Supplementary Study Pack for Underperforming Schools

MATHEMATICS

JSS 3

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TEACHERS' GUIDE

Dear Teacher,

This manual is part of an effort taken by the Teaching Service Commission (TSC) to improve the quality of teaching and learning of Mathematics during the Covid-19 pandemic in Sierra Leone, to serve as supplementary materials for mathematics to the already existing ones. The resourses are designed to make Mathematics teaching and learning effective in every community and to ensure continuous improvement in the BECE in Sierra Leone.

As a Mathematics teacher, you are already knowledgeable in the subject matter. Therefore your lesson must be approached from a child centred perspective. You are advised to make explanations, demonstrations and discussions very simple to the level of children's understanding.

Teachers are to avoid the use of jargons in the teaching and learning of Mathematics and key words must be clearly explained or broken down. Be aware that the teaching and learning must be centred on young pupil's. Allow pupil's to be actively involved in the teaching and learning process through classroom activities, discussions, demonstrations and carrying out calculations for the entire class. Teachers should give every child an opportunity to access the material in this booklet. This could be achieved through clear explanation and the provision of enough time for every pupil to complete tasks set in all the units. Teachers to provide an opportunity for pair assessment and self-assessment for a better understanding of every unit completed. All answers for the exercise are can be found at the back of this booklet.

TABLE OF CONTENTS

UNIT 1

SET LANGUAGE AND NOTATION

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to identify elements of a set and use set language and symbols.

SET LANGUAGE AND NOTATION

TEACHER'S GUIDE

Teachers should use simple language to explain the concepts.

SET : A set is a collection of well-defined groups of objects called its elements. Examples of objects can be numbers, letters, diagrams, symbols and so on. The elements of a set are written within curly brackets and are separated by commas.

Example $A = \{1,2,3,4,5\}$

We write 3 A which means 3 is an element of set A or 3 belongs to set A. 6 A which means 6 is not an element of set A. Sets are denoted by capital letters and the elements by small letters for Example $V = \{a, e, l, o, u\}$. A set can be described in three ways.

I. By listing its elements Example. $P = \{2 ,3, 5,7\}$
II. By word description Example P = {prime numbers from 1 to 10}.
III. By set builder notation Example $P = \{x:1 \le x\le 10$, where x is a prime number$\}$

The number of elements in a set refers to the cardinality of a set

Example $S = \{a, e, I, o, u\}$. The cardinality of set S i.e., $|S| = n(S) = 4$.

Exercise

1. List the set of prime numbers between 10 and 30.
2. Write down the set of square numbers between 1 and 40.
3. List the first 5 elements in the set of (a) square numbers (b) cube numbers

UNIT 2

BASIC CONCEPTS AND TYPES OF SETS

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to apply key words in solving everyday problems involving sets.

TEACHER’S GUIDE

Teachers to clearly explain the meaning of the key words like finite sets and to ask pupil's to give their own examples. Teacher to mark and give feedback to pupils on every exercise completed.

PUPIL'S GUIDE

Pupils to write examples in their exercise books and to ensure exercises are completed.

A SET CAN BE FINITE OR INFINITE

FINITE SETS: This refers to a set that has a definite number of elements for example, A = {1,2,3,4,5}, n(A) = 5

INFINITE SET: This refers to the set that has an indefinite number of elements for example, R = {1,2,3,4.}. R = {All positives integers}. Here n(R) is unknown the elements are uncountable.

NULL SETS: A set that has no element is called an empty set. It is denoted by { } or Ø

UNIVERSAL SET: A set that has all possible elements within a particular scope. It is denoted by U or Ɛ.

EQUIVALENT SETS: Sets that have the same number of elements are equivalent sets.

Example P = {1,3,5} and Q = {a, c, e}

n(P) = n(Q) therefore, P and Q are equivalent.

EQUAL SET: Two sets are said to be equal when they have the same members (elements).

Example $A = \{8,9,10\}$
$B = \{9,8,10\}$

$A = B$ because each member (element) in A has a corresponding member in B. Although the order of listing may not be the same.

SUBSETS: Let A and B be two non-empty sets. If some elements of A are the elements of B, the B is said to be a subset of A denoted by $B \subseteq A$. The symbol means subset and $\supseteq$ means superset.

COMPLIMENT OF A SET. The compliment of a set is the collection of all elements (members) that are in the universal set but not in the set P.

