WALT - apply negative Indices

Success Criteria I know negative power means it changes to the denominator for a decimal value

Recap on indices rules

List of Indice Laws

•
$$x^0 = 1$$

$$\bullet x^n \cdot x^m = x^{n+m}$$

•
$$x^n \div x^m = x^{n-m}$$

$$\bullet (x^n)^m = x^{n \cdot m}$$

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

EXTRA Practice

https://drive.google.com/file/d/16oth8EX9OPbEw087jNc-S53cMrtaHBRx/view?usp=sharing

Use the link to practice more indices

View

Negative Indices explained - Fractional for extra information

The correct negative indices We saw

Play Kahoot on the previous learning



Check your answers

Think/Apply
Each number in the second row can be found by multiplying the number before it by $\frac{1}{3}$.
Multiplying a number by $\frac{1}{3}$ is the same as dividing it by 3.

 1 Multiply the numbers in the second row by $\frac{1}{2}$ to complete the table. Hence find the meaning of 2^{-1} , 2^{-2} , 2^{-3} .

 2^3 2^2 2^1 2^0 2^{-1} 2^{-2} 2^{-3}

 8 $8 \times \frac{1}{2} = \dots$ $\times \frac{1}{2} = \dots$ $\times \frac{1}{2} = \dots$ $\times \frac{1}{2} = \dots$

 Hence
 $2^{-1} = \frac{1}{\square} = \frac{1}{2^{\square}}$ $2^{-2} = \frac{1}{\square} = \frac{1}{2^{\square}}$ $2^{-3} = \frac{1}{\square} = \frac{1}{2^{\square}}$

 2 Multiply the numbers in the second row by $\frac{1}{10}$ to complete the table and find the meaning of 10^{-1} , 10^{-2} , 10^{-3} .

 10^3 10^2 10^1 10^0 10^{-1} 10^{-2} 10^{-3}

 1000 10^{-1} 10^{-2} 10^{-3} 10^{-3} 10^{-3}

 Hence
 $10^{-1} = \frac{1}{10^{\square}} = \frac{1}{10^{\square}}$ $10^{-2} = \frac{1}{10^{\square}} = \frac{1}{10^{\square}}$ $10^{-3} = \frac{1}{10^{\square}} = \frac{1}{10^{\square}}$

Check Your Answers

1	23	22	21	2º
	8	$8 \times \frac{1}{2} = 4$	$4 \times \frac{1}{2} = 2$	$2 \times \frac{1}{2} = 1$

2^{-1}	2-2	2^{-3}
$1 \times \frac{1}{2} = \frac{1}{2}$	$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$	$\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$

Hence
$$2^{-1} = \frac{1}{2} = \frac{1}{2^1}$$

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

$$2^{-3} = \frac{1}{8} = \frac{1}{2^3}$$

2
$$10^3$$
 10^2 10^1 10^0
 1000 $1000 \times \frac{1}{10} = 100$ $100 \times \frac{1}{10} = 10$ $10 \times \frac{1}{10} = 1$

10-1	10-2	10-3
$1 \times \frac{1}{10} = \frac{1}{10}$	$\frac{1}{10} \times \frac{1}{10} = \frac{1}{100}$	$\frac{1}{100} \times \frac{1}{10} = \frac{1}{1000}$

Hence
$$10^{-1} = \frac{1}{10} = \frac{1}{10^1}$$

 $10^{-2} = \frac{1}{100} = \frac{1}{10^2}$
 $10^{-3} = \frac{1}{1000} = \frac{1}{10^3}$

- **a** Use the index laws to simplify $3^4 \div 3^6$.
- **b** Write in expanded form and show that $3^4 \div 3^6 = \frac{1}{3^2}$. **c** Hence show that $3^{-2} = \frac{1}{3^2}$.

