Week two-session 1
WALT multiplying numbers with exponents
Success criteria I know I can add powers when multiplying numbers with powers
Algebra In Action
Multiplying numbers with exponents

Warm-up activity DO Now use your calculator and say your answers

10 Use your calculator to evaluate the following.

a 3^6	**b** 5^7	**c** 4^5	**d** 8^3	**e** 9^8
f 10^3	**g** 7^4	**h** 2^8	**i** 6^4	**j** 11^3
k 1.6^4	**l** 3.8^3	**m** 4.5^4	**n** 7.4^2	**o** 6.2^3

B Multiplying numbers with the same base

EXAMPLE 1

a Write the following in expanded form.
i 3^2 **ii** 3^4 **iii** $3^2 \times 3^4$
b Write the answer for part **iii** in index form.
c Does $3^2 \times 3^4 = 3^{2+4}$?

a **i** $3^2 = 3 \times 3$
ii $3^4 = 3 \times 3 \times 3 \times 3$
iii $3^2 \times 3^4 = 3 \times 3 \times 3 \times 3 \times 3 \times 3$
b $3^2 \times 3^4$ in index form $= 3^6$ The base, 3, is repeated 6 times.
c Yes, $3^2 \times 3^4 = 3^{2+4} = 3^6$

Discuss and then work in your books

Exercise 4B

1 **a** Write the following in expanded form.
i $5^2 =$ ___ $\times$ ___
ii $5^7 =$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___
iii $5^2 \times 5^7 =$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___ $\times$ ___
b Write the answer to part **iii** in index form.
$5^2 \times 5^7$ in index form = ___
c Does $5^2 \times 5^7 = 5^{2+7}$? Explain.

2 **a** Write the following in expanded form.
i 7^3 **ii** 7^4 **iii** $7^3 \times 7^4$
b Write the answer to part **iii** in index form.
c Does $7^3 \times 7^4 = 7^{3+4}$?

3 **a** Write the following in expanded form.
i 6^3 **ii** 6^5 **iii** $6^3 \times 6^5$
b Write the answer to part **iii** in index form.
c Does $6^3 \times 6^5 = 6^{3+5}$?

4 **a** Write the following in expanded form.
i 10^6 **ii** 10^5 **iii** $10^6 \times 10^5$
b Write the answer in part **iii** in index form.
c Does $10^6 \times 10^5 = 10^{6+5}$?

Check your answers

Exercise 4B

1 a i $5^2 = 5 \times 5$

ii $5^7 = 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

iii $5^2 \times 5^7 = 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

b $5^2 \times 5^7$ in index form $= 5^9$

c Yes, 5 is being multiplied 9 (2 + 7) times.

2 a i $7 \times 7 \times 7$ **ii** $7 \times 7 \times 7 \times 7$

iii $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7$

b 7^7 **c** Yes

3 a i $6 \times 6 \times 6$ **ii** $6 \times 6 \times 6 \times 6 \times 6$

iii $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$

b 6^8 **c** Yes

4 a i $10 \times 10 \times 10 \times 10 \times 10 \times 10$

ii $10 \times 10 \times 10 \times 10 \times 10$

iii $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$

b 10^{11} **c** Yes

EXAMPLE 2

Write the following in index form.

a $5^2 \times 5^4$ **b** $2^3 \times 2^7$

a $5^2 \times 5^4$

$5 \times 5 \times 5 \times 5 \times 5 \times 5 = 5^{2+4} = 5^6$

Count the number of 5s.

b $2^3 \times 2^7$

$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^{3+7} = 2^{10}$

Count the number of 2s.

5 Simplify the following by writing in index form.

a $8^4 \times 8^{10} = 8^{\square + 10} = 8^{\square}$ **b** $7^7 \times 7^2 = 7^{7 + \square} = 7^{\square}$

c $9^7 \times 9^3 = 9^{\square + \square} = 9^{\square}$ **d** $5^6 \times 5^{11} = 5^{\square + \square} = 5^{\square}$

6 Simplify the following by writing in index form.

a $3^5 \times 3^4$ **b** $2^7 \times 2^5$ **c** $7^2 \times 7^8$ **d** $5^7 \times 5^2$ **e** $4^{10} \times 4^6$

f $6^9 \times 6^4$ **g** $10^5 \times 10^4$ **h** $2^{10} \times 2^{10}$ **i** $5^{20} \times 5^{10}$ **j** $3^{11} \times 3^7$

k $3^4 \times 3^6$ **l** $7^5 \times 7^8$ **m** $2^4 \times 2^4$ **n** $8^9 \times 8^{12}$ **o** $3^{14} \times 3^3$

7 Can you see a rule emerging? Complete the following statement.
Choose from these words: base, add, indices, multiplying.
When _____ numbers with the same _____, _____ the _____.
Construct your own example to explain the rule.

