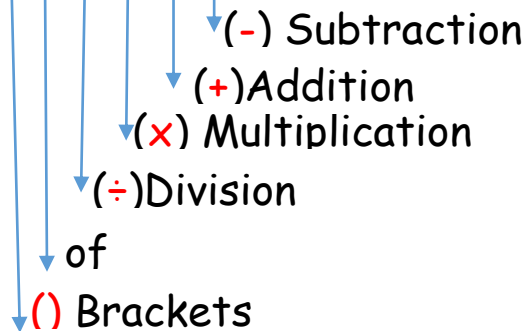THEME: NUMERACY

TOPIC: OPERATION ON WHOLE NUMBERS

The following are the major operations:

B O D M A S

(-) Subtraction

(+)Addition

(x) Multiplication

(÷)Division

of

() Brackets

ADDITION AND SUBTRACTION OF WHOLE NUMBERS

Consider; 4 + 5 = 9

In the above mathematical problem, 4 and 5 are called addends while 9 is the sum.

Consider 20 – 14 = 6

In the above mathematical problem, 20 is the minuend, 14 is the subtrahend while 6 is the difference.

EXAMPLES:

1. Find the sum of 389,754 and 23,657

```
    1  1  1  1  1
    3  8  9  7  5  4
+      2  3  6  5  7
    4  1  3  4  1  1
```

2. There are 58167 pens in a box and 789968 pens in another box. What is the total number of pens in the two boxes?

```
      1   1  1  1  1
      5  8  6  1  7  4
+  7  8  9  9  6  8
   1  3  7  6  1  4  2
```

There are 1, 376, 142 pens altogether

3. Find the difference of 5233186 and 1345102

```
        4   11  12  13
        5̶   2̶   3̶   3̶   1   8   6
    -   3   9   8   8   0   8   4
```

4. The number of cows in a district was 1,238,960 but 765,874 cows were slaughtered. How many cows remained?

```
        0   11  13      8   15  10
        1̶   2̶   3̶   8   9̶   6̶   0̶
    -       7   6   5   8   7   4
        0   4   7   3   0   8   6
```

There were 473,086 cows that remained

5. Work out: 345,783 – 472,096 + 432,562

(345,783 + 432,562) – 472,096

```
            1   1
        3   4   5   7   8   3
    +   4   3   2   5   6   2
        7   7   8   3   4   5
```

```
                    2   13  15
        7   7   8   3̶   4̶   5̶
    -   4   7   2   0   9   6
        0   0   6   2   4   9
```

ACTIVITY

1. Work out: 8975631 + 2867542   2. Find the sum of 231048 and 524628

3. There were 351 272 books in a library and 189 242 more books were donated to the same library. How many books are there altogether?

4. Find the difference of 678231 and 354986

5. What must be added to 237428 to get 885643?

6. Subtract 452 367 from 872 291

7. Decrease 845654 by 518349

8. A dairy processed 5300,450 litres of milk and sold 3450,833 litres. How many litres were left?

MULTIPLICATION OF WHOLE NUMBERS

Consider $8 \times 7 = 56$

In the above mathematical problem, 8 is the multiplier, 7 is the multiplicand while 56 is the product.

Examples

1. Work out: 357×9

```
  5 6
  3 5 7
×     9
─────────
  3 2 1 3
```

Method II

```
  3 5 7
×     9
─────────
```

9×7	$= 63$
9×50	$= 450$
9×300	$= 2700$

```
  1 1
  2 7 0 0
      4 5 0
+       6 3
─────────────
  3 2 1 3
```

2. Find the product of 348 and

```
  3 4 8
×   2 6
─────────
  2 0 8 8
+ 6 9 6
─────────
  9 0 4 8
```

Method II

```
  3 4 8
×   2 6
─────────
```

6×8	$= 48$
6×40	$= 240$
6×300	$= 1800$
20×8	$= 160$
20×40	$= 800$
20×300	$= 6000$

```
  1   1
  6 0 0 0
  1 8 0 0
    8 0 0
    2 4 0
    1 6 0
+     4 8
─────────────
  9 0 4 8
```

3. Find the product of 4520 and 739.

```
      4 5 2 0
×       7 3 9
─────────────────
      4 0 6 8 0
    1 3 5 6 0
+ 3 1 6 4 0
─────────────────
  3 3 4 0 2 8 0
```