	Solve/Think	Apply
a	$3^4 \div 3^6 = 3^{4-6} = 3^{-2}$	Simplify using the index laws and
b	$3^{4} \div 3^{6} = \frac{\cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}}}{\cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}} \times \cancel{\cancel{3}} = \frac{1}{3^{2}}$	by writing in expanded form and cancelling. In general:
c	From parts a and b , $3^{-2} = \frac{1}{3^2}$.	$3^{-n}=\frac{1}{3^n}$

3 a Use the index laws to simplify $5^3 \div 5^7$.

b By writing in expanded form, show that $5^3 \div 5^7 = \frac{1}{5^4}$.

c Hence show that $5^{-4} = \frac{1}{5^4}$.

4 Write the following with positive indices.

 $a 3^{-1}$

 $b 4^{-3}$

 $f 12^{-1}$

 $g 9^{-2}$

 $h 6^{-1}$

i 7⁻³

k 2⁻⁸

1 5⁻¹

 $m 10^{-5}$

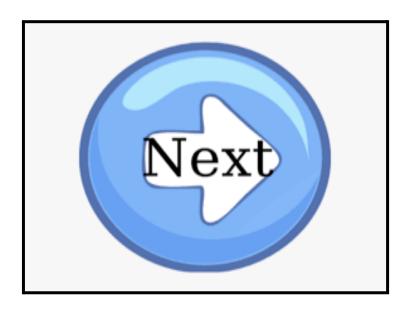
n 5⁻¹⁰

Check your answers

3 a
$$5^3 \div 5^7 = 5^{3-7} = 5^{-4}$$

b
$$5^3 \div 5^7 = \frac{5 \times 5 \times 5}{5 \times 5 \times 5 \times 5 \times 5 \times 5} = \frac{1}{5^4}$$

c From parts **a** and **b**, $5^{-4} = \frac{1}{5^4}$ 4 **a** $\frac{1}{3}$ **b** $\frac{1}{4^3}$ **c** $\frac{1}{2^5}$ **d** $\frac{1}{8^2}$ **e** $\frac{1}{5^4}$ f $\frac{1}{12}$ **g** $\frac{1}{9^2}$ **h** $\frac{1}{6}$ **i** $\frac{1}{7^3}$ **j** $\frac{1}{3^6}$ k $\frac{1}{2^8}$ **l** $\frac{1}{5}$ **m** $\frac{1}{10^5}$ **n** $\frac{1}{5^{10}}$ **o** $\frac{1}{4^{15}}$



Write the following as simplified fractions or mixed numerals.

9 5

b 3-5

	Solve	Think	Apply
а	$5^{-2} = \frac{1}{25}$	$5^{-2} = \frac{1}{5^2} = \frac{1}{25}$	Write with a positive index then evaluate using a calculator if necessary.
b	$3^{-5} = \frac{1}{243}$	$3^{-5} = \frac{1}{3^5} = \frac{1}{243}$	

5 Write the following as simplified fractions or mixed numerals.

a 3⁻²

b 2-5

c 4⁻³

d 5⁻⁴

e 2⁻¹⁰

f 6⁻³ k 7⁻³ g 9⁻² 1 4⁻⁴ h 3⁻⁴ m 3⁻⁶ i 5^{-5} n $(\frac{2}{5})^{-1}$ j 2^{-9} o $\left(1\frac{3}{4}\right)^{-1}$

EXAMPLE 4

Write the following with negative indices.

a 1/3

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

 $c = \frac{1}{3}$

	Solve/Think	Apply
a	$\frac{1}{3} = \frac{1}{3^1} = 3^{-1}$	$3^{-n} = \frac{1}{3^n}$ is equivalent to $\frac{1}{3^n} = 3^{-n}$.
b	$\frac{1}{3^2} = 3^{-2}$	
c	$\frac{1}{3^8} = 3^{-8}$	