Example $U = \{1,2,3.........10\}$
$P = \{2,4,6,8\}$

The compliment of P denoted by $P^1 = \{1,3,5,7,9, 10\}$ P and P^1 are disjoint.

UNION AND INTERSECTION OF SET: Let A and B be non-empty sets. The collection of all elements that belong to either A or B or both A and B refers to the union of A and B.

For example: $A = \{1,2,3,4,5,6\}$
$B = \{1,3,5,7,9,10\}$.

A union B is given by $AUB = \{1,2,3,4,5,6,7,9 ,10\}$

$8 \in AUB$ because it is not in A and also not in B.

The collection of all elements that belong to A and B refers to the intersection of A and B denoted by AnB. from the above example $AnB = \{1,3,5\}$ because these elements can be found in both A and B.

Example 1. If $U = \{1,2,3......10\}$
$A = \{2,4,6,8,10\}$
$B = \{1,2,3,6,7\}$

Find the elements of:

I. A^1
II. B^1
III. AUB
IV. $A \cap B$
V. $(AUB)^1$
VI. $A^1 \cap B^1$

Solution

Given U = {1,2,3,4,5,6,7,8,9,10}
A = {2,4,6,8,10}
B = {1,2,3,6,7,}

i. $A^1 = \{1,3,5,7,9\}$
ii. $B^1 = \{4,5,8,9,10\}$
iii. AUB = {1,2,3,4,6,7,8,10}
iv. $A \cap B = \{2,6\}$
v. $(AUB)^1 = \{5,9\}$
vi. $A^1 \cap B^1 = \{5,9\}$

Exercise

Write down the elements of the following sets:
Given U = {2, 4, 6, 8, 10,}

I. A^1
II. B^1
III. AUB
IV. $A \cap B$
V. $(AUB)^1$
VI. $A^1 \cap B^1$

UNIT 3

DESCRIBING AND WRITING SETS

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use different properties of numbers to solve problems with sets.

TEACHER'S GUIDE

Teacher to explain the properties of numbers and write them in the form of a set.

PUPIL'S GUIDE

Pupils to copy the properties of numbers in their exercise books.

USING DIFFERENT TYPES OF NUMBERS TO DESCRIBE SETS.

a) **THE SET OF EVEN NUMBERS**: numbers that can be exactly divided by 2. That is {2,4,6,8,10……………}

b) **THE SET OF ODD NUMBERS**: Numbers that cannot be exactly divided by 2. That is {1,3,5,7,9,11……….}

c) **THE SET OF PRIME NUMBERS**: Numbers that have only two factors (i.e. itself and 1) that is {2,3,5,7,11,13,17...}

d) **THE SET OFWHOLE NUMBERS**: Numbers denoted by W.
W = {0,1,2,3,4,5…….}

e) **THE SET OF NATURAL NUMBERS**: Numbers denoted by N.
N = {1,2,3,4,5….}

f) **THE SET OF INTEGERS**: This refers to positive and negative whole
Z = {-3, -2, -1,0,1,2,3…….}

g) **THE SET OF SQUARE NUMBERS**. That is {1,4,9,16,25….}.

MULTIPLES OF A NUMBER: Refers to numbers obtained by multiplying the number by 1,2,3 and so on. The set of multiples of 5 is {5,10,15,20,25….}, The set of multiples of 3 is {3,6,9,12,15,18……}.

UNIT 4

VENN DIAGRAMS

(35 minutes)

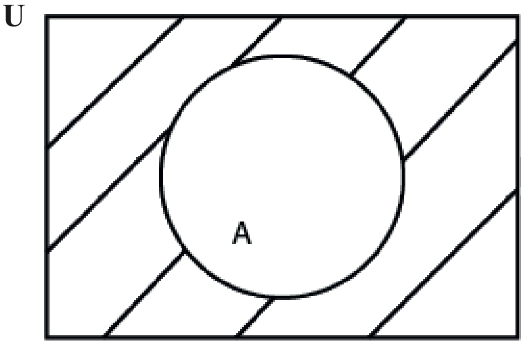
LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use Venn diagrams to solve simple problems involving sets.

This is a rectangle that may contain one, two or three circles that can be used to solve problems in sets. The rectangle always represents the universal set and the circles, the subsets.