The product of 4520 and 739 is 3,340,280

4. There are 24 bottles of soda in a crate. How many bottles are in 297 crates?

(297 x 24) bottles

```
    2 9 7
×     2 4
─────────
  1 1 8 8
+ 5 9 6
─────────
  7 1 4 8
```

There are 7,148 bottles of soda in 297 crates

5. A carpenter needs 46 screws to fix a bed. How many screws does he need to fix 792 beds?

$$(792 \times 46) \text{ screws}$$

```
      7 9 2
  ×     4 6
  ───────────
    4 7 5 2
+ 3 1 6 8
  ───────────
  3 6 4 3 2
  ───────────
```

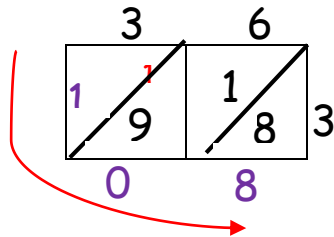He needs 36,432 screws to make 792 beds

Activity

1. Work out the product of the following numbers

   a) 84 and 32   b) 637 and 18   c) 2508 and 16

2. To plant a garden of bananas on a hectare of land, you need 538 suckers. How many suckers do you need to plant on 63 hectares of land?

3. A bus carries 67 passengers per trip. How many people can be carried by the same bus in 98 trips?

4. A school consumes 3568kg of rice per month. How many kilograms can the same school consume in 47 seven months?

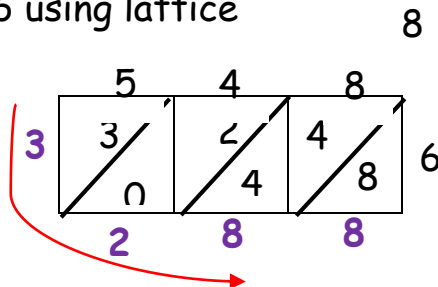## MULTIPLICATION OF WHOLE NUMBERS USING LATTICE METHOD

Examples

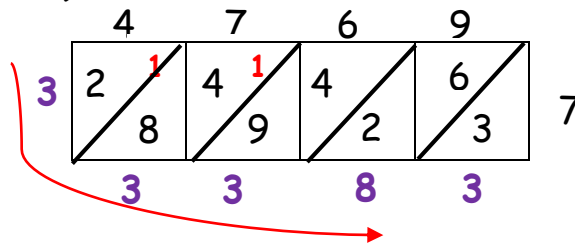1. Work out 36 x 3 using lattice method.

```
        3       6
   ┌───────┬───────┐
 1 │  /1   │  /    │
   │ /     │1/     │ 3
   │/  9   │ / 8   │
   └───────┴───────┘
      0       8
```

34 x 3 = 108

2. Work out 548 x 6 using lattice

```
              8
       5       4       8
   ┌───────┬───────┬───────┐
 3 │ 3/    │ 2/    │ 4/    │
   │  /    │  /    │  /    │ 6
   │ /  0  │ / 4   │ / 8   │
   └───────┴───────┴───────┘
      2       8       8
```
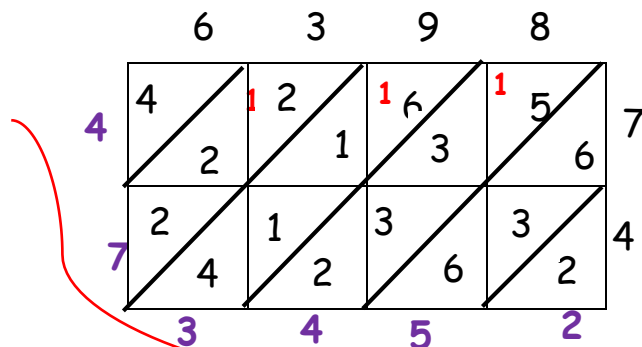
548 x 6 = 3,288

3. A university uses 4769 litres of water daily. How much water does it uses in a week? (Use lattice method)

(4769 x 7) litres

```
       4       7       6       9
   ┌───────┬───────┬───────┬───────┐
 3 │ 2/1   │ 4/1   │ 4/    │ 6/    │
   │  /    │  /    │  /    │  /    │ 7
   │ /  8  │ / 9   │ / 2   │ / 3   │
   └───────┴───────┴───────┴───────┘
      3       3       8       3
```

