Solutions to Sample Quiz

① $(2^1x^{-3}y^1)^{-2} = 2^{-2}x^6y^{-2} = \frac{1}{2^2}\frac{x^6}{1}\frac{1}{y^2} = \boxed{\frac{x^6}{4y^2}}$

Inside/out

② $\left[\frac{(2^1x^3y^1)^5}{6^1x^{-3}y^6}\right]^{-3} = \left[\frac{2^5x^{15}y^5}{6^1x^{-3}y^6}\right]^{-3}$

$= \left[\left[\frac{2^5}{2^13^1}\right]\left[\frac{x^{15}x^3}{1}\right]\left[\frac{1}{y^1}\right]\right]^{-3}$

$= \left[\frac{2^4}{3}\frac{x^{18}}{1}\frac{1}{y}\right]^{-3}$

$= \frac{2^{-12}}{3^{-3}}\frac{x^{-54}}{1}\frac{1}{y^{-3}}$

$= \frac{3^3}{2^{12}}\frac{1}{x^{54}}\frac{y^3}{1} = \boxed{\frac{27y^3}{4096x^{54}}}$

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② $\left[\frac{(2^1x^3y^1)^5}{6^1x^{-3}y^6}\right]^{-3} = \left[\frac{2^5x^{15}y^5}{6^1x^{-3}y^6}\right]^{-3}$ outside/in

$= \frac{2^{-15}x^{-45}y^{-15}}{6^{-3}x^9y^{-18}} = \frac{6^3}{2^{15}}\frac{1}{x^9x^{45}}\cdot\frac{y^{18}}{y^{15}}$

$= \frac{216}{36864}\frac{1}{x^{54}}y^3 = \boxed{\frac{27y^3}{4096x^{54}}}$

(3) $\left[\frac{5^1 x^3 y^{-4}}{15^1 x^{-3} y^1}\right]^{-4} = \frac{5^{-4} x^{-12} y^{16}}{15^{-4} x^{12} y^{-4}} = \frac{15^4}{5^4} \frac{1}{x^{12} x^{12}} \frac{y^{16} y^4}{1}$

outside/in

$= \frac{(3 \cdot 5)^4}{5^4} \frac{1}{x^{24}} \frac{y^{20}}{1}$

$= \frac{3^4 \cdot 5^4}{5^4} \frac{1}{x^{24}} \cdot \frac{y^{20}}{1} = \boxed{\frac{81 y^{20}}{x^{24}}}$

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(3) Inside/out

$\left[\frac{5^1}{15^1} \frac{x^3}{x^{-3}} \frac{y^{-4}}{y^1}\right]^{-4} = \left[\frac{1}{3} \frac{x^3 x^3}{1} \cdot \frac{1}{y^4 y^1}\right]^{-4}$

$= \left[\frac{1}{3} \frac{x^6}{1} \frac{1}{y^5}\right]^{-4}$

$= \left[\left(\frac{1}{3}\right)^{-4} \frac{x^{-24}}{1} \frac{1}{y^{-20}}\right]$

$= \left[\frac{1}{3^{-4}} \frac{1}{x^{24}} \cdot \frac{y^{20}}{1}\right]$

$= \left[\frac{3^4}{1} \frac{1}{x^{24}} \cdot \frac{y^{20}}{1}\right]$

$= \boxed{\frac{81 y^{20}}{x^{24}}}$

④ $\left[\frac{5^1 x^4 y^1}{z^6}\right]^{-2} = \frac{5^{-2} x^{-8} y^{-2}}{z^{-12}} = \boxed{5^{-2} x^{-8} y^{-2} z^{12}}$

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⑤ $\left[\frac{x^9 y^3}{16^1 z^1}\right]^4 = \frac{x^{36} y^{12}}{16^4 z^4} = \boxed{16^{-4} x^{36} y^{12} z^{-4}}$

$= (z^4)^{-4} x^{36} y^{12} z^{-4}$

$= \boxed{z^{-16} x^{36} y^{12} z^{-4}}$

Also acceptable ↑

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⑥ $12 x^4 y^{-3} z^8 = 12 x^4 \frac{1}{y^3} z^8 = \boxed{\frac{12 x^4 z^8}{y^3}}$

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⑦ $16 x^{-4} y^1 z^{-12} = \frac{16}{1}, \frac{1}{x^4}, \frac{y^1}{1}, \frac{1}{z^{12}}$

$= \boxed{\frac{16 y^1}{x^4 z^{12}}}$

⑧ $\left[\dfrac{(3^{v}x^{2}y^{3w})^{0}\cdot(9x^{-3}y^{4})^{-v}}{(12x^{4w}y^{-v})^{-vw}}\right]^{2}$

$\left[\dfrac{3^{0}x^{0}y^{0}\ 9^{-v}x^{3v}y^{-4v}}{12^{-w}x^{-4w^{2}}y^{vw}}\right]^{2}$

Inside/out

$\left[\dfrac{9^{-v}}{12^{-w}}\ \dfrac{x^{3v}}{x^{-4w^{2}}}\ \dfrac{y^{-4v}}{y^{vw}}\right]^{2}$

$\left[\dfrac{12^{w}}{9^{v}}\ \dfrac{x^{3v}x^{4w^{2}}}{1}\ \dfrac{1}{y^{4v}y^{vw}}\right]^{2}$

$\left[\dfrac{12^{w}}{9^{v}}\ \dfrac{x^{3v+4w^{2}}}{1}\ \dfrac{1}{y^{4v+vw}}\right]^{2}$

$\dfrac{12^{2w}}{9^{2v}}\ \dfrac{x^{6v+8w^{2}}}{1}\ \dfrac{1}{y^{8v+2vw}}$

$\boxed{\dfrac{12^{2w}x^{6v+8w^{2}}}{9^{2v}y^{8v+2vw}}}$ or $\boxed{\dfrac{144^{w}x^{6v+8w^{2}}}{81^{v}y^{8v+2vw}}}$

⑧ $\left[\dfrac{(3^v x^2 y^{3w})^0 \cdot (9x^{-3}y^4)^{-v}}{(12x^{4w}y^{-v})^{-w}}\right]^2$

$\left[\dfrac{3^0 x^0 y^0 \; 9^{-v} x^{3v} y^{-4v}}{12^{-w} x^{-4w^2} y^{vw}}\right]^2$ outside/in

$\left[\dfrac{1 \cdot 1 \cdot 1 \; 9^{-v} x^{3v} y^{-4v}}{12^{-w} x^{-4w^2} y^{vw}}\right]^2$

$\dfrac{9^{-2v} x^{6v} y^{-8v}}{12^{-2w} x^{-8w^2} y^{2vw}}$

$\dfrac{12^{2w}}{9^{2v}} \; \dfrac{x^{6v} x^{8w^2}}{1} \; \dfrac{1}{y^{8v} y^{2vw}}$

$\boxed{\dfrac{12^{2w} x^{6v+8w^2}}{9^{2v} y^{8v+2vw}}}$ OR $\boxed{\dfrac{144^w x^{6v+8w^2}}{81^v y^{8v+2vw}}}$