6 Write the following with negative indices.

a

 $b \frac{1}{2^2}$

 $c \frac{1}{2^8}$

 $d \frac{1}{2^5}$

 $e^{-\frac{1}{2^3}}$

 $f = \frac{1}{5}$

 $g \frac{1}{7^2}$

 $h = \frac{1}{4^3}$

 $i = \frac{1}{3^4}$

0 1

Check your answers

 $e \frac{1}{1024}$ $\mathbf{g} \ \frac{1}{81}$ $\mathbf{h} \ \frac{1}{81}$ **j** $\frac{1}{512}$ **b** 2^{-2} **c** 2^{-8} $d 2^{-5}$ $e^{2^{-3}}$ f 5⁻¹ g 7⁻² $h 4^{-3}$ i 3⁻⁴ j 5⁻⁶ n 4⁻⁹ $k 3^{-10}$ 16^{-1} $m7^{-5}$ $0 10^{-1}$

Write $\frac{1}{5^{-3}}$ with a positive index.

Solve/Think	Apply
$\frac{1}{5^{-3}} = \frac{1}{\underline{1}}$	Write 5^{-3} with a positive index and divide the fractions.
$ \begin{array}{r} 5 \\ 5 \\ -5 \\ -5 \\ -5 \\ -5 \\ -5 \\ -5 \\ -$	Or write 1 as 5° and divide using the index laws. To divide by a fraction, invert the fraction (turn it upside down) and multiply.

- 7 Write the following with positive indices.
- **b** $\frac{1}{2^{-7}}$
- **c** $\frac{1}{7^{-2}}$ **d** $\frac{1}{6^{-1}}$

EXAMPLE 6

Evaluate $\left(\frac{3}{7}\right)^{-1}$.

Solve/Think	Apply
$\left(\frac{3}{7}\right)^{-1} = \frac{1}{\frac{3}{7}}$ $= 1 \times \frac{7}{3}$ $= \frac{7}{3} \text{ or } 2\frac{1}{3}$	Write $\left(\frac{3}{7}\right)^{-1}$ with a positive index and divide the fractions.

- 8 Evaluate the following.

- **b** $(\frac{3}{4})^{-1}$ **c** $(\frac{7}{8})^{-1}$ **d** $(\frac{1}{5})^{-1}$ **e** $(\frac{1}{10})^{-1}$ **f** $(1\frac{1}{2})^{-1}$ **g** $(2\frac{3}{4})^{-1}$

9 Using the results of questions 7 and 8, simplify $\left(\frac{a}{b}\right)^{-1}$.

Check your answers

7 **a** 3⁴ **b** 2⁷ **c** 7² **d** 6¹ = 6 **e** 4⁵

8 **a**
$$1\frac{1}{2}$$
 b $1\frac{1}{3}$ **c** $1\frac{1}{7}$ **d** 5

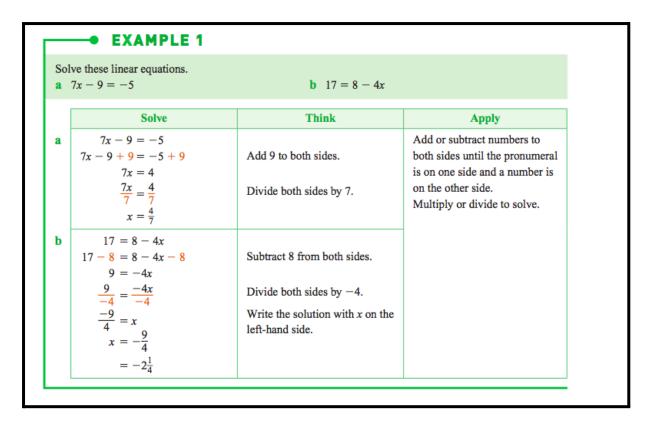
e 10 **f** $\frac{2}{3}$ **g** $\frac{4}{11}$

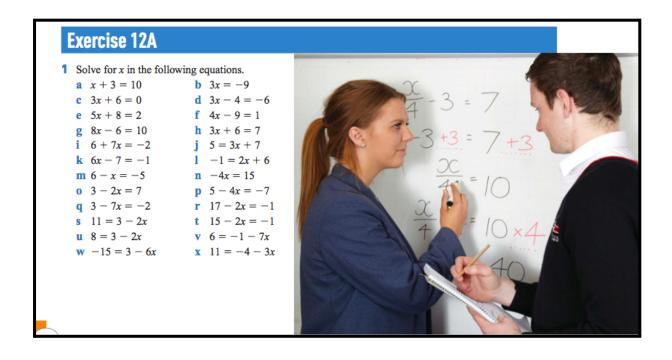
Next session We will work with variables for negative indices