The university uses 33,383 litres of water in a week

4. Kato collects 6398 eggs daily on his farm. How many eggs does he collect in 74 days?

```
       6       3       9       8
   ┌───────┬───────┬───────┬───────┐
 4 │ 4/    │ 2/1   │ 6/1   │ 5/1   │
   │  /    │  /    │  /    │  /    │ 7
   │ /  2  │ / 1   │ / 3   │ / 6   │
   ├───────┼───────┼───────┼───────┤
 7 │ 2/    │ 1/    │ 3/    │ 3/    │
   │  /    │  /    │  /    │  /    │ 4
   │ /  4  │ / 2   │ / 6   │ / 2   │
   └───────┴───────┴───────┴───────┘
      3       4       5       2
```

He collected 473,452 eggs in 74 days

ACTIVITY

1. Work out the following using lattice method.
   a) 82 x 4   b) 753 x 6   c) 2,3647 x 5   d) 438 x 69

2. There are 94 books in each bookshelf. If there are 75 bookshelves, how many books are there altogether?

3. A maize mill processes 873 bags of flour in a day. How many bags of flour are processed in 69 days?

DIVISION OF WHOLE NUMBERS

Consider; 30 ÷ 2 = 15

In the above division problem, 30 is the dividend, 2 is the divisor while 15 is the quotient.

Examples:

1. Work out the following using long division.

   a) 1 8 6 ÷3

      186 ÷ 3 =62

b) $1976 \div 13$

```
              0 1  5  2
        13 ) 1  9  7  6
13x 0 =      - 0
              1  9
13x 1 =
              1  3
             _0 6  7

13x 5 =         6  5
                2  6
               -2  6
13x 2 =         0  0
```

1X13 =13
2X13 =26
3X13 =39
4X13 =52
5X13 =65
6X13 =78

$1976 \div 13 = 152$

2. On a farm, 14,167kg of tomatoes were picked in a month of 31days. What was the average weight of tomatoes picked every day? $(141676 \div 31)$ kg

```
                0  0  4  5  7
         31 ) 1  4  1  6  7
31x 0 =      - 0
              1  4
31x 0 =       0  0
              1  4  1
31x 4 =      -1  2  4
              0  1  7  6
             -1  5  5
31x 5 =       0  2  1  7
             -2  1  7
              0  0  0
```

1X31 =31
2X31 =62
3X31 =93
4X31 =124
5X31 =155
6X31 =188
7x31 =217

The average weight was 457kg of tomatoes

Activity

1. Work out the following using long division.
   a) 8416 ÷ 4   b) 18372 ÷ 6   c) 7290 ÷ 18   d) 11,776 ÷ 46
2. Share 759 books among 23 pupils.
3. Find the quotient of 5040 and 63.
4. A farmer packed 7500 mangoes in 15 similar cartons. How many mangoes were packed in each carton?
5. The Baby coach carried 34100 passengers in 50 trips. How passengers did it carry per trip?
6. A company makes 375000 books every day. If 250 books are packed in each carton, how many cartons are produced every day?

COMBINED OPERATIONS

In case of more than one operation in a problem, we follow the order of BODMAS.

B O D M A S

→ Subtraction
→ Addition
→ Multiplication
→ Division
Of
Brackets

Examples
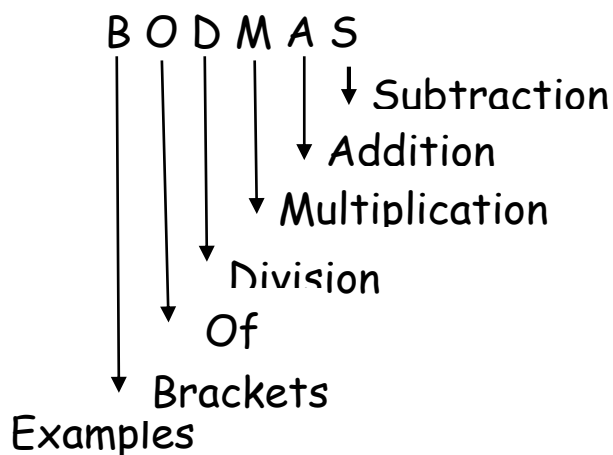
1. Work out the following correctly:

   a)   28 – 13 + 45

   (28 +45) - 13
   73- 13
   60

   b) 8 × 48 ÷ 4

   (48÷4) × 8
   12 × 8
   96

   c) 85 + (7 × 10)

