Exponent Laws

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PRE-CALCULUS 11
EXPONENTS
EXPONENT LAWS

A. Grade 10 Exponent Laws

1) Negative Exponents

$$a^{-m} = \frac{1}{a^m}$$

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

b) $(-3)^{-3} = \frac{1}{(-3)^3} = \frac{-1}{27}$

c) $-m^{-4} = \frac{-1}{m^4}$

2) Product of Powers

$$(a^m)(a^n) = a^{m+n}$$

a) $(2^3)(2^2) = 2^{3+2}$
$= 2^5$ or 32

b) $(-3)^{-4}(-3)^6$
$= (-3)^{-4+6} = (-3)^2$ or 9

c) $(x)^{-2}(x)^{-1}$
$= (x)^{-2+-1} = (x)^{-3} = \frac{1}{(x)^3}$

3) Quotient of Powers

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

a) $\frac{4^5}{4^2} = 4^{5-2}$
$= 4^3$ or 64

b) $\frac{a^6}{a^{-4}} = a^{6+-4}$
$= a^{10}$

c) $\frac{(-9)^{-5}}{(-9)^{-3}} = (-9)^{-5+-3}$
$= (-9)^{-2} = \frac{1}{(-9)^2} = \frac{1}{81}$

4) Zero Exponents

$$a^0 = 1$$

a) $5^0 = 1$

b) $-y^0 = -1$

c) $-(-2)^0 = -1$

5) Power of a Power

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

a) $(n^2)^4 = n^{2\cdot 4} = n^8$

b) $(7^3)^4 = 7^{3\cdot 4} = 7^{12}$

c) $(4^2)^9 = 4^{2\cdot 9} = 4^{18}$

6) Power of a Product

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

a) $(3m)^3 = 3^3 m^3 = 27m^3$

b) $(-2m)^4 = (-2)^4 m^4 = 16m^4$

c) $(6a^2bc^3)^2 = 6^2 a^{2\cdot 2} b^2 c^{3\cdot 2} = 36a^4b^2c^6$

7) Power of a Quotient

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

a) $\left(\frac{2}{3}\right)^3 = \frac{(2)^3}{(3)^3} = \frac{8}{27}$

b) $\left(\frac{3m}{4n}\right)^2 = \frac{(3)^2 m^2}{(4)^2 n^2} = \frac{9m^2}{16n^2}$

c) $\left(\frac{4a^{-1}}{5b^3}\right)^{-2} = \frac{(4)^{-2} a^{-1\cdot -2}}{(5)^{-2} b^{3\cdot -2}} = \frac{(4)^{-2} a^2}{(5)^{-2} b^{-6}} = \frac{(5)^2 a^2 b^6}{(4)^2} = \frac{25a^2b^6}{16}$

B. Practice Questions

1) Write the following as a single power and then evaluate.

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

$= 2^{2\cdot3} \times 2^{2\cdot2}$

$= 2^6 \times 2^4$

$= 2^{6+4}$

$= \boxed{2^{10} \text{ or } 1024}$

b) $\dfrac{(-2)^4(-2)^5}{(-2)^2(-2)^4} = \dfrac{(-2)^{4+5}}{(-2)^{2+4}} = \dfrac{(-2)^9}{(-2)^6} = (-2)^{9-6}$

$= \boxed{(-2)^3 \text{ or } -8}$

2) Simplify the following. Do not leave any negative exponents.

a) $c^{-3} \times c^{-2} \div c^{-8}$

$= c^{-3+-2+8}$

$= \boxed{c^3}$

b) $\dfrac{(s)^{-1}(s)^{-3}}{(s)^{-5}(s)^{-3}} = \dfrac{(s)^{-1+-3}}{(s)^{-5+-3}} = \dfrac{(s)^{-4}}{(s)^{-8}}$

$= (s)^{-4++8}$

$= \boxed{(s)^4}$

c) $\dfrac{5x^2y}{10x^{-3}y^{-3}} = \dfrac{1x^{2+3}y^{1+3}}{2}$

$= \boxed{\dfrac{1x^5y^4}{2} \text{ or } \dfrac{x^5y^4}{2}}$

d) $\dfrac{\left(2x^2y\right)^3}{\left(4xy^{-1}\right)^2} = \dfrac{(2)^3x^{2\cdot3}y^3}{(4)^2x^2y^{-1\cdot2}} = \dfrac{(2)^3x^6y^3}{(4)^2x^2y^{-2}}$

$= \dfrac{8x^6y^3}{16x^2y^{-2}} = \dfrac{1x^{6-2}y^{3+2}}{2}$

$= \boxed{\dfrac{1x^4y^5}{2} \text{ or } \dfrac{x^4y^5}{2}}$

Assignment : Exponent Laws Assignment #1 – 24

PRE-CALCULUS 11
EXPONENT LAWS
ASSIGNMENT

A. Simplify the following. Do not leave any negative exponents.

1) $(3x)(2x)$

2) $(-5x^{-1})(3x^4)$

3) $(2m^7n^2)(3m^4n^{-2})$

4) $(4mn^3)(5m^3n^{-1})$

5) $x^7 \div x^3$

6) $m^{-3} \div m^{-4}$

7) $\frac{m^5n^4}{mn^2}$

8) $\frac{x^{-4}y^3}{xy^{-5}}$

9) $\frac{10x^2y}{5x^4y^{-3}}$

10) $\frac{12mn^{-1}}{18m^{-2}n^2}$

11) $(2x^3y)^3$

12) $(3m^{-1}n)^2$

13) $(-4x^{-2}y^{-3})^3$

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

15) $\left(\frac{-5m}{-6n^{-3}}\right)^{-2}$

16) $(5xy^{-1})^3$

17) $\frac{(x^{-2}y^2)^{-2}}{(xy^2)^{-1}}$

18) $\frac{6x^2y^{-2}}{8x^4y^{-4}}$

19) $(-6x^2y^{-2})(-2xy^{-3})^{-2}$

20) $\frac{(2m^{-1}n^3)^{-1}}{(4m^2n^{-2})^{-2}}$

21) $(3x^2y^{-2})^{-2}$

22) $\frac{(-6x^{-2}y^4)^2}{(4x^3y^{-1})^2}$

23) $\frac{4x^3y^{-2}}{2x^3y}$

24) $(x^3y^5)^{-1}(x^3y^2)^2$

Answers

1) $6x^2$

2) $-15x^3$

3) $6m^{11}$

4) $20m^4n^2$

5) x^4

6) m

7) m^4n^2

8) $\frac{y^8}{x^5}$

9) $\frac{2y^4}{x^2}$

10) $\frac{2m^3}{3n^3}$

11) $8x^9y^3$

12) $\frac{9n^2}{m^2}$

13) $\frac{-64}{x^6y^9}$

14) $\frac{8x^6y^3}{27}$

15) $\frac{36}{25m^2n^6}$

16) $\frac{125x^3}{y^3}$

17) $\frac{x^5}{y^2}$

18) $\frac{3y^2}{4x^2}$

19) $\frac{-3y^4}{2}$

20) $\frac{8m^5}{n^7}$

21) $\frac{y^4}{9x^4}$

22) $\frac{9y^{10}}{4x^{10}}$

23) $\frac{2}{y^3}$

24) $\frac{x^3}{y}$