



YouTube Live Lessons

Getting ready for A-Level Maths...

*"We are what we repeatedly do.
Excellence is not an act, but a habit."*



Laws of indices (4)

Getting ready for A-Level Maths...

What you need...

- Your brain and attention
- A device to watch connected to internet
- A pen and paper
- Can do attitude

Laws of indices (4)

Important rules

$$a^1 = a$$

$$a^0 = 1$$

$$a^m \times a^n = a^{m+n}$$

$$a^m \div a^n = \frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$(ka^m)^n = k^n a^{mn}$$

$$a^{-m} = \frac{1}{a^m}$$

$$a^{\frac{1}{m}} = \sqrt[m]{a}$$

$$a^{\frac{n}{m}} = \left(\sqrt[m]{a}\right)^n$$

Laws of indices (4)

My turn

Simplify the following, leaving your answer in index form.

$$\frac{3^{-\frac{6}{5}} \times 3^4 \times 3^{\frac{1}{5}}}{3^7}$$

$$\frac{3^{-\frac{6}{5}} \times 3^4 \times 3^{\frac{1}{5}}}{3^7} = \left(3^{-\frac{6}{5} + 4 + \frac{1}{5}} \right) \omega$$

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

$$= 3^{3-7}$$

$$= 3^{-4}$$

$$\underline{\underline{3^{-4}}}$$

$$\omega: -\frac{6}{5} + 4 + \frac{1}{5} = 4 + \frac{1}{5} - \frac{6}{5}$$

$$= 4 - \frac{5}{5}$$

$$= 4 - 1$$

$$= 3$$

Your turn

Simplify the following, leaving your answer in index form.

$$\frac{5^{-\frac{1}{4}} \times 5^3 \times 5^{\frac{9}{4}}}{5^8}$$

$$\frac{5^{-\frac{1}{4}} \times 5^3 \times 5^{\frac{9}{4}}}{5^8} = \frac{5^{-\frac{1}{4} + 3 + \frac{9}{4}}}{5^8}$$

$$= \frac{5^{-\frac{1}{4} + 3 + \frac{9}{4}}}{5^8} \omega$$

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

$$= 5^{-3}$$

$$\underline{\underline{5^{-3}}}$$

$$\omega: -\frac{1}{4} + 3 + \frac{9}{4} = 3 + \frac{9}{4} - \frac{1}{4}$$

$$= 3 + \frac{8}{4}$$

$$= 3 + 2$$

$$= 5$$

Laws of indices (4)

My turn

Simplify the following, leaving your answer in index form.

$$\frac{(7^{\frac{4}{5}})^{15} \times (7^2)^{-3}}{(7^{-1})^{-8}}$$

$$\begin{aligned}\frac{(7^{\frac{4}{5}})^{15} \times (7^2)^{-3}}{(7^{-1})^{-8}} &= \frac{7^{\frac{4}{5} \times 15} \times 7^{2 \times -3}}{7^{-1 \times -8}} \\ &= \frac{7^{12} \times 7^{-6}}{7^8} \\ &= \frac{7^{12-6}}{7^8} \\ &= \frac{7^6}{7^8} \\ &= 7^{6-8} \\ &= \underline{\underline{7^{-2}}}\end{aligned}$$

Your turn

Simplify the following, leaving your answer in index form.

$$\frac{(2^{\frac{2}{3}})^{18} \times (2^4)^{-5}}{(2^{-1})^{-2}}$$

$$\begin{aligned}\frac{(2^{\frac{2}{3}})^{18} \times (2^4)^{-5}}{(2^{-1})^{-2}} &= \frac{2^{\frac{2}{3} \times 18} \times 2^{4 \times -5}}{2^{-1 \times -2}} \\ &= \frac{2^{12} \times 2^{-20}}{2^2} \\ &= \frac{2^{12-20}}{2^2} \\ &= \frac{2^{-8}}{2^2} \\ &= 2^{-8-2} \\ &= \underline{\underline{2^{-10}}}\end{aligned}$$

Laws of indices (4)

My turn

Simplify fully.

