

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](#) x

[Multiplying numbers with exponents](#)

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

## 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**  $5^2 = \underline{\quad} \times \underline{\quad}$   
**ii**  $5^7 = \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad}$   
**iii**  $5^2 \times 5^7 = \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad}$

**b** Write the answer to part **iii** in index form.  
 $5^2 \times 5^7$  in index form =  $\underline{\quad}$

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

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  $5 \times 5^8$

e  $7 \times 7^{11}$

## 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  $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$   
**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

**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 by powers inside the bracket when dividing subtract the powers

[Watch a video on basics of index notation](#)

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

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

**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

$$16 \text{ a } 4^{2+1-5} = 4^8$$

$$\text{b } 6^{2-4+3} = 6^9$$

$$\text{c } 10^{13}$$

$$\text{d } 2^{24}$$

$$\text{e } p^{11}$$

$$\text{f } m^{18}$$

$$17 \text{ a } 2^{13}$$

$$\text{b } 3^{18}$$

$$\text{c } 5^{14}$$

$$\text{d } 9^{11}$$

$$\text{e } 4^{16}$$

$$\text{f } a^{11}$$

$$\text{g } y^{12}$$

$$\text{h } n^{19}$$

$$\text{i } p^{20}$$

$$\text{j } t^7$$

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  $(7^2)^5$

$$\begin{aligned} \text{a } (3^2)^3 &= (3 \times 3)^3 \\ &= (3 \times 3) \times (3 \times 3) \times (3 \times 3) = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \\ &= 3^6 \end{aligned}$$

$$\begin{aligned} \text{b } (7^2)^5 &= (7 \times 7 \times 7)^5 \\ &= (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \times (7 \times 7 \times 7) \\ &= 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \\ &= 7^{15} \end{aligned}$$

## Exercise 4C

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

$$\begin{aligned} \text{a } (4^2)^3 &= (4 \times \underline{\quad} \times \underline{\quad} \times 4)^3 \\ &= (4 \times \underline{\quad} \times \underline{\quad} \times 4) \times (4 \times \underline{\quad} \times \underline{\quad} \times 4) \times (4 \times \underline{\quad} \times \underline{\quad} \times 4) \\ &= 4^{\square} \end{aligned}$$

$$\begin{aligned} \text{b } (8^3)^2 &= (8 \times \underline{\quad} \times \underline{\quad})^2 \\ &= (8 \times \underline{\quad} \times \underline{\quad}) \times (8 \times \underline{\quad} \times \underline{\quad}) \\ &= 8^{\square} \end{aligned}$$

$$\begin{aligned} \text{c } (2^5)^3 &= (2 \times 2 \times 2 \times \underline{\quad} \times \underline{\quad})^3 \\ &= (2 \times 2 \times 2 \times \underline{\quad} \times \underline{\quad}) \times (2 \times 2 \times 2 \times \underline{\quad} \times \underline{\quad}) \times (2 \times 2 \times 2 \times \underline{\quad} \times \underline{\quad}) \\ &= 2^{\square} \end{aligned}$$

$$\begin{aligned} \text{d } (7^2)^5 &= (7 \times 7 \times \underline{\quad})^5 \\ &= (7 \times 7 \times \underline{\quad}) \times (7 \times 7 \times \underline{\quad}) \times (7 \times 7 \times \underline{\quad}) \times (7 \times 7 \times \underline{\quad}) \times (7 \times 7 \times \underline{\quad}) \\ &= 7^{\square} \end{aligned}$$

2 Can you see a rule emerging?

a Review your answers for question 1.

$$(4^2)^3 = 4^{\square} \quad (8^3)^2 = 8^{\square} \quad (2^5)^3 = 2^{\square} \quad (7^2)^5 = 7^{\square}$$

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  $(5^2)^2$

c  $(2^3)^4$

d  $(3^5)^3$

e  $(7^4)^5$

f  $(10^2)^5$

g  $(4^2)^6$

h  $(6^2)^7$

i  $(3^8)^3$

j  $(2^7)^{10}$

k  $(3^4)^5$

l  $(3^5)^4$

m  $(5^2)^4$

n  $(5^6)^2$

o  $(9^{15})^2$

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

a  $(a^2)^2$

b  $(b^9)^9$

c  $(c^2)^6$

d  $(d^5)^{11}$

e  $(e^4)^{10}$

f  $(f^2)^7$

g  $(g^9)^4$

h  $(h^{11})^3$

i  $(i^5)^5$

j  $(j^2)^2$

k  $(k^2)^8$

l  $(l^2)^8$

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

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

3 a  $3^6$    b  $5^9$    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  $5^9$    o  $9^{10}$

4 a  $a^6$    b  $b^{24}$    c  $c^{42}$    d  $d^{25}$

e  $e^{40}$    f  $f^{14}$    g  $g^{16}$    h  $h^{33}$

i  $i^{20}$    j  $j^8$    k  $k^{56}$    l  $l^{40}$

m  $m^{36}$    n  $n^{27}$    o  $o^{53}$

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

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  $5^8 \div 5^3 = \frac{5 \times 5 \times 5 \times 5 \times 5 \times \square \times \square \times \square}{5 \times 5 \times 5 \times 5 \times 5}$   
 $= \square^\square$

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

Simplify your answers by cancelling.



[Watch video on rules explained](#)