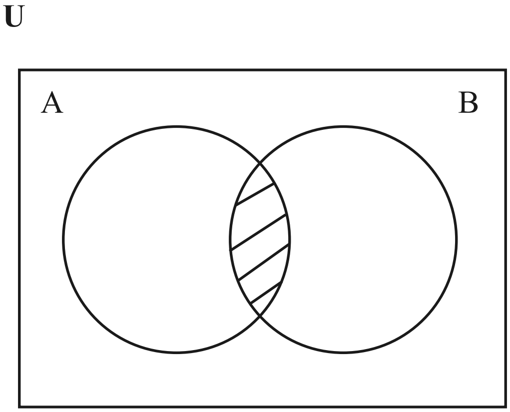
SOME RELATIONSHIPS BETWEEN SETS.

i



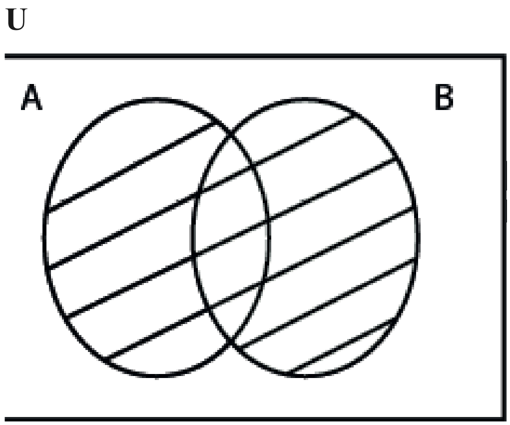
The shaded portion represent the compliment of A that is. A^1

ii



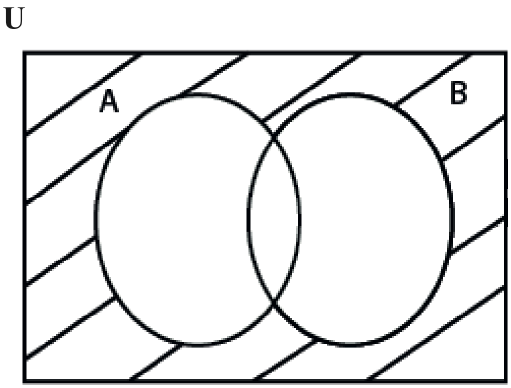
The shaded portion represents AnB

iii



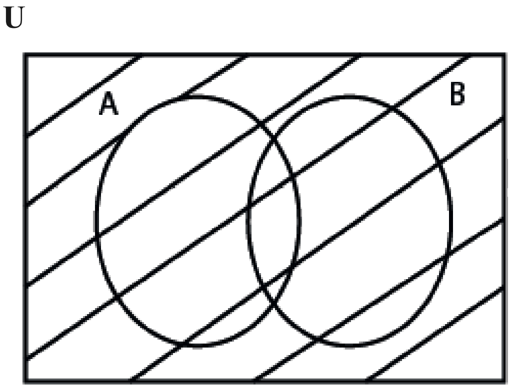
The shaded portion represents AUB

iv



The shaded portion represents (AUB)^{1}

v



The shaded portion represents (AUB) U (AUB)^{1}

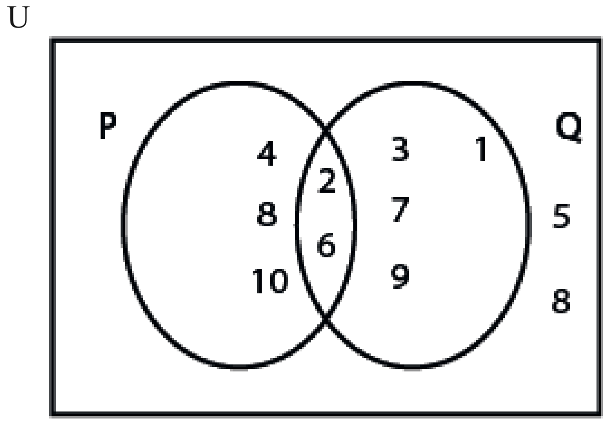
Examples: Given that

U = {1,2,3…….10}
P = {2,4,6,8,10}
Q = {1,2,3,6,7,9}.

Represent the information on a Venn diagram.

Solution

U = {1,2,3,4,5,6,7,8,9,10}
P = {2,4,6,8,10}
Q = {1,2,3,6,7,9}



Note that P ∩ Q = {2,6} P U Q = {1,2,3,4,6,7,9,10}. (P U Q)^1 = {5,8}.

Exercise

1. Given that

U = {1,2,3…….12}
P = {2,4,6,8,10,12}
Q = {1,2,3,6,7,9,11}.

