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Simplify and express the following expressions with positive indices.

1. $\frac{(x^4y^{-3})^4}{xy}$

Solution:

$$\begin{aligned}\frac{(x^4y^{-3})^4}{xy} &= \frac{x^{16}y^{-12}}{xy} \\ &= x^{16-1}y^{-12-1} \\ &= x^{15}y^{-13} \\ &= \frac{x^{15}}{y^{13}}\end{aligned}$$

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

Solution:

$$\begin{aligned}\frac{(x^{-5}y^{-4})^{-2}}{x^3y^2} &= \frac{x^{10}y^8}{x^3y^2} \\ &= x^{10-3}y^{8-2} \\ &= x^7y^6\end{aligned}$$

3. $\frac{(x^5y^3)^{-1}}{xy^2}$

Solution:

$$\begin{aligned}\frac{(x^5y^3)^{-1}}{xy^2} &= \frac{x^{-5}y^{-3}}{xy^2} \\ &= x^{-5-1}y^{-3-2} \\ &= x^{-6}y^{-5} \\ &= \frac{1}{x^6y^5}\end{aligned}$$

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

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Solution:

$$\begin{aligned}\frac{(x^{-3}y^{-1})^2}{x^4y} &= \frac{x^{-6}y^{-2}}{x^4y}\\ &= x^{-6-4}y^{-2-1}\\ &= x^{-10}y^{-3}\\ &= \frac{1}{x^{10}y^3}\end{aligned}$$

5. $\frac{(x^4y^{-5})^{-1}}{x^2y^5}$

Solution:

$$\begin{aligned}\frac{(x^4y^{-5})^{-1}}{x^2y^5} &= \frac{x^{-4}y^5}{x^2y^5}\\ &= x^{-4-2}y^{5-5}\\ &= x^{-6}y^0\\ &= \frac{1}{x^6}\end{aligned}$$

6. $\frac{x^{-3}y^{-5}}{(x^2y^{-1})^{-2}}$

Solution:

$$\begin{aligned}\frac{x^{-3}y^{-5}}{(x^2y^{-1})^{-2}} &= \frac{x^{-3}y^{-5}}{x^{-4}y^2}\\ &= x^{-3-(-4)}y^{-5-2}\\ &= x^1y^{-7}\\ &= \frac{x}{y^7}\end{aligned}$$

7. $\frac{x^5y^{-3}}{(x^{-3}y^2)^5}$

Solution:

$$\begin{aligned}\frac{x^5y^{-3}}{(x^{-3}y^2)^5} &= \frac{x^5y^{-3}}{x^{-15}y^{10}}\\ &= x^{5-(-15)}y^{-3-10}\\ &= x^{20}y^{-13}\\ &= \frac{x^{20}}{y^{13}}\end{aligned}$$

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8. $\frac{x^{-4}y^3}{(x^{-3}y^4)^{-2}}$

Solution:

$$\begin{aligned}\frac{x^{-4}y^3}{(x^{-3}y^4)^{-2}} &= \frac{x^{-4}y^3}{x^6y^{-8}} \\ &= x^{-4-6}y^{3-(-8)} \\ &= x^{-10}y^{11} \\ &= \frac{y^{11}}{x^{10}}\end{aligned}$$

9. $\frac{x^{-5}y^3}{(xy^4)^4}$

Solution:

$$\begin{aligned}\frac{x^{-5}y^3}{(xy^4)^4} &= \frac{x^{-5}y^3}{x^4y^{16}} \\ &= x^{-5-4}y^{3-16} \\ &= x^{-9}y^{-13} \\ &= \frac{1}{x^9y^{13}}\end{aligned}$$

10. $\frac{x^3y^3}{(x^3y^{-1})^{-5}}$

Solution:

$$\begin{aligned}\frac{x^3y^3}{(x^3y^{-1})^{-5}} &= \frac{x^3y^3}{x^{-15}y^5} \\ &= x^{3-(-15)}y^{3-5} \\ &= x^{18}y^{-2} \\ &= \frac{x^{18}}{y^2}\end{aligned}$$

11. $\frac{x^{-2}}{y}\left(\frac{y^3}{x^5}\right)^{-2}$

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Solution:

$$\begin{aligned}\frac{x^{-2}}{y}\left(\frac{y^3}{x^5}\right)^{-2} &= \frac{x^{-2}}{y}\cdot\frac{y^{-6}}{x^{-10}}\\ &= x^{-2-(-10)}y^{-6-1}\\ &= x^8y^{-7}\\ &= \frac{x^8}{y^7}\end{aligned}$$

12. $\frac{x^{-2}}{y^2}\left(\frac{y^4}{x}\right)^{-4}$

Solution:

$$\begin{aligned}\frac{x^{-2}}{y^2}\left(\frac{y^4}{x}\right)^{-4} &= \frac{x^{-2}}{y^2}\cdot\frac{y^{-16}}{x^{-4}}\\ &= x^{-2-(-4)}y^{-16-2}\\ &= x^2y^{-18}\\ &= \frac{x^2}{y^{18}}\end{aligned}$$

13. $\frac{x^{-4}}{y^{-1}}\left(\frac{y^2}{x^{-3}}\right)^2$

Solution:

$$\begin{aligned}\frac{x^{-4}}{y^{-1}}\left(\frac{y^2}{x^{-3}}\right)^2 &= \frac{x^{-4}}{y^{-1}}\cdot\frac{y^4}{x^{-6}}\\ &= x^{-4-(-6)}y^{4-(-1)}\\ &= x^2y^5\end{aligned}$$

14. $\frac{x^{-2}}{y^{-4}}\left(\frac{y^2}{x^{-5}}\right)^{-4}$

Solution:

$$\begin{aligned}\frac{x^{-2}}{y^{-4}}\left(\frac{y^2}{x^{-5}}\right)^{-4} &= \frac{x^{-2}}{y^{-4}}\cdot\frac{y^{-8}}{x^{20}}\\ &= x^{-2-20}y^{-8-(-4)}\\ &= x^{-22}y^{-4}\\ &= \frac{1}{x^{22}y^4}\end{aligned}$$

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15. $\frac{x^{-2}}{y^{-1}}\left(\frac{y^5}{x^{-3}}\right)^{-4}$

Solution:

$$\begin{aligned}\frac{x^{-2}}{y^{-1}}\left(\frac{y^5}{x^{-3}}\right)^{-4} &= \frac{x^{-2}}{y^{-1}} \cdot \frac{y^{-20}}{x^{12}} \\ &= x^{-2-12}y^{-20-(-1)} \\ &= x^{-14}y^{-19} \\ &= \frac{1}{x^{14}y^{19}}\end{aligned}$$