



# 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 (1)

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 (1)

## Important rules

$$a^1 = a$$

$$a^0 = 1$$

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

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

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

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

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

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

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

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

$$a^{-\frac{n}{m}} = \frac{1}{\sqrt[m]{a^n}} = \frac{1}{(\sqrt[m]{a})^n}$$

# Laws of indices (1)

## My turn

Evaluate:

$$3^{-4}$$

$$\begin{aligned} 3^{-4} &= \frac{1}{3^4} \\ &= \frac{1}{3 \times 3 \times 3 \times 3} \end{aligned}$$

$$3^{-4} = \frac{1}{81}$$

## Your turn

Evaluate:

$$2^{-4}$$

$$\begin{aligned} 2^{-4} &= \frac{1}{2^4} \\ &= \frac{1}{2 \times 2 \times 2 \times 2} \end{aligned}$$

$$2^{-4} = \frac{1}{16}$$

# Laws of indices (1)

## My turn

Write as a fraction.

$$t^{-9}$$

$$t^{-9} = \frac{1}{t^9}$$

## Your turn

Write as a fraction.

$$t^{-12}$$

$$t^{-12} = \frac{1}{t^{12}}$$

# Laws of indices (1)

## My turn

Write as a fraction.

$$7r^{-4}$$

$$\begin{aligned}7r^{-4} &= 7 \times r^{-4} \\ &= 7 \times \frac{1}{r^4} \\ &= \frac{7}{r^4}\end{aligned}$$

## Your turn

Write as a fraction.

$$10r^{-9}$$

$$\begin{aligned}10r^{-9} &= 10 \times r^{-9} \\ &= 10 \times \frac{1}{r^9} \\ &= \frac{10}{r^9}\end{aligned}$$

# Laws of indices (1)

## My turn

Simplify the following, leaving your answer in index form:

$$(r^{-6})^4$$

$$\begin{aligned}(r^{-6})^4 &= r^{-6 \times 4} \\ &= r^{-24}\end{aligned}$$

        

## Your turn

Simplify the following, leaving your answer in index form:

$$(r^8)^{-4}$$

$$\begin{aligned}(r^8)^{-4} &= r^{8 \times -4} \\ &= r^{-32}\end{aligned}$$

# Laws of indices (1)

## My turn

Simplify the following, writing your answer as a fraction:

$$(3r^{-6})^4$$

$$(3r^{-6})^4 = (3)^4 (r^{-6})^4$$

$$= 81 \times r^{-24}$$

$$= 81 \times \frac{1}{r^{24}}$$

$$= \underline{\underline{\frac{81}{r^{24}}}}$$

## Your turn

Simplify the following, writing your answer as a fraction:

$$(4r^{-8})^3$$

$$(4r^{-8})^3 = (4)^3 (r^{-8})^3$$

$$= 64 r^{-24}$$

$$= 64 \times \frac{1}{r^{24}}$$

$$= \underline{\underline{\frac{64}{r^{24}}}}$$



# Laws of indices (1)

## My turn

Simplify the following, writing your answer as a fraction:

$$(3r^{-6})^{-4}$$

$$(3r^{-6})^{-4} = (3)^{-4} (r^{-6})^{-4}$$

$$= \frac{1}{3^4} \times r^{24}$$

$$= \frac{r^{24}}{81}$$

## Your turn

Simplify the following, writing your answer as a fraction:

$$(4r^{-8})^{-3}$$

$$(4r^{-8})^{-3} = (4)^{-3} (r^{-8})^{-3}$$

$$= \frac{1}{4^3} \times r^{24}$$

$$= \frac{r^{24}}{64}$$

# Laws of indices (1)

## My turn

Simplify the following, writing your answer as a fraction:

$$(2r^4t^{-5})^7$$

$$(2r^4t^{-5})^7 = (2)^7 (r^4)^7 (t^{-5})^7$$

$$= 128 r^{28} t^{-35}$$

$$= 128r^{28} \times \frac{1}{t^{35}}$$

$$= \frac{128r^{28}}{t^{35}}$$



## Your turn

Simplify the following, writing your answer as a fraction:

$$(3rt^{-8})^4$$

$$(3rt^{-8})^4 = (3)^4 (r)^4 (t^{-8})^4$$

$$= 81 r^4 t^{-32}$$

$$= 81 r^4 \times \frac{1}{t^{32}}$$

$$= \frac{81r^4}{t^{32}}$$



# Laws of indices (1)

## My turn

Simplify the following:

$$5t^2 \times 7t^{-3} \times t$$

$$\begin{aligned} 5t^2 \times 7t^{-3} \times t &= 35 \times t^2 \times t^{-3} \times t^1 \\ &= 35t^{2+(-3)+1} \\ &= 35t^0 \\ &= 35 \end{aligned}$$

