

More Properties of Exponents

① $(x^{-2} x^{-3})^4$

$$x^{-8} x^{-12}$$

$$\frac{1}{x^8} \frac{1}{x^{12}}$$

$$\boxed{\frac{1}{x^{20}}}$$

Outside/In

Inside/out

$$(x^{-5})^4$$

$$\frac{x^{-20}}{\boxed{\frac{1}{x^{20}}}}$$

③ $(n^3)^3 2n^{-1}$

$$n^9 2n^{-1}$$

$$2 \frac{n^9}{n^1}$$

$$\boxed{2n^8}$$

$$2n^9 n^{-1}$$

$$\boxed{2n^8}$$

⑤ $2x^2y^4 \cdot 4x^2y^4 \cdot 3x$

$$3x^{-3}y^2$$

$$\frac{2 \cdot 4 \cdot 3}{3}$$

$$\frac{x^2 x^2 x^1}{x^{-3}}$$

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

$$\frac{24}{3}$$

$$\frac{x^5}{x^3} \frac{y^8}{y^2}$$

$$8 x^2 x^3 y^6$$

$$= \boxed{8x^5y^6}$$

$$\begin{aligned} \textcircled{7} \quad \frac{x^3 y^3 \cdot x^3}{4x^2} &= \frac{1}{4} \cdot \frac{x^3 x^3}{x^2} \cdot \frac{y^3}{1} = \frac{1}{4} \frac{x^6}{x^2} \frac{y^3}{1} \\ &= \frac{1}{4} \frac{x^4}{1} \frac{y^3}{1} \\ &= \boxed{\frac{x^4 y^3}{4}} \end{aligned}$$

$$\textcircled{9} \quad \frac{x^1}{(2x^0)^2} = \frac{x^1}{2^2 x^0} = \frac{x^1}{4} = \boxed{\frac{x}{4}}$$

$$\begin{aligned} \textcircled{11} \quad \frac{(2m^2)^{-1}}{m^2} &= \frac{2^{-1} m^{-2}}{m^2} = \frac{1}{2^1} \frac{1}{m^2 m^2} = \frac{1}{2} \frac{1}{m^4} \\ &= \boxed{\frac{1}{2m^4}} \end{aligned}$$

$$\textcircled{13} \quad (a^{-3} b^{-3})^0 = a^0 b^0 = 1 \cdot 1 = \boxed{1}$$

$$\begin{aligned} \textcircled{15} \quad b^1 a^4 \cdot (2^1 b^1 a^4)^{-3} &= b^1 a^4 2^{-3} b^{-3} a^{-12} \\ &= \frac{1}{2^3} \frac{a^4}{a^{12}} \cdot \frac{b^1}{b^3} \\ &= \frac{1}{8} \frac{1}{a^8} \frac{1}{b^2} \\ &= \boxed{\frac{1}{8a^8 b^2}} \end{aligned}$$

$$\begin{aligned} (17) \quad \frac{2^1 k^3 k^2}{k^{-3}} &= 2^1 k^3 k^2 k^3 \\ &= 2^1 k^8 \\ &= \boxed{2k^8} \end{aligned}$$

$$\begin{aligned} (19) \quad \frac{(2^1 x^1)^{-4}}{x^{-1} x^1} &= \frac{2^{-4} x^{-4}}{x^{-1} x^1} = \frac{1}{2^4} \frac{x^1}{x^4 x^1} \\ &= \frac{1}{16} \frac{x^1}{x^5} = \boxed{\frac{1}{16x^4}} \end{aligned}$$

$$\begin{aligned} (21) \quad \frac{(2^1 p^1 m^{-1} q^0)^{-4} 2^1 m^{-1} p^3}{2^1 p^1 q^2} &= \frac{2^{-4} p^{-4} m^4 q^0 2^1 m^{-1} p^3}{2^1 p^1 q^2} \\ &= \frac{2^1}{2^5} \frac{m^4}{m^1} \frac{p^3}{p^1 p^4} \cdot \frac{q^0}{q^2} \\ &= \frac{2^1}{2^5} \frac{m^3}{1} \frac{p^3}{p^5} \frac{1}{q^2} \\ &= \frac{1}{2^4} \frac{m^3}{1} \frac{1}{p^2} \frac{1}{q^2} = \boxed{\frac{m^3}{16p^2 q^2}} \end{aligned}$$