$$\frac{15yz^{-\frac{1}{4}}}{3yz^{\frac{3}{4}}}$$

$$\begin{aligned}\frac{15yz^{-\frac{1}{4}}}{3yz^{\frac{3}{4}}} &= \frac{15}{3} \times \frac{y^1}{y^1} \times \frac{z^{-\frac{1}{4}}}{z^{\frac{3}{4}}} \\ &= 5 \times y^0 \times z^{-\frac{1}{4}-\frac{3}{4}} \\ &= 5 \times 1 \times z^{-1} \\ &= \frac{5}{z}\end{aligned}$$

Your turn

Simplify fully.

$$\frac{24y^2z^{-\frac{4}{5}}}{6yz^{\frac{1}{5}}}$$

$$\begin{aligned}\frac{24y^2z^{-\frac{4}{5}}}{6yz^{\frac{1}{5}}} &= \frac{24}{6} \times \frac{y^2}{y^1} \times \frac{z^{-\frac{4}{5}}}{z^{\frac{1}{5}}} \\ &= 4 \times y^{2-1} \times z^{-\frac{4}{5}-\frac{1}{5}} \\ &= 4 \times y \times z^{-1} \\ &= \frac{4y}{z}\end{aligned}$$

Laws of indices (4)

My turn

Simplify fully.

$$\frac{(5x^{\frac{1}{4}})^3}{125x^2}$$

$$\begin{aligned}\frac{(5x^{\frac{1}{4}})^3}{125x^2} &= \frac{(5)^3(x^{\frac{1}{4}})^3}{125x^2} \\ &= \frac{125x^{\frac{3}{4}}}{125x^2} \\ &= 1 \times x^{\frac{3}{4}-2} \quad \omega \\ &= \underline{\underline{x^{-\frac{5}{4}}}}\end{aligned}$$

$$\begin{aligned}\frac{3}{4} - \frac{2}{1} &= \frac{3}{4} - \frac{8}{4} \\ &= \underline{\underline{-\frac{5}{4}}}\end{aligned}$$

Exam Q

Your turn

Simplify fully.

$$\frac{(4x^{\frac{1}{5}})^3}{64x^4}$$

$$\begin{aligned}\frac{(4x^{\frac{1}{5}})^3}{64x^4} &= \frac{(4)^3(x^{\frac{1}{5}})^3}{64x^4} \\ &= \frac{64x^{\frac{3}{5}}}{64x^4} \\ &= 1 \times x^{\frac{3}{5}-4} \quad \omega \\ &= \underline{\underline{x^{-\frac{17}{5}}}}\end{aligned}$$

$$\begin{aligned}\omega: \frac{3}{5} - \frac{4}{1} &= \frac{3}{5} - \frac{20}{5} \\ &= \underline{\underline{-\frac{17}{5}}}\end{aligned}$$

Exam Q

Laws of indices (4)

My turn

Simplify fully.

$$\frac{(a^6b)^{\frac{8}{3}}}{(a^3b^{\frac{1}{3}})^{-4}}$$

$$\begin{aligned}\frac{(a^6b)^{\frac{8}{3}}}{(a^3b^{\frac{1}{3}})^{-4}} &= \frac{(a^6)^{\frac{8}{3}} (b)^{\frac{8}{3}}}{(a^3)^{-4} (b^{\frac{1}{3}})^{-4}} \\ &= \frac{a^{16} b^{\frac{8}{3}}}{a^{-12} b^{-\frac{4}{3}}} \\ &= a^{16-(-12)} b^{\frac{8}{3}-(-\frac{4}{3})} \\ &= \underline{\underline{a^{28} b^4}}\end{aligned}$$

Exam Q

Your turn

Simplify fully.

$$\frac{(a^6b)^{\frac{7}{2}}}{(a^4b^{\frac{1}{2}})^{-5}}$$

$$\begin{aligned}\frac{(a^6b)^{\frac{7}{2}}}{(a^4b^{\frac{1}{2}})^{-5}} &= \frac{(a^6)^{\frac{7}{2}} (b)^{\frac{7}{2}}}{(a^4)^{-5} (b^{\frac{1}{2}})^{-5}} \\ &= \frac{a^{21} b^{\frac{7}{2}}}{a^{-20} b^{-\frac{5}{2}}} \\ &= a^{21-(-20)} b^{\frac{7}{2}-(-\frac{5}{2})} \\ &= a^{41} b^{12} \\ &= \underline{\underline{a^{41} b^{12}}}\end{aligned}$$

