Warm-up

Evaluate:

$0.75 = \frac{75}{100} = \frac{3}{4}$

① $(81)^{0.75}$

$= 81^{3/4}$ ← exp, ← index

$= \left(\sqrt[4]{81}\right)^3$

$= (3)^3$

$= 27$

② $32^{-2/5}$

$= \left(\frac{1}{32}\right)^{2/5}$

$= \frac{1^{2/5}}{32^{2/5}}$

$= \frac{\left(\sqrt[5]{1}\right)^2}{\left(\sqrt[5]{32}\right)^2}$

5 $\sqrt[x]{y}$ 3 2 =

$= \frac{(1)^2}{(2)^2}$

$= \left(\frac{1}{4}\right)$

Important Rules to Remember !!

Exponent Laws

Product of powers:	$a^m \cdot a^n = a^{m+n}$
Quotient of powers:	$a^m \div a^n = a^{m-n}, a \neq 0$
Power of a power:	$(a^m)^n = a^{mn}$
Power of a product:	$(ab)^m = a^m b^m$
Power of a quotient:	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$

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$5^2 \times 5^{11}$

$= 5^{2+11}$

$= 5^{13}$

② $x^5 \cdot x^{-3}$

$= x^{5+(-3)}$

$= x^2$

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① $5^8 \div 5^6$

$= \frac{5^8}{5^6}$

$= 5^{8-6}$

$= 5^2$

$= 25$

② $\frac{x^8}{x^{-10}}$

$= x^{8-(-10)}$

$= x^{18}$

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Power of a power

$(5^8)^3$

$= 5^{8 \cdot 3}$

$= 5^{24}$

② $(y^3)^{-2}$

$= y^{3 \cdot -2}$

$= y^{-6}$

$= \left(\frac{1}{y}\right)^6$

$= \frac{1}{y^6}$

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Power of a product

① $(xy)^3$

$= x^3 y^3$

② $(x^2y)^3$

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

$= x^6 y^3$

③ $(3xy^2)^4$

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

$= 81x^4 y^{2\cdot 4}$

$= 81x^4 y^8$

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Power of a quotient

$$\left(\frac{x}{y}\right)^2$$

$$= \frac{x^2}{y^2}$$

$$\left(\frac{x^8}{y6}\right)^2$$

$$= \frac{(x^8)^2}{(y^6)^2}$$

$$= \frac{x^{8\cdot 2}}{y^{6\cdot 2}}$$

$$= \frac{x^{16}}{y^{12}}$$

More Practice

① $\left(\frac{a^2 b^{-3} c}{y}\right)^{-4}$

$= \left(\frac{y}{a^2 b^{-3} c}\right)^{4}$

$= \frac{(y)^4}{(a^2 b^{-3} c)^4}$

$= \frac{y^4}{(a^2)^4 (b^{-3})^4 c^4}$

$= \frac{y^4}{a^8 b^{-12} c^4}$

$= \boxed{\frac{b^{12} y^4}{a^8 c^4}}$

d) $\dfrac{9^{\frac{5}{4}} \cdot 9^{-\frac{1}{4}}}{9^{\frac{3}{4}}}$

$= \dfrac{9^{\frac{5}{4} + \left(\frac{-1}{4}\right)}}{9^{\frac{3}{4}}}$

$= \dfrac{9^{\frac{4}{4}}}{9^{\frac{3}{4}}}$

$= 9^{4/4 - 3/4}$

$= 9^{1/4}$

$= \sqrt[4]{9}$

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3, 5, 6, 7, 8, 9, 10, 16

Simplify by Writing as a Single Power

a) $0.3^{-3} \cdot 0.3^{5}$

Simplify by Writing as a Single Power

a) $0.3^{-3} \cdot 0.3^{5}$

$= 0.3^{(-3)+5}$

$= 0.3^{2}$

b) $\dfrac{b^3 \times b^{-5}}{b^7}$

Simplify the numerator first!!

b) $\dfrac{b^3 \times b^{-5}}{b^7}$

Simplify the numerator first!!