Day two Week two

WALT solve linear equations

Success criteria I can add and subtract numbers to both sides until variable/unknown/pronumeral is one side and the number is on the other side





Solve for *m* in the equation $\frac{m}{3} - 5 = -2$.

Solve	Think	Apply
$\frac{m}{3} - 5 = -2$ $\frac{m}{3} - 5 + 5 = -2 + 5$ $\frac{m}{3} = 3$ $\frac{m}{3} \times 3 = 3 \times 3$ $m = 9$	Add 5 to both sides. Multiply both sides by 3.	Add or subtract numbers first, then multiply to solve.

2 Solve these equations for x.

$$\frac{x}{2} + 3 = 8$$

b
$$\frac{x}{3} - 1 = 4$$

$$\frac{x}{5} + 2 = -3$$

$$\frac{x}{6} + 3 = -4$$

b
$$\frac{x}{3} - 1 = 4$$

e $\frac{x}{7} - 2 = 4$

$$\frac{x}{10} - 6 = -1$$

3 Check the given solution by substitution and say whether or not it is correct.

a
$$2x + 8 = 15$$
 $(x = 7)$

b
$$7 + 5x = 9$$
 $(x = 2)$
d $\frac{x}{5} - 3 = 6$ $(x = \frac{9}{5})$

c
$$-15 = 6 - 7x$$
 $(x = 3)$

$$\frac{x}{5} - 3 = 6$$

$$(x=\frac{9}{5})$$

Check your

EXAMPLE 3

If y = 5x - 3 find x when y = -18.

Solve	Think	Apply
$y = 5x - 3$ $-18 = 5x - 3$ $-18 + 3 = 5x - 3 + 3$ $-15 = 5x$ $\frac{-15}{5} = \frac{5x}{5}$ $-3 = x$ $x = -3$	Substitute $y = -18$. Add 3 to both sides. Divide both sides by 5.	Often when substituting and solving an equation, the pronumeral is on the right-hand side. Solve as normal and then write the pronumeral on the left-hand side.

- 4 a Given that y = 3x 5, find x when y = 5.
- **b** Given that y = 4x + 2, find x when y = 11.
- c Given that y = 7 5x, find x when y = 0.
- **d** Given that y = 4 3x, find x when y = -3.
- e Given that y = 5 7x, find x when y = -5.
- f Given that y = 3x 5, find x when y = 8.

Exercise 12A

1 **a**
$$x = 7$$
 b $x = -3$ **c** $x = -2$
d $x = -\frac{2}{3}$ **e** $x = -\frac{6}{5}$ **f** $x = \frac{5}{2}$
g $x = 2$ **h** $x = \frac{1}{3}$ **i** $x = -\frac{8}{7}$
j $x = -\frac{2}{3}$ **k** $x = 1$ **l** $x = -\frac{7}{2}$
m $x = 11$ **n** $x = -\frac{15}{4}$ **o** $x = -2$
p $x = 3$ **q** $x = \frac{5}{7}$ **r** $x = 9$
s $x = -4$ **t** $x = 8$ **u** $x = -\frac{5}{2}$
v $x = -1$ **w** $x = 3$ **x** $x = -5$

2 **a** $x = 10$ **b** $x = 15$ **c** $x = -25$

d $x = -42$ **e** $x = 42$ **f** $x = 50$

3 **a** No **b** No **c** Yes **d** No

4 **a** $x = \frac{10}{3}$ **b** $x = \frac{9}{4}$ **c** $x = \frac{7}{5}$

d $x = \frac{7}{3}$ **e** $x = \frac{10}{7}$ **f** $x = \frac{13}{3}$