   (7 × 10) + 85
   70 + 85
   155

d) ½ of 50 + 39 ÷ 3

$\frac{1}{2}$ of 50 + (39 ÷ 3)

($\frac{1}{2}$ of 50 + 13

$\frac{1}{2}$ × 5̶0̶ **25** + 13

(1 × 25) + 13

25 + 13

38

e) (48 – 10) – (5 × 2) + (6 × 2)

(48 – 10) – (5 × 2) + (6 × 2)

38   -   10   +   12

(38 + 12) – 10

50 -   10

40

2. Kamu had sh.8000 on her mobile money account. She received sh.3700 more from her mother and later used sh.1700 as airtime. How much was left on her account?

Sh.8000 + sh.3700) – sh.1700

(sh.8000 + sh.3700) – sh.1700

Sh.11700   -   sh.1700

Sh.3800

She was left with sh. 10000 on her account

3. Benti had sh.54000 and used $\frac{1}{3}$ of it to pay electricity bills. She then sold her hen at sh.16000. How many money does have now?

$sh.\,54000 - \frac{1}{3}$ × sh.54000) + sh.16000

Sh.54000   - ($\frac{1}{3}$ × sh.5̶4̶ 000) **18 000** + sh.16000

Sh.54000 – sh.18000) + sh.16000

(sh.54000 + sh.16000) – sh.36000

Sh.70000   – sh.36000

Sh. 34,000

She has sh.34,000 now

Activity

1. Work out the following correc‌

a) 48 – 20 + 22

b) 72 ÷ 4 × 3

c) 9 ÷ 9 + 5 – 3

d) 56 ÷ (7 × 8) + 9

e) (8 – 3) – (4 × 2) + (6 × 3)

f) $\frac{3}{10}$ of 60 + $\frac{2}{5}$ of 30

g) 6 × 2 + 14 ÷ 14

h) 30 – 4 × 5

2. Kiku had 24 fruits and have away $\frac{1}{4}$ of them to a friend. Kiku later got 12 fruits more from his daddy. How many fruits did he remain with altogether?

3. Andema had sh.7500 and received sh.4500 more from a friend. He later equally shared the money with his elder brother. How much did each get?

PROPERTIES OF NUMBERS
   a) Commutative property
   b) Associative property
   c) Distributive property

COMMUTATIVE PROPERTY
It states that the order numbers in a multiplication problem (multiplicand & multiplier) does not change the product.
Example
7 x 3 = 21
3 x 7 =21
It also states that the order of numbers in an addition problem (addends) does not affect the sum.
Example
9 + 15 = 24
15 + 9 = 24
NB: Division and subtraction are not commutative.
Examples
   a) 20 – 7 = 13
      7 – 20 =⁻13
   b) 36 ÷9 = 4
      9÷36 = $\frac{9}{36}$

ASSOCIATIVE PROPERTY
It states that the sum or product of three or more numbers will not change regardless of what sequence/order.

Examples
a) 3 x 7 x 5
   (3 x 7) x 5
   21 x 5
    105
   Or
   3 x 7 x 5
   3 x (7 x 5)
   3 x 35
   105

b) 8 + 11 + 9
   (8 + 11) + 9
   19 + 9
   28
   Or
   8 + (11 + 9)
    8 + 20
     28

NOTE: subtraction and division are not associative

Examples
a) 8 – 9 – 4
   (8-9) – 4
    ⁻1 – 4
     ⁻5
   Or
   8 – (9 – 4)
   8 – 5
   3

b) 100 ÷ 4 ÷ 5
   (100 ÷ 4) ÷ 5
    25 ÷ 5
     5
   Or
   100 ÷ (4 ÷ 5)
   $100 ÷ \frac{4}{5}$
   $100 × \frac{5}{4}$
   25 x 5
   125

DISTRIBUTIVE PROPERTY /DISTRIBUTIVE LAW

It states that multiplying two addends by a number gives the same product as multiplying each addends by the same number

e.g.   2(3+9) = (2 x 3) + (2 x 9)

        2 x 12 = 6 +18

         24   = 24

It states that multiplying the subtrahend and minuend by the same number gives the same product as multiplying by individual subtrahend and minuend by the same number

e.g.   4(25-10) = (4 x 25) – (4 x 10)

   4 x 15 = 100 – 40

   60 = 60

It states that dividing the sum of two numbers by the same number gives the same quotient as adding the quotient of individual division problems by the same number.

e.g. (60 + 44) ÷ 4 = 60 ÷ 4 + 44 ÷ 4

   104   ÷ 4 =   15 + 11

   26 =   26

It states that dividing the difference of two numbers by the same number gives the same quotient as subtracting the quotient of individual division problems by the same number.