Exam Q

Laws of indices (4)

My turn

Simplify fully.

$$\sqrt{\frac{32x^{-5}y^2}{4xy^{-4}}}$$

$$\frac{32x^{-5}y^2}{4xy^{-4}} = 8x^{-5-1}y^{2-(-4)}$$

$$= 8x^{-6}y^6$$

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

$$\sqrt{\frac{32x^{-5}y^2}{4xy^{-4}}} = \sqrt{\frac{8y^6}{x^6}}$$

$$= \frac{(8y^6)^{\frac{1}{2}}}{(x^6)^{\frac{1}{2}}}$$

$$= \frac{2(8)^{\frac{1}{2}}y^3}{x^3}$$

$$= \frac{2\sqrt{2}y^3}{x^3}$$

$$\begin{aligned} \omega: 8^{\frac{1}{2}} &= \sqrt{8} \\ &= \sqrt{4 \times 2} \\ &= 2\sqrt{2} \end{aligned}$$

Your turn

Simplify fully.

$$\sqrt{\frac{40x^{-9}y^6}{2xy^{-8}}}$$

$$\frac{40x^{-9}y^6}{2xy^{-8}} = 20x^{-9-1}y^{6-(-8)}$$

$$= 20x^{-10}y^{14}$$

$$= \frac{20y^{14}}{x^{10}}$$

$$\sqrt{\frac{40x^{-9}y^6}{2xy^{-8}}} = \sqrt{\frac{20y^{14}}{x^{10}}}$$

$$= \frac{(20y^{14})^{\frac{1}{2}}}{(x^{10})^{\frac{1}{2}}}$$

$$= \frac{2(20)^{\frac{1}{2}}y^7}{x^5}$$

$$= \frac{2\sqrt{20}y^7}{x^5}$$

$$\begin{aligned} \omega: 20^{\frac{1}{2}} &= \sqrt{20} \\ &= \sqrt{4 \times 5} \\ &= 2\sqrt{5} \end{aligned}$$

Laws of indices (4)

Review Exercise

1. Simplify the following, leaving your answer in index form.

$$\frac{3^{-\frac{13}{6}} \times 3^5 \times 3^{\frac{1}{6}}}{3^8}$$

2. Simplify the following, leaving your answer in index form.

$$\frac{(5^{\frac{7}{2}})^6 \times (5^3)^{-4}}{(5^{-1})^{-12}}$$

3. Simplify fully.

$$\frac{20yz^{-\frac{1}{3}}}{5yz^{\frac{2}{3}}}$$

4. Simplify fully.

$$\frac{(3x^{\frac{1}{3}})^4}{81x^4}$$

5. Simplify fully.

$$\frac{(a^8b)^{\frac{3}{4}}}{(a^2b^{\frac{1}{4}})^{-5}}$$

6. Simplify fully.

$$\sqrt{\frac{48x^{-7}y^2}{4xy^{-8}}}$$

Laws of indices (4)

Review Exercise (Answers)

1. Simplify the following, leaving your answer in index form.

$$\frac{3^{-\frac{13}{6}} \times 3^5 \times 3^{\frac{1}{6}}}{3^8} \quad 3^{-5}$$

2. Simplify the following, leaving your answer in index form.

$$\frac{(5^{\frac{7}{2}})^6 \times (5^3)^{-4}}{(5^{-1})^{-12}} \quad 5^{-3}$$

3. Simplify fully.

$$\frac{20yz^{-\frac{1}{3}}}{5yz^{\frac{2}{3}}} \quad \frac{4}{z}$$

4. Simplify fully.

$$\frac{(3x^{\frac{1}{3}})^4}{81x^4} \quad \frac{1}{x^{\frac{8}{3}}}$$

5. Simplify fully.

$$\frac{(a^8b)^{\frac{3}{4}}}{(a^2b^{\frac{1}{4}})^{-5}} \quad a^{18}b^2$$

6. Simplify fully.

$$\sqrt{\frac{48x^{-7}y^2}{4xy^{-8}}} \quad \frac{2\sqrt{3}y^5}{x^4}$$