Warm-up

Evaluate:

① $(81)^{0.75}$

$(81)^{3/4}$ ← exponent, ← index

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

$(3)^3$

$27$

② $\left(\frac{16}{81}\right)^{-5/4}$

$\left(\frac{81}{16}\right)^{5/4}$ ← exponent, ← index

$\frac{(\sqrt[4]{81})^5}{(\sqrt[4]{16})^5}$

$\frac{(3)^5}{(2)^5}$

$\frac{243}{32}$

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

$= 5^{2+11}$

$= 5^{13}$

$= 1220703125$

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$$5^8 \div 5^6$$

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

$$= 5^{8-6}$$

$$= 5^2$$

$$= 25$$

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$$(5^8)^3$$

$$= 5^{8(3)}$$

$$= 5^{24}$$

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$(xy)^3$

$= x^3 y^3$

$(x^2y)^3$

$= x^{2(3)} y^{1(3)}$

$= x^6 y^3$

**Exponent Laws**

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$$\left(\frac{x^1}{y^1}\right)^2$$

$$\frac{x^{1(2)}}{y^{1(2)}}$$

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

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

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

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

# Simplify by Writing as a Single Power

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

$= 0.3^{-3+5}$

$= 0.3^{2}$

# 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!!

$$= \frac{b^{3+(-5)}}{b^7}$$

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

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

$$= b^{-9}$$

$$= \left(\frac{1}{b}\right)^9$$

$$= \frac{(1)^9}{(b)^9}$$

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

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

$= \dfrac{(a^{5+(-3)})^{-2}}{a^{-2}}$

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

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

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

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

$= a^{-2}$

$= \left(\dfrac{1}{a}\right)^2$

$= \dfrac{1}{a^2}$

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

3+4

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

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

$= 1.4^{9}$

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

$\left(\frac{-3}{2}\right)^{-4\times 2} \cdot \left(\frac{-3}{2}\right)^{2\times 3}$

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

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

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

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

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

$= \frac{4}{9}$

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

$= 0.8^{-5}$

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

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