(100 - 40) ÷ 4 = 100 ÷ 4 - 40 ÷ 4

   60   ÷ 4 =   25 - 10

   15 =   15

Examples

Work out the following using distributive property.

a) (87 x 19) + (19 x 13)   Note: Identify the common factor and then factorize

Common factor

19(87 + 13)

19 x 100

1900

b)   (52 x 4) + (4 x 18)

(52 + 18)4

70 x 4

280

c) (87 x 25) - (27 x 25)

Common factor

25(87 - 27)

25 x 60

1500

d)   (26 x 8) - (11 x 8)

(26 - 11)8

15 x 8

60

e) (59 ÷ 6) + (13 ÷ 6)

Common factor

(59 + 13) ÷6

72 ÷6

12

f) (143 ÷ 10) - (23 ÷ 10)

Common factor

(143 - 23) ÷10

120 ÷10

12

Activity

Work out the following using distributive property.

   a) (4 x 17) + (23 x 4)
   b) (16 x 100) + (100 x 14)
   c) (72 x 15) – (15 x 42)
   d) (81 x 7) – (7 x 11)
   e) (161 ÷ 8) + (39 ÷ 8)
   f) (360 ÷ 9) + (90 ÷ 9)

MORE DISTRIBUTIVE PROPERTY

Example

Work out the following using distributive property:

a) $(54 \times 2.7) + (0.3 \times 54)$

Common factor

$54(2.7 + 0.3)$

54×3.0

162

b) $(100 \times 0.25) + (0.11 \times 100)$

Common factor

$100(0.25 + 0.11)$

100×0.36

$\overset{1}{\cancel{100}} \times \dfrac{36}{\cancel{100}_{1}}$

36

C) $(23 \div 0.25) + (27 \div 0.25)$

Common factor

$(23 + 27) \div 0.25$

$50 \div 0.25$

$50 \div \dfrac{25}{100}$

$50 \div \dfrac{25}{100}$

$\overset{2}{\cancel{50}} \times \dfrac{100}{\cancel{25}_{1}}$

2×100

200

d) $(167 \div 0.65) - (37 \div 0.65)$

Common factor

$(165 - 37) \div 0.65$

$130 \div 0.65$

$130 \div \frac{65}{100}$

$\overset{2}{\cancel{130}} \div \frac{65}{100}$

$\overset{2}{\cancel{130}} \times \frac{100}{\cancel{65}_{1}}$

2×100

200

ACTIVITY

Work out the following using distributive property:

a) $(25 \div 0.4) + (75 \div 0.4)$

b) $(16 \div 0.05) + (34 \div 0.05)$

c) $(56 \div 0.2) - (24 \div 0.2)$

d) $(56 \times 0.2) - (24 \times 0.2)$

e) $(66 \times 0.6) + (54 \times 0.6)$

f) $(280 \times 0.6) + (280 \times 0.2)$

SCIENTIFIC NOTATION/STANDARD FORM

A number in scientific notation takes the form of $a \times m^n$ where a is positive integer from 1.0 to 9.9, m is base ten while n is an exponent/index.

Hints

❖ If a number is more than ten, divide it until you get a quotient which is between 1 and 10.

❖ If a number is less than one (1), multiply it by ten (10) until the product is between one (1) and ten (10).

Examples
1. Express 7845 in standard form.

