}{y^6 x^{12}}$$

Homework

Page 233-234

#3a,b,c,d

#4a,c

#6a,b,c

#7a,b,c,

#9a,c,e,g

#10a,c

~~#12~~

~~#13a,b,d,e~~

$\frac{1}{5^4} = 5^{-4}$

$\left(-\frac{1}{2}\right)^{-3} = (-2)^3$ (flip fraction)

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

$\left(\frac{x^3}{y^7}\right)^{-2} = \left(\frac{y^7}{x^3}\right)^2 = \frac{y^{14}}{x^6}$ (flip fraction)

Test Unit 4 Probably

~~Friday or Monday~~

March 1

4) $4^2 = 16$

$4^{-2} = \frac{1}{4^2} = \frac{1}{16} = 0.0625$

Write the reciprocal for each:

a) 7^{-3} b) 242 c) $\frac{1}{6}$ d) 8^{2}

Simplify the following (Leave your answer with positive exponents):

a) $(3xy^{-2})^{4}$ b) $\frac{(12r^{6}t^{3})}{(3r^{10}t^{2})}$

What is the value of $\left(\frac{a^6b^9}{a^5b^8}\right)^{-2}$ when $a = -3$ and $b = 2$?

b) $\left[\left(-\frac{3}{2}\right)^{-4}\right]^{2} \cdot \left[\left(-\frac{3}{2}\right)^{2}\right]^{3}$