*Look at question **6** to determine the rule.*

8 **a** Write 4^3 in expanded form.

b Write $4^3 \times 4$ in expanded form.

c Write your answer for part **b** in index form.

d Is $4^3 \times 4 = 4^3 \times 4^1$? Explain.

e Hence, is 4 the same as 4^1?

9 Simplify by writing the following in index form.

a $5^4 \times 5$ **b** $3^7 \times 3$ **c** $2^9 \times 2$ **d** 5×5^8 **e** 7×7^{11}

Check your answers

1 **a** **i** $5^2 = 5 \times 5$

ii $5^7 = 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

iii $5^2 \times 5^7 = 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

b $5^2 \times 5^7$ in index form $= 5^9$

c Yes, 5 is being multiplied 9 (2 + 7) times.

2 **a** **i** $7 \times 7 \times 7$ **ii** $7 \times 7 \times 7 \times 7$

iii $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7$

b 7^7 **c** Yes

3 **a** **i** $6 \times 6 \times 6$ **ii** $6 \times 6 \times 6 \times 6 \times 6$

iii $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$

b 6^8 **c** Yes

4 **a** **i** $10 \times 10 \times 10 \times 10 \times 10 \times 10$

ii $10 \times 10 \times 10 \times 10 \times 10$

iii $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$

b 10^{11} **c** Yes

5 **a** $8^4 \times 8^{10} = 8^{4 + 10} = 8^{14}$

b $7^7 \times 7^2 = 7^{7 + 2} = 7^9$

c $9^7 \times 9^3 = 9^{7 + 3} = 9^{10}$

d $5^6 \times 5^{11} = 5^{6 + 11} = 5^{17}$

6 **a** 3^9 **b** 2^{12} **c** 7^{10} **d** 5^9

e 4^{16} **f** 6^{13} **g** 10^9 **h** 2^{20}

i 5^{30} **j** 3^{18} **k** 3^{10} **l** 7^{13}

m 2^8 **n** 8^{21} **o** 3^{17}

7 Rule: When multiplying numbers with the same base, add the indices.

8 **a** $4 \times 4 \times 4$

b $4 \times 4 \times 4 \times 4$

c 4^4

d Yes, 4 is being multiplied 4 times.

e Yes

9 **a** 5^5 **b** 3^8 **c** 2^{10} **d** 5^9 **e** 7^{12}

Now working with variables Day 2 21st April 2020

WALT: use indices rules for multiplication, division and raising powers

Success Criteria: I know how to apply the rule when multiplying add the powers and when raising the powers then multiply powers inside the bracket.

Watch video on basics

Simplify the following by writing in index form.

a $2^3 \times 2^5 \times 2^4$ **b** $3^5 \times 3^6 \times 3^3$

Remember: You can add indices if the bases are the same.

a $2^3 \times 2^5 \times 2^4 = 2^{3+5+4} = 2^{12}$

b $3^5 \times 3^6 \times 3^3 = 3^{5+6+3} = 3^{14}$

16 Complete the following to write the answer in index form.

a $4^2 \times 4 \times 4^5 = 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^{2+1+5} = 4^{\square}$

b $6^2 \times 6^4 \times 6^3 = 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 = 6^{\square+4+\square} = 6^{\square}$

c $10^5 \times 10^2 \times 10^8$ **d** $2^7 \times 2^{13} \times 2 \times 2^3$

e $p^3 \times p^6 \times p^2$ **f** $m^7 \times m^4 \times m^2 \times m^5$

Letters can also be a base.

