Exponents

Recall:

$2^3 = 2 \cdot 2 \cdot 2 = 8$

exponent

base

$= 4 \cdot 2$

$2^3 = 2 \times 2 \times 2 = 8$

4×2

in general:

$$x^n = \underbrace{x \cdot x \cdots x}_{n \text{ times}}$$

$$x^3 = x \cdot x \cdot x$$

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

$$x^3 \cdot x^5 = \underbrace{(x \cdot x \cdot x)}_{3 \text{ times}} \underbrace{(x \cdot x \cdot x \cdot x \cdot x)}_{5 \text{ times}}$$

$$= \underbrace{x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x}_{8 \text{ times}}$$

$$x^3 \cdot x^5 = x^8$$

$3+5=8$

Multiplication Rule

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

Examples:

1) $x^4 \cdot x^8 = x^{4+8} = x^{12}$

2) $y^3 \cdot y^7 = y^{3+7} = y^{10}$

3) $a^{12} \cdot a^1 = a^{12+1} = a^{13}$

4) $(3x^4)(5x^3)$

$= (3)(5)(x^4)(x^3)$

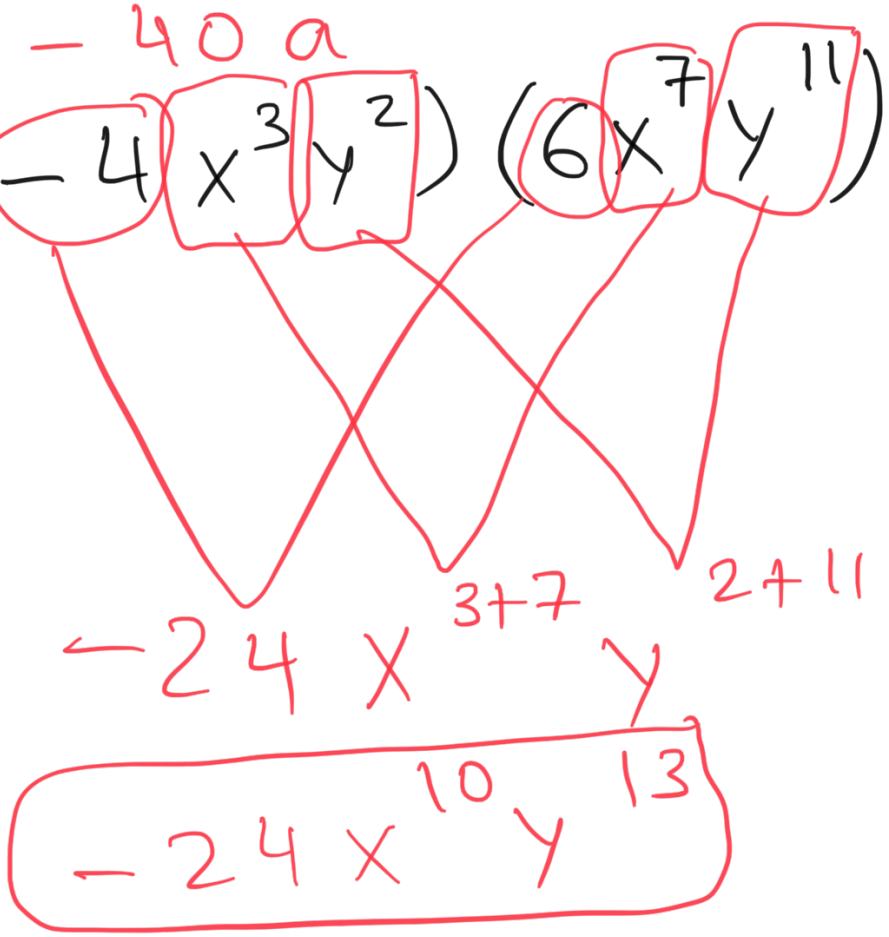
$= 15x^7$

5) $(-8a^7)(5a^5)$

$-40a^{7+5}$

$-40a^{12}$

6) $(-4x^3y^2)(6x^7y^{11})$



Zero Exponent Rule

$a^0 = 1$ for all $a \neq 0$

Examples:

$x^0 = 1$

$4x^0 = 4$ (1)

Division Rule

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

Examples:

1) $\frac{x^8}{x^5} = x^{8-5} = x^3$

2) $\frac{y^{12}}{y^9} = y^{12-9} = y^3$

3) $24x^8$ $8-2$ $24x^6$

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

$= 4x^6$

4) $\frac{-60x^7y^5}{+15x^2y^3}$

$7-2 \quad 5-3$

$= -4x \quad y$

$= \boxed{-4x^5y^2}$

5) $\frac{4a^8b^{12}}{20ab^2}$ (÷4, ÷4)

$= \frac{1a^{8-1}b^{12-2}}{}$

$$= \frac{1}{5} a^{7} b^{10}$$

$$= \frac{a^{7} b^{10}}{5}$$

The Power Rule

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

Examples:

1) $(x^{3})^{5}$

$= x^{3 \cdot 5}$

$= \boxed{x^{15}}$

2) $(y^4)^8$

$= y^{4 \cdot 8}$

$= \boxed{y^{32}}$

3) $(a^2)^7$

$= a^{2 \cdot 7}$

$= a^{14}$

Distributive Property for Multiplication and

Division

$$(x \cdot y)^n = x^n y^n$$

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

Examples:

1) $(x^2 y^3)^4$

$= (x^2)^4 (y^3)^4$

$= x^{2 \cdot 4}$

$= \boxed{x^8 y^{12}}$

2) $(3x^4)^3$

$= (3)^3 (x^4)^3$

$3 \cdot 3 \cdot 3$

$4 \cdot 3$

$= 27x^{12}$

Exercises:

1) $(2a^5)^3 (b^2)^4$

$= (2)^3 (a^5)^3 b^{2 \cdot 4}$

$2 \cdot 2 \cdot 2$ $\quad 5 \cdot 3$ $\quad 8$

$$= 8\,a\ b$$

$$= \boxed{8\,a^{15}\,b^{8}}$$