Represent these on a Venn diagram.

U = {1,2,3…….12}
Q = {1,2,3,6,7,9,11}
P = {,2,4,6,8,10,12}.

UNIT 5

IDENTIFICATION OF NUMBER SYSTEM (BASE) USED BY DIFFERENT CULTURES

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to identify number bases used by different cultures.

TEACHER'S GUIDE

Teacher to explain the different number system used by various cultures.

A number base system is a system for representing numbers, involving a variety of digits or symbols of a given set in a consistent manner.
Ideally, a numerical system will:

- Represent useful set of numbers (for example all integers or rational numbers).
- ensure that every number represented is a unique representation (or at least a standard representation).
- Reflect the algebraic and arithmetic structure of numbers.

The ancient Egyptian numbers were used by early Egyptians until the early first millennium AD. Some cultures traditionally count in 5's. when counting the days of the week, we count in 7's; time in seconds is counted in 60's.

The number system 0,1,2,3,4,5,6,7,8,9 is mostly known as Arabic numbers or Indo – Arabic numbers. The reason why this number system is popular, is because it was spread by the Arabs in Europe. The system was developed by the Indian Mathematicians and adopted by Persian and Arab Mathematicians.

This number system is the simplest used number system in the world and Sierra Leone and its culture is not an exception. All local languages and culture in Sierra Leone count in the base 10 number system using the numerals, 0,1,2,3,4,5,6,7,8,9.

ROMAN NUMERALS

The symbols are

i. 1
ii. 2
iii. 3
iv. 4
v. 5

X - 10
L - 50
C - 100
D - 500
M – 1,000

UNIT 6

NUMBER BASE

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to solve problems involving convertion from one number base to another number base.

TEACHER'S GUIDE

Teacher should review basic rules in order to write numbers in an index form.

PUPIL'S GUIDE

Pupils to copy relevant examples in their exercise books.

HOW TO CONVERT OTHER BASES TO BASE 10

There are two methods

1) The power expansion method.
2) The successive multiplication method.

Example 1

Convert 11001_{two} to base 10.
Power expansion method

$$\begin{aligned} 11001_{two} &= (1 \text{ x } 2^4) + (1 \text{ x } 2^3) + (0 \text{ x } 2^2) + (0 \text{ x } 2^1) + (1 \text{ x } 2^0) \\ &= (1 \text{ x } 16) + (1 \text{ x } 8) + (0 \text{ x } 4) + (0 \text{ x } 2) + (1 \text{ x } 1) \\ &= 16 + 8 + 0 + 0 + 1 \\ &= 25_{10} \end{aligned}$$

Successive multiplication method

$$\begin{aligned} 11001_{(2)} &= (1 \text{ x } 2) + 1 \\ &= (3 \text{ x } 2) + 0 \\ &= (6 \text{ x } 2) + 0 \\ &= (12 \text{ x } 2) + 1 \\ &= 25_{10} \end{aligned}$$

Example 2

Convert 342_{five} to a number in base 10.

Power expansion method

$$\begin{aligned} 342_{(5)} &= (3 \text{ x } 5^2) +(4 \text{ x } 5^1) +(2 \text{ x } 5^0) \\ &= (3 \text{ x } 25) +(4 \text{ x } 5) +(2 \text{ x } 1) \\ &= 75+ 20 +2 \\ &=97_{10.} \end{aligned}$$

Successive multiplication method

$$\begin{aligned} 342_{(5)} &= (3 \text{ x } 5) +4 \\ &= (19 \text{ x } 5) +2 \\ &= 95 +2 \\ &= 97_{10.} \end{aligned}$$

HOW TO CONVERT FROM ONE BASE TO ANOTHER BASE

Here we first convert to base 10 and by successive division, we convert to the desired base. Base 10 is considered as the bridge to the desired destination.

Example 1

Convert 67_{10} to a number in base 6.

6	67
6	11R1
6	1R5
	0R5

↑ $551_{(6)}$

Since the number was already in base 10, we proceed by successively dividing.

UNIT 7

LAWS OF INDICES

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use multiplication and division rules of indices to solve problems.

TEACHER'S GUIDE

Teacher to carefully explain the multiplication and division rules of indices with the guided examples.

PUPIL'S GUIDE

Pupils to ensure they copy all the laws of indices and examples in their exercise books.

LAWS OF INDICES.