$7\ 8\ 4\ 5 = 7.845 \times 10^3$

$7845 \div 10 = 784.5$ (1)
$784.5 \div 10 = 78.45$ (2)
$78.45 \div 10 = 7.845$ (3)
    7.845×10^3

2. Express 39000 in scientific notation.

$3\ 9\ 0\ 0\ 02 = 3.9 \times 10^4$

Or
$39000 \div 10 = 3900.0$ (1)
$3900.0 \div 10 = 390.00$ (2)
$390.00 \div 10 = 39.000$ (3)
$39.000 \div 10 = 3.900$ (4)
    3.9×10^4

3. Write 879.643 in scientific notation

$8\ 7\ 9.6\ 4\ 3 = 8.796 \times 10^2$

Or
$879.643 \div 10 = 87.9643$ (1)
$87.9643 \div 10 = 8.79643$ (2)
    8.79643×10^2

4. Express 9.876 in standard form
    9.876×10^0

5. Write 0.0985 in scientific notation

$0\ .0\ 9\ 8\ 5 = 9.85 \times 10^{-2}$

Or

$0.0985 \times 10 = 0.985$ (1)
$0.985 \times 10 = 9.85$ (2)
    9.85×10^{-2}

7. Write 0.00306 in standard form.

$0.\ 0\ 0\ 3\ 0\ 6 = 3.06 \times 10^{-3}$

Or
$0.00306 \times 10 = 0.0306$ (1)
$0.0306 \times 10 = 0.306$ (2)
$0.306 \times 10 = 3.06$ (3)
    3.06×10^{-3}

Activity

Express the following in scientific notation/standard form

    a)   2463   b) 879400   c) 20098

    d)   2.3456   e) 751.98   f) 9001.87

    g) 0.0046   h) 0.0009082

FINDING STANDARDIZED NUMBERS

Examples

1. Write 3.789×10^5 in its original form.

$$\frac{3789}{1000} \times 10 \times 10 \times 10 \times 10 \times 10$$

$$\frac{3789}{1\cancel{000}} \times 1\,0\,0,\cancel{0}\,\cancel{0}\,\cancel{0}$$

$$3789 \times 100$$

$$378,900$$

2. What number has been written in standard form give 3.75642×10^2?

$$\frac{375642}{100000} \times 10 \times 10$$

$$\frac{375642}{1\,0\,0\,0\cancel{0}\cancel{0}} \times 1\cancel{0}\,\cancel{0}$$

$$\frac{375642}{1\,0\,0\,0}$$

$$3.75642 \times 10^2 = 3756.42$$

3. Writ the number whose standard form is 2.109×10^0.

$$\frac{2109}{1000} \times 1$$

$$\frac{2109}{1000} \qquad\qquad 2.109 \times 10^0 = 2.109$$

4. What number has been written in standard form to give 8.56×10^{-4}?

$$\frac{856}{100} \times \frac{1}{10000}$$

$$\frac{856}{1000000}$$

$$0.000856$$

$8.56 \times 10^{-4} = 0.000856$

5. What number has been written in standard form to give 3.6×10^{-2}?

$$\frac{36}{10} \times \frac{1}{100}$$

$$\frac{36}{1000}$$

0.036

$3.6 \times 10^{-2} = 0.036$

Activity

What number has been written in standard form to give each of the following?

a) 8.6×10^4

b) 7.00458×10^5

c) 1.2068×10^0

d) 7.24×10^{-2}

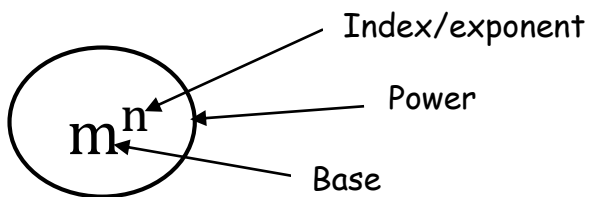e) 3.491×10^{-4}

f) 5.438×10^{-1}

INDICES/EXPONENTS

Consider the illustration below;

EVALUATING POWERS

Examples

Evaluate the following:

i) $2^2 + 2^4$

$(2 \times 2) + (2 \times 2 \times 2 \times 2)$

$4 \quad + (4 \times 4)$

$4 + 16$

20

ii) $(3^2 + 3^1)^0$

$(3 \times 3 + 3)^0$

$(9 + 3)^0$

12^0

1

iii) $y^3 + y^3$

$y^3 + y^3$

$2y^3$

iv) $3Y^2 + 5y^2$

$\qquad 3Y^2 + 5y^2$

$\qquad\quad 8y^2$

v) $5Y^4 + y^4$

$\qquad 5Y^4 + y^4$

$\qquad\quad 6y^4$

Activity

Work out the following:

a) $\quad 9^5 + 9^2$ b) $3^1 + 3^7$ c) $4^3 + 4^6$ d) $2a^4 + 6a^2$

e) $3b^6 + b^2$ f) $m^5 + m^7$ g) $2k^3 + 3k$ h) $8^2 + 8$

EVALUATION OF POWERS

Examples

Simplify the following:

a) $\quad 3^3 - 2^3$

$\quad (3 \times 3) - (2 \times 2 \times 2)$

$\qquad 9 - 8$

$\qquad\quad 1$

b) $4^3 - 2^3$

$\quad (4 \times 4 \times 4) - (2 \times 2 \times 2)$

$\qquad (16 \times 4) - (4 \times 2)$

$\qquad\quad 64 - 8$

$\qquad\qquad 56$

c) $3w^4 - w^4$

$\quad 3w^4 - w^4$

$\qquad 2w^4$

d) $5n^4 - n^3$

$\quad 5n^4 - n^3$

e) $(4 + 8)^0$

$\quad 12^0$

$\qquad 1$

ACTIVITY

Work out the following:

i) $\quad 4t^5 - t^3$ ii) $\quad 6^2 - 3^3$ iii) $5^2 - 4^2$

iv) $\quad 6d^3 - 2d^3$ v) $5h^8 - 3h^8$ vi) $10n^7 - 9n^7$

LAWS OF INDICES

1st law of indices states "the when multiplying powers of the same base, maintain the base and add the indices/exponents".e.g.

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

2nd law states that when dividing powers of the same base, maintain the base and subtract the exponents.

$b^8 \div b^5 = b^{8-5}$

The above laws are summarized as MA/DS; multiplication we add and division we subtract.

APPLICATION OF LAWS OF INDICES IN MULTIPLICATION
Examples

1. Simplify $4^3 \times 4^2$ using laws of indices

    4^{3+2}

    4^5

    Without laws of indices

    $4^3 \times 4^2$

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

    4^5

2. Simplify $m^8 \times m^2$

    m^{8+2}

    m^{10}

    Without laws of indices

    $m^8 \times m^2$

    $m \times m \times m \times m \times m \times m \times m \times m \times m \times m$

    m^{10}

3. Simplify $k^3 \times k \times k^6$

    K^{3+1+6}

    K^{10}

    Without laws of indices

    $K^3 \times k^1 \times k^6$

    $k \times k \times k \times k \times k \times k \times k \times k \times k \times k$

    k^{10}

4. Simplify $10^p \times 10^n$

    10^{p+n}

Activity

Simplify the following:

  a) $3^2 \times 3^6$ b) $4^8 \times 4^{12}$ c) $w^2 \times w^6$ d) $p^5 \times p^4$ e) $y^7 \times y^5 \times y3$

  f) $c^8 \times c^1 \times c^0$ g) $d^1 \times d^{10} \times d^5$

APPLICATION OF LAWS OF INDICES IN DIVISION

Examples

1. Simplify $3^4 \div 3^2$

          3^{4-2}

          3^2

          3×3

          9

Without laws of indices

$3^4 \div 3^2$

$$\frac{3 \times 3 \times \cancel{3} \times \cancel{3}}{\cancel{3} \times \cancel{3}}$$

          3×3

          3^2

          3×3

          9

2. Simplify $p^{10} \div p^6$

          p^{10-6}

          p^4

Without laws of indices

$p^{10} \div p^6$

$$\frac{p \times p \times p \times p \times \cancel{p} \times \cancel{p} \times \cancel{p} \times \cancel{p} \times \cancel{p} \times \cancel{p}}{\cancel{p} \times \cancel{p} \times \cancel{p} \times \cancel{p} \times \cancel{p} \times \cancel{p}}$$

          $p \times p \times p \times p$

          p^4

3. Simplify $36m^8 \div 9m^3$

      $36 \div 9 \ (m^{8-3})$

      $4m^5$

Without laws of indices

$36m^8 \div 9m^3$

$$\frac{36 \times m \times m \times m \times m \times m \times \cancel{m} \times \cancel{m} \times \cancel{m}}{\cancel{9} \times \cancel{m} \times \cancel{m} \times \cancel{m}}$$

