4.2 Working with Integer Exponents

Laws of Exponents: (when the bases are the same)

1. Multiplying.

$4^3 \times 4^2 = (4 \times 4 \times 4) \times (4 \times 4) = 4^5$ $\quad a^n \times a^m = a^{m+n}$

Law: when multiplying exponents of the same base, add the exponents

2. Dividing:

$$\frac{5^6}{5^2} = \frac{5\times5\times5\times5\times\cancel{5}\times\cancel{5}}{\cancel{5}\times\cancel{5}} = 5^4$$

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

Law: When dividing exponents of the same base, subtract the exponents.

3. Power:

$$\left(3^2\right)^4 = (3\times3)\times(3\times3)\times(3\times3)\times(3\times3) = 3^8$$

Law: When raising to a power, multiply the exponents.

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

4. Zero.

$7^0 = 1$

Why? $\longrightarrow$ $\frac{7^2}{7^2} = \frac{49}{49} = 1$ $\qquad 7^{2-2} = 7^0$

$(200^{100000})^0 = 1$

Law: Anything raised to the power of zero is 1.

5. Negatives.

$4^3 = 64$

$4^2 = 16$

$4^1 = 4$

$4^0 = 1$

÷4 ÷4 ÷4 ÷4

×4

$4^{-3} = \frac{1}{4^3} = \frac{1}{64}$

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

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

÷4

Note:

$$\frac{1}{3^{-2}} = 3^2 = 9$$

Notes: - Always leave your answers with positive exponents.

- Simplify means to rewrite to 1 exponent

- Evaluate means to give a numerical answer.

Ex: Simplify, then evaluate.

① $\dfrac{(2^3)(2^4)}{2^2} = \dfrac{2^7}{2^2} = 2^5 = 32$

② $\dfrac{(3^{-1})^3}{3^{-3}} = \dfrac{3^{-3}}{3^{-3}} = 3^{-3-(-3)} = 3^{-3+3} = 3^0 = 1$

③ $\left[\dfrac{(4^6)(4^3)}{(4^2)(4^7)}\right]^{-2} = \left[\dfrac{4^9}{4^9}\right]^{-2} = (4^0)^{-2}$

$= 4^0 = 1$