17 Simplify the following by writing in index form.

a $2^4 \times 2^6 \times 2^3$ **b** $3^8 \times 3^3 \times 3^7$ **c** $5^3 \times 5^7 \times 5^4$ **d** $9^2 \times 9^5 \times 9^4$

e $4^6 \times 4^3 \times 4$ **f** $a^4 \times a^5 \times a^2$ **g** $y^7 \times y^3 \times y^2$ **h** $n^9 \times n^8 \times n^2$

i $p^6 \times p^3 \times p^{11}$ **j** $t^4 \times t^1 \times t^2$

18 Summary of findings: Complete each statement and copy it into your exercise book.
Choose from these words: 1, index, letters, bases, add.

a Only _____ indices if the _____ are the same.

b Indices is the plural of the word _____.

c Bases can be numbers or _____.

d A single digit or letter has an index value of _____.

Check your answers

16 a $4^{2+1-5} = 4^{-2}$ b $6^{2-4+3} = 6^{1}$
c 10^{15} d 2^{50} e p^{11} f m^{18}
17 a 2^{13} b 3^{18} c 5^{14} d 9^{11} e 4^{16}
f a^{11} g y^{12} h n^{19} i p^{20} j t^{7}
18 a Only add indices if the bases are the same.
b Indices is the plural of the word index.
c Bases can be numbers or letters.
d A single digit or letter has an index value of 1.

C Raising a number to a power

EXAMPLE 1

Simplify each of the following by writing it in expanded form. Record your findings in index form.
a $(3^2)^3$ b $(7^3)^5$

a $(3^2)^3 = (3 \times 3)^3$
$= (3 \times 3) \times (3 \times 3) \times (3 \times 3) = 3 \times 3 \times 3 \times 3 \times 3 \times 3$
$= 3^6$

b $(7^3)^5 = (7 \times 7 \times 7)^5$
$= (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7)$
$= 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7$
$= 7^{15}$

Exercise 4C

1 Simplify each of the following by writing in expanded form. Record your findings in index form.

a $(4^4)^3 = (4 \times \_\_ \times \_\_ \times 4)^3$
$= (4 \times \_\_ \times \_\_ \times 4) \times (4 \times \_\_ \times \_\_ \times 4) \times (4 \times \_\_ \times \_\_ \times 4)$
$= 4^{\square}$

b $(8^3)^2 = (8 \times \_\_ \times \_\_)^2$
$= (8 \times \_\_ \times \_\_) \times (8 \times \_\_ \times \_\_)$
$= 8^{\square}$

c $(2^5)^3 = (2 \times 2 \times 2 \times \_\_ \times \_\_)^3$
$= (2 \times 2 \times 2 \times \_\_ \times \_\_) \times (2 \times 2 \times 2 \times \_\_ \times \_\_) \times (2 \times 2 \times 2 \times \_\_ \times \_\_)$
$= 2^{\square}$

d $(7^3)^5 = (7 \times 7 \times \_\_)^5$
$= (7 \times 7 \times \_\_) \times (7 \times 7 \times \_\_) \times (7 \times 7 \times \_\_) \times (7 \times 7 \times \_\_) \times (7 \times 7 \times \_\_)$
$= 7^{\square}$

2 Can you see a rule emerging?
a Review your answers for question 1.
$(4^4)^3 = 4^{\square}$ $(8^3)^2 = 8^{\square}$ $(2^5)^3 = 2^{\square}$ $(7^3)^5 = 7^{\square}$
Write the rule in your own words.
b Complete the rule below based on your findings from part **a**. Copy it into your exercise book.
When raising a number to a higher power, _____ the indices.

3 Write each of the following in index form by applying the rule.

a $(3^2)^3$	b $(5^3)^2$	c $(2^3)^4$	d $(3^5)^3$	e $(7^4)^5$
f $(10^2)^5$	g $(4^2)^6$	h $(6^3)^7$	i $(3^8)^3$	j $(2^7)^{10}$
k $(3^4)^5$	l $(3^5)^4$	m $(5^2)^6$	n $(5^6)^2$	o $(9^{15})^2$

4 Write each of the following in index form by applying the rule.

a $(a^3)^2$	b $(b^6)^9$	c $(c^7)^6$	d $(d^5)^{11}$	e $(e^4)^{10}$
f $(f^2)^7$	g $(g^9)^4$	h $(h^{11})^3$	i $(i^6)^5$	j $(j^6)^2$
k $(k^7)^8$	l $(l^5)^8$	m $(m^6)^6$	n $(n^9)^3$	o $(o^9)^7$