          $4m^5$

Activity

Simplify the following;

a) $2^6 \div 2^2$ b) $d^{18} \div d^{11}$ c) $n^9 \div n^7$ d) $n^{24} \div n^{10}$ e) $x^5 \div n^5$

f) $2k^5 \div k^2$ h) $8g^{13} \div g^9$ i) $18b^7 \div 3b^4$ j) $28m^8 \div 7m^3$

APPLICATION OF LAWS OF INDICES IN MULTIPLICTAION

Examples

1. Solve for x: $2^p = 32$
➢ Express 32 as a power of 2

2	32
2	16
2	8
2	4
2	2
	1

$2^p = 2 \times 2 \times 2 \times 2 \times 2$

$2^p = 2^5$ Since the bases are the same, ignore
                them and equate the indices

P = 5

2. Solve for w: $3^w \times 3^1 = 81$
➢ Express 81 as a power of 3

3	81
3	27
3	9
3	3
3	3
	1

$3^w \times 3^1 = 3 \times 3 \times 3 \times 3$

$3^w \times 3^1 = 3^4$

Apply a law of indices in multiplication

$3^{w+1} = 3^4$ Since the bases are the same, ignore them
                and equate the indices

W + 1 = 4
W + 1 – 1 = 4 – 1
W = 3

3. Solve for y: $2^y \times 3^3 = 108$

$2^y \times 3^3 = 2 \times 2 \times 3 \times 3 \times 3$

$2^y \times 3^3 = 2^2 \times 3^3$

$2^y \times 3^3 \div 3^3 = 2^2 \times 3^3 \div 3^3$

$2^y = 2^2$

$Y = 2$

2	108
2	54
3	27
3	9
3	3
	1

4. Solve for a: $2^3 \times 5^a = 200$

$2^3 \times 5^a = 2 \times 2 \times 2 \times 5 \times 5$

$5^a \times 2^3 = 2^3 \times 5^2$

$5^a \times 2^3 \div 2^3 = 2^3 \div 2^3 \times 5^2$

$5^a = 5^2$

$a = 2$

2	200
2	100
2	50
5	25
5	5
	1

Activity

Solve the following equations

a) $2^d = 2^6$ b) $2^n = 16$ c) $3^f = 27$ d) $2^k \times 2^2 = 32$

e) $4^1 \times 4y^y = 256$ f) $2^2 \times 5^r = 100$ g) $3^m \times 5^2 = 75$

APPLICATION OF LAWS OF INDICES IN DIVISION

Examples

1. Solve for m: $2^m \div 2^1 = 8$

➤ Express 8 as a power of 2

$2^m \div 2^1 = 2 \times 2 \times 2$

$2^m \div 2^1 = 2^3$

2	8
2	4
2	2
	1

1

Apply a law of indices in division

$2^{m-1} = 2^3$ Since the bases are the same, ignore them and equate the indices

$m - 1 = 3$

$m - 1 = 3$

$m - 1 + 1 = 3 + 1$

$m = 4$

2. Solve for x: $4^{3x} \div 4^x = 256$

$$4^{3x} \div 4^x = 256$$

$$4^{3x} \div 4^x = 4 \times 4 \times 4 \times 4$$

$$4^{3x} \div 4^x = 4^4$$

$$4^{3x-x} = 4^4$$

$$4^{2x} = 4^4$$

$$\frac{\cancel{2}^{1} x}{\cancel{2}} = \frac{\cancel{4}^{2}}{\cancel{2}}$$

$$X = 2$$

4	256	1
4	64	
4	16	
4	4	
	1	

3. Solve for k: $3^k \div 3^2 = 27$

$$3^k \div 3^2 = 3 \times 3 \times 3$$

$$3^k \div 3^2 = 3^3$$

$$3^{k-2} = 3^3$$

$$K - 2 = 3$$

$$K - 2 + 2 = 3 + 2$$

$$K = 5$$

3	27
3	9
3	3
	1

ACTIVITY

Solve the following equations

i) $2^r \div 2^2 = 4$ ii) $4^y \div 4^2 = 16$ iii) $2^{3y} \div 2^y = 16$

iv) $4^{2x} \div 4^x = 64$ v) $5^{3p} \div 5^p = 625$ vi) $3^{2n} \div 3^n = 27$

Vii) $6^b \div 6^1 = 36$ viii) $2^b \div 2^2 = 8$