

# Negative Indices

The PowerPoint contains the slides shown below and these give an animated presentation explaining of how to use the rules of indices for multiplication and division with terms with the same bases and negative indices. There are questions with worked answers.

Negative Indices

Objective

Use the rules of indices for multiplication and division with terms to evaluate terms the same bases and negative indices

☆ 1

Dealing with a Negative Indices

We can evaluate calculations like  $12 \times 2^4$  or  $3 \div 2^{-4}$  using a scientific calculator:

$$12 \times 2^4 = 1.5$$

$$3 \div 2^{-4} = 24$$

But we need to be able to do this without a calculator. To explain how this can be done, we start with the division  $2^2 \div 2^3$  ...

☆ 2

We can write  $2^2 \div 2^3$  as...

$$\frac{2^2}{2^3} = \frac{2 \times 2}{2 \times 2 \times 2 \times 2}$$

Cancel out like terms

$$= \frac{1}{2^3}$$

Tidy up...

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

The same

$$= 2^{-3}$$

Doing it by subtracting powers, gives a negative index

☆ 3

Now, we have a way to evaluate expressions like...

$$12 \times 2^{-3} = 12 \times \frac{1}{2^3}$$

We can work out  $2^3 = 8$

So

$$= 12 \times \frac{1}{8}$$

Multiply

$$= \frac{12}{8}$$

Write as a decimal or mixed number

$$= 1.5 \text{ or } 1\frac{1}{2}$$

☆ 4

Using the example below as a guide, evaluate these:

$$12 \times 2^{-2} = 12 \times \frac{1}{2^2}$$

$$= 12 \times \frac{1}{4}$$

$$= \frac{12}{4}$$

$$= 1.5 \text{ or } 1\frac{1}{2}$$

If it's negative upstairs, it's positive downstairs

- $18 \times 3^{-2} = 2$
- $50 \times 5^{-2} = 2$
- $48 \times 4^{-2} = 3$
- $40 \times 2^{-4} = 5$
- $81 \times 3^{-4} = 3$
- $25 \times 5^{-4} = 0.2$
- $90 \times 6^{-2} = 2.5$
- $96 \times 4^{-4} = 1.5$

☆ 5

The calculation  $3 \div 2^{-3}$  could be written as

$$\frac{3}{2^{-3}} = 3 \times 2^3$$

So, rewrite as...

$$= 3 \times 8$$

We can work out  $2^3 = 8$

$$= 24$$

The term with the negative index is downstairs

And if it's negative downstairs, it's positive upstairs

☆ 6

Using the example below as a guide, evaluate these:

$$\frac{3}{2^{-3}} = 3 \times 2^3$$

$$= 3 \times 8$$

$$= 24$$

If it's negative downstairs, it's positive upstairs

- $\frac{4}{2^{-4}} \rightarrow 4 \times 2^4 = 32$
- $\frac{3}{4^{-2}} \rightarrow 3 \times 4^2 = 48$
- $\frac{5}{3^{-2}} \rightarrow 5 \times 3^2 = 45$
- $\frac{6}{5^{-2}} \rightarrow 6 \times 5^2 = 150$

☆ 7

If it's negative upstairs, it's positive downstairs

And if it's negative downstairs, it's positive upstairs

Using these rules enables us to evaluate expressions that appear complicated. Here is an example:

$$\frac{5 \times 8^{-2}}{2 \times 4^{-2}} \rightarrow \frac{5 \times 4^2}{2 \times 8^2} \rightarrow \frac{5 \times 16}{2 \times 64} \rightarrow 0.625$$

☆ 8

Evaluate these:

- $\frac{3 \times 4^{-2}}{2 \times 2^{-3}} \rightarrow \frac{3 \times 2^3}{2 \times 4^2} \rightarrow \frac{3 \times 8}{2 \times 16} \rightarrow 0.75$
- $\frac{4 \times 3^{-3}}{5 \times 9^{-2}} \rightarrow \frac{4 \times 9^2}{5 \times 3^3} \rightarrow \frac{3 \times 81}{5 \times 27} \rightarrow 2.4$
- $\frac{8 \times 2^{-2}}{10 \times 4^{-3}} \rightarrow \frac{8 \times 4^3}{10 \times 2^2} \rightarrow \frac{8 \times 64}{10 \times 4} \rightarrow 12.8$
- $\frac{6 \times 2^{-4}}{4 \times 8^{-2}} \rightarrow \frac{6 \times 8^2}{4 \times 2^4} \rightarrow \frac{6 \times 64}{4 \times 16} \rightarrow 6$

☆ 9