Check your answers

Exercise 4C

1 **a** $(4 \times 4 \times 4 \times 4)^3 = (4 \times 4 \times 4 \times 4) \times (4 \times 4 \times 4 \times 4) \times (4 \times 4 \times 4 \times 4) = 4^{12}$

b $(8 \times 8 \times 8)^2 = (8 \times 8 \times 8) \times (8 \times 8 \times 8) = 8^6$

c $(2 \times 2 \times 2 \times 2 \times 2)^3 = (2 \times 2 \times 2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2 \times 2) = 2^{15}$

d $(7 \times 7 \times 7)^5 = (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) = 7^{15}$

2 **a** $(4^4)^3 = 4^{12}$ $(8^3)^2 = 8^6$ $(2^5)^3 = 2^{15}$ $(7^3)^5 = 7^{15}$

b When raising a number to a higher power, multiply the indices.

3 **a** 3^6 **b** 5^6 **c** 2^{12} **d** 3^{15}
e 7^{20} **f** 10^{10} **g** 4^{12} **h** 6^{21}
i 3^{24} **j** 2^{70} **k** 3^{20} **l** 3^{20}
m 5^8 **n** 5^8 **o** 9^{30}

EXAMPLE 2

Simplify the following by writing in index form.

a $(3^2)^3 \times 3^5$ **b** $7^4 \times (7^5)^6$

a $(3^2)^3 \times 3^5 = 3^6 \times 3^5 = 3^{11}$

b $7^4 \times (7^5)^6 = 7^4 \times 7^{30} = 7^{34}$

5 Simplify the following by writing in index form.

a $(8^4)^2 \times 8^3 = 8^8 \times 8^{\square} = 8^{\square}$ **b** $10^9 \times (10^2)^6 = 10^9 \times 10^{\square} = 10^{\square}$

c $(7^4)^3 \times 7^2$ **d** $(5^5)^2 \times 5^4$ **e** $(9^2)^4 \times 9^3$ **f** $(3^6)^5 \times 3^3$
g $8^5 \times (8^3)^2$ **h** $6^2 \times (6^4)^4$ **i** $10^3 \times (10^2)^5$ **j** $4^8 \times (4^7)^{10}$

6 Simplify the following.

a $7^6 \times (7^2)^5$ **b** $(2^3)^2 \times (2^4)^3$ **c** $(5^2)^4 \times (5^3)^2$ **d** $(7^4)^2 \times (7^3)^3$
e $(3^4)^5 \times (3^2)^4$ **f** $(9^2)^5 \times (9^3)^4$ **g** $(4^6)^2 \times (4^7)^3$ **h** $(8^3)^5 \times (8^7)^7$

Check your answers

5 **a** $(8^4)^2 \times 8^3 = 8^8 \times 8^3 = 8^{11}$

b $10^9 \times (10^2)^6 = 10^9 \times 10^{12} = 10^{21}$

c 7^{16} **d** 5^{14} **e** 9^{11} **f** 3^{35}
g 8^{11} **h** 6^{18} **i** 10^{13} **j** 4^{28}

6 **a** 7^{16} **b** 2^{18} **c** 5^{14} **d** 7^{17}
e 3^{28} **f** 9^{22} **g** 4^{33} **h** 8^{56}

D Dividing numbers with the same base

EXAMPLE 1

a Write $6^8 \div 6^5$ in expanded form.
b Write your answer in index form.

a $6^8 \div 6^5 = \frac{6^8}{6^5} = \frac{6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6}{6 \times 6 \times 6 \times 6 \times 6}$

$= 6 \times 6 \times 6$

b Index form $= 6^3$

Exercise 4D

1 Complete the following to write each in expanded form. Express your answer in index form.

a $4^7 \div 4^3 = \frac{4 \times 4 \times 4 \times \square \times \square \times \square \times \square}{4 \times 4 \times 4}$

$= 4^{\square}$

b $9^6 \div 9^2 = \frac{9 \times 9 \times \square \times \square \times \square \times \square}{9 \times 9}$

$= 9^{\square}$

c $5^8 \div 5^5 = \frac{5 \times 5 \times 5 \times 5 \times 5 \times \square \times \square \times \square}{5 \times 5 \times 5 \times 5 \times 5}$

$= \_\_^{\square}$

Simplify your answers by cancelling.

d $2^{10} \div 2^6 = \frac{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times \square \times \square \times \square \times \square}{2 \times 2 \times 2 \times 2 \times 2 \times 2}$

$= \_\_^{\square}$

Basic rules explained