$= \dfrac{b^{-2}}{b^7}$

$= b^{-2-7}$

$= b^{-9}$

$= \dfrac{1}{b^9}$

ALWAYS express your answer with a positive exponent!!

c) $\dfrac{(a^{5} \times a^{-3})^{-2}}{a^{-2}}$

c) $\dfrac{(a^5 \times a^{-3})^{-2}}{a^{-2}}$

$= \dfrac{(a^2)^{-2}}{a^{-2}}$

$= \dfrac{a^{-4}}{a^{-2}}$

$= a^{-4 - (-2)}$

$= a^{-4 + 2}$

$= a^{-2}$

$= 1/a^2$

d) $\dfrac{(1.4^3)(1.4^4)}{1.4^{-2}}$

d) $\dfrac{(1.4^3)(1.4^4)}{1.4^{-2}}$

Use the product of powers law. **(ADD)**

$$= \frac{1.4^{3+4}}{1.4^{-2}}$$

$$= \frac{1.4^7}{1.4^{-2}}$$

Use the quotient of powers law. **(SUBTRACT)**

$$= 1.4^{7-(-2)}$$

$$= 1.4^9$$

e) $\left[\left(-\frac{3}{2}\right)^{-4}\right]^{2} \cdot \left[\left(-\frac{3}{2}\right)^{2}\right]^{3}$

e) $\left[\left(-\frac{3}{2}\right)^{-4}\right]^{2} \cdot \left[\left(-\frac{3}{2}\right)^{2}\right]^{3}$

First use the power of a power law:
For each power, multiply the exponents.

$$= \left(-\frac{3}{2}\right)^{-8} \cdot \left(-\frac{3}{2}\right)^{6}$$

Then use the product of powers law. **(ADD)**

$$= \left(-\frac{3}{2}\right)^{-2}$$

Write with a positive exponent.

$$= \left(-\frac{2}{3}\right)^{2}$$

f) $\left(\dfrac{7^{\frac{2}{3}}}{7^{\frac{1}{3}} \cdot 7^{\frac{5}{3}}}\right)^{6}$

f) $\left(\dfrac{7^{\frac{2}{3}}}{7^{\frac{1}{3}} \cdot 7^{\frac{5}{3}}}\right)^6$

Use the product of powers law. **(ADD)**

$$= \left(\frac{7^{\frac{2}{3}}}{7^{\frac{1}{3}+\frac{5}{3}}}\right)^6$$

$$= \left(\frac{7^{\frac{2}{3}}}{7^{\frac{6}{3}}}\right)^6$$

Use the quotient of powers law. **(SUBTRACT)**

$$= \left(7^{\frac{2}{3}-\frac{6}{3}}\right)^6$$

$$= \left(7^{-\frac{4}{3}}\right)^6$$

Use the power of a power law. **(MULTIPLY)**

$$= 7^{\left(-\frac{4}{3}\right)(6)}$$

$$= 7^{-\frac{24}{3}}$$

$$= 7^{-8}$$

Write with a positive exponent.

$$= \frac{1}{7^8}$$

CHECK YOUR UNDERSTANDING

Simplify by writing as a single power. Explain your reasoning.

a) $0.8^{2} \cdot 0.8^{-7}$

b) $\left[\left(-\frac{4}{5}\right)^{2}\right]^{-3} \div \left[\left(-\frac{4}{5}\right)^{4}\right]^{-5}$

c) $\frac{(1.5^{-3})^{-5}}{1.5^{5}}$

d) $\frac{9^{\frac{5}{4}} \cdot 9^{-\frac{1}{4}}}{9^{\frac{3}{4}}}$

a) $0.8^{2} \cdot 0.8^{-7}$

$= \mathbf{0.8^{-5}}$

b) $\left[\left(-\frac{4}{5}\right)^{2}\right]^{-3} \div \left[\left(-\frac{4}{5}\right)^{4}\right]^{-5}$

$\left(-\frac{4}{5}\right) \quad \div \left(-\frac{4}{5}\right)$

c) $\dfrac{(1.5^{-3})^{-5}}{1.5^{5}}$