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.
$$v^0 = 1$$

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.
$$(z^5)^2 = z^{10}$$

5. EXPANDED POWER RULE:

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

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

Examples:

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

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

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

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

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

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

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

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

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 <u>only</u> the factor it is directly next to *unless* parentheses enclose other factors.

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

B.
$$-3^2 = -9$$

EXPONENTS PRACTICE

Simplify:

1.
$$3 \cdot 4^3$$

2.
$$4x^3 \cdot 2x^3$$

3.
$$x^5 \cdot x^3$$

4.
$$2x^3 \cdot 2x^2$$

5.
$$\frac{6^5}{6^3}$$

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

8.
$$-(9x)^0$$

9.
$$(y^4)^3$$

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

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

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

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

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

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

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

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

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

19.
$$v^{-7}$$

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

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

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

29.
$$f^{-3}(f^2)(f^{-3})$$

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

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

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

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

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

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

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

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

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

EXPONENTS PRACTICE ANSWERS

17.
$$\frac{x^{12}}{64y^9}$$

18.
$$\frac{x^8}{256y^{16}}$$

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

20.
$$\frac{1}{49}$$

21.
$$x^5$$

23.
$$x^4$$

24.
$$\frac{1}{x^6}$$

25.
$$x^2$$

26.
$$\frac{1}{j^3}$$

27.
$$x^7$$

28.
$$4x^{13}$$

29.
$$\frac{1}{f^4}$$

30.
$$x^5$$

31.
$$2x^{14}$$

32.
$$\frac{1}{4x^4y^6}$$

33.
$$\frac{y^6}{4x^6}$$

34.
$$\frac{1}{4x^3y^7}$$

$$35. \, \frac{64x^{12}}{y^{12}}$$

36.
$$\frac{10x^6}{v^2}$$

$$37.\,\frac{81a^4b^4c^{12}}{2401}$$

$$38. \, \frac{9b^2c^{14}}{4a^2}$$

2.
$$4x^3 \cdot 2x^3$$

3.
$$x^5 \cdot x^3$$

4.
$$2x^3 \cdot 2x^2$$

5.
$$\frac{6^5}{6^3}$$

6.
$$\frac{x}{x^7}$$

7.
$$8^0$$

8.
$$-(9x)^{0}$$

9.
$$(v^4)^3$$

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

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

12.
$$\frac{8x^3}{4x^2}$$

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

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

2.
$$8x^6$$

3.
$$x^8$$

4.
$$4x^5$$

6.
$$\frac{1}{x^3}$$

9.
$$y^{12}$$

10.
$$x^8y^4$$

11.
$$3x^3$$

12.
$$2x^3$$
13. $4c^7d^{13}$

14.
$$16f^{10}g^{22}$$

15.
$$x^4y^4$$