## Your turn

Simplify the following:

$$4t^6 \times 9t^{-5} \times t$$

$$\begin{aligned} 4t^6 \times 9t^{-5} \times t &= 4 \times 9 \times t^6 \times t^{-5} \times t^1 \\ &= 36 \times t^{6+(-5)+1} \\ &= 36t^2 \end{aligned}$$

# Laws of indices (1)

## My turn

Simplify the following, leaving your answer in index form:

$$\frac{18r^{-8}}{6r^{-2}}$$

$$\begin{aligned}\frac{18r^{-8}}{6r^{-2}} &= \frac{18}{6} \times \frac{r^{-8}}{r^{-2}} \\ &= 3 \times r^{-8} \div r^{-2} \\ &= 3 \times r^{-8-(-2)} \\ &= 3 \times r^{-6} \\ &= \underline{\underline{3r^{-6}}}\end{aligned}$$

## Your turn

Simplify the following, leaving your answer in index form:

$$\frac{36r^{-12}}{9r^{-16}}$$

$$\begin{aligned}\frac{36r^{-12}}{9r^{-16}} &= \frac{36}{9} \times \frac{r^{-12}}{r^{-16}} \\ &= 4 \times r^{-12-(-16)} \\ &= 4 \times r^4 \\ &= \underline{\underline{4r^4}}\end{aligned}$$

# Laws of indices (1)

## My turn

Simplify.

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

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

$$= \frac{(a^{-2})^3(b^3)^3}{c^{12}}$$

$$= \frac{a^{-6}b^9}{c^{12}}$$

$$= \underline{\underline{\frac{b^9}{a^6c^{12}}}}$$

## Your turn

Simplify.

$$\left(\frac{a^{-5}b^2}{c^6}\right)^4$$

$$\left(\frac{a^{-5}b^2}{c^6}\right)^4 = \frac{(a^{-5}b^2)^4}{(c^6)^4}$$

$$= \frac{(a^{-5})^4(b^2)^4}{c^{24}}$$

$$= \frac{a^{-20}b^8}{c^{24}}$$

$$= \underline{\underline{\frac{b^8}{a^{20}c^{24}}}}$$

# Laws of indices (1)

## Review Exercise

1. Evaluate  $4^{-3}$ .

2. Write as a fraction:  $t^{-7}$

3. Write as a fraction:  $6r^{-5}$

4. Simplify the following, leaving your answer in index form:

$$(r^{-7})^6$$

5. Simplify the following, writing your answer as a fraction:

$$(5r^{-9})^3$$

6. Simplify the following, writing your answer as a fraction:

$$(6r^{-8})^{-3}$$

7. Simplify the following, writing your answer as a fraction:

$$(2r^5t^{-7})^6$$

8. Simplify the following, leaving your answer in index form:

$$3t^6 \times 8t^{-4} \times t$$

9. Simplify the following, leaving your answer in index form:

$$\frac{24r^{-14}}{4r^{-5}}$$

10. Simplify.

$$\left( \frac{a^{-3}b^4}{c^6} \right)^5$$

# Laws of indices (1)

## Review Exercise (Answers)

1. Evaluate  $4^{-3}$ .

$$\frac{1}{64}$$

2. Write as a fraction:  $t^{-7}$

$$\frac{1}{t^7}$$

3. Write as a fraction:  $6r^{-5}$

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

4. Simplify the following, leaving your answer in index form:  
 $(r^{-7})^6$

$$r^{-42}$$

5. Simplify the following, writing your answer as a fraction:  
 $(5r^{-9})^3$

$$\frac{125}{r^{27}}$$

6. Simplify the following, writing your answer as a fraction:  
 $(6r^{-8})^{-3}$

$$\frac{r^{24}}{216}$$

7. Simplify the following, writing your answer as a fraction:  
 $(2r^5t^{-7})^6$

$$\frac{64r^{30}}{t^{42}}$$

8. Simplify the following, leaving your answer in index form:  
 $3t^6 \times 8t^{-4} \times t$

$$24t^3$$

9. Simplify the following, leaving your answer in index form:

$$\frac{24r^{-14}}{4r^{-5}}$$

$$6r^{-9}$$

10. Simplify.

$$\left(\frac{a^{-3}b^4}{c^6}\right)^5$$

$$\frac{b^{20}}{a^{15}c^{30}}$$