$a^3 = a \times a \times a$
$a^4 = a \times a \times a \times a$

So $a^3 \times a^4 = (a \times a \times a) \times (a \times a \times a \times a)$
$= a^7$

1. The first law of indices known as the multiplication or product rule.
$a^m \times a^n = a^{m+n}$

Example 1 simplify the following:

i. $5^3 \times 5^2$
ii. $2x^4 \times 4x^3$
iii. $12a^3b^3$

Solution

1. $5^3 \times 5^2 = 5^{3+2}$
$= 5^5$
$= 3,125.$

ii. $2x^4 \text{ x } 4x^3$
$= (2 \text{ x } 4)x^{4+3}$
$= 8x^7$

iii. $3a^2b^{-3} \text{ x } 4ab^6 = (3\text{x}4) \text{ x } a^{2+1} \text{ x } b^{-3+6}$
$=12a^3b^3$

2. The second law of Indices or the division law

$$a^m \div a^n = a^{m-n}$$

Also, if we have $p^4 \div p^3 = \frac{\cancel{p} \text{ x } \cancel{p} \text{ x } \cancel{p} \text{ x } p}{\cancel{p} \text{ x } \cancel{p} \text{ x } \cancel{p}}$

$= p$

3. The third law of Indices

$$(a^m)^n = a^{m \text{ x } n}$$
$$= a^{mn}$$

Example 2 Simplify the following:

i. $21x^{12} \div 14x^3$
ii. $2^5 \div 2^2$
iii. $(4^2 \text{ x } 2^3)^2$
iv. $(10b^6c^2)^2$
v. $(12a^4 \text{ x } 2a^2) \div (5a^2 \text{ x } 6a^3)$

Solution

i. $21x^{12} \div 14x^3 = \frac{\cancel{21}x^{12}}{\cancel{14}x^3}$

$= \frac{3x^{12-3}}{2}$

$= \frac{3x^9}{2}$

ii. $2^5 \div 2^2 = 2^{5-2}$
$= 2^3$
$= 8$

iii. $(4^2 \text{ x } 2^3)^2 = 4^{2\text{x}2} \text{ x } 2^{3\text{x}2}$

$= 4^4 \text{ x } 2^6$

$= \underline{(2^2)}^4 \text{ x } 2^6$

$= 2^{2\text{x}4} \text{ x } 2^6$

$= 2^8 \text{ x } 2^6$

$= 2^{8+6}$

$= 2^{14}$

$= 16384$

iv. $(10b^6c^2)^2 = 10^2 \text{ x } b^{6\text{x}2} \text{ x } c^{2\text{x}2}$

$= 100b^{12}c^4$

v. $(12a^4 \text{ x } 2a^2) \div (5a^2 \text{ x } 6a^3) = \dfrac{12 \text{ x } 2 \text{ x } a^{4+2}}{5 \text{ x } 6 \text{ x } a^{2+3}}$

$= \dfrac{24a^6}{30a^5}$

$= \dfrac{4a^{6-5}}{5}$

$= \dfrac{4a}{5}$

UNIT 8

PROPERTIES OF INDICES

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use/apply positive and negative fractional indices to solve problems.

1. ZERO POWER

$a^0 = 1$

2. NEGATIVE INDEX

$-n = \frac{1}{a^n}$

3. FRACTIONAL INDEX

$a^{1/2} = \sqrt{a}$

$a^{1/n} = \sqrt[n]{a}$

Example. Find the values of

i. $(\frac{25}{4})$ ½

ii. $8^{-2/3}$

iii $\frac{2^6 \text{ x } 2^2}{4^4}$

iv. $16^4 \text{ x } 8^{1/3}$

v. $27^{-1/3}$

Solution

i. $(\frac{25}{4})^{1/2} = \frac{25^{1/2}}{4^{1/2}}$

$= \frac{5}{2}$

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

$$= \frac{1}{(2^3)^{2/3}}$$

$$= \frac{1}{2^{3x2/3}}$$

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

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

iii. $\frac{2^6 \text{ x } 2^2}{4^4} = \frac{2^6/2}{(2^2)^4}$

$$= \frac{2^8}{2^8}$$

$$= 2^{8-8}$$

$$= 2^0$$

$$= 1$$

iv. $27- {}^1/_3 = \frac{I}{27^{1/3}}$

$$= \frac{1}{(3^3)^{1/3}}$$

$$= \frac{1}{3^{3x1/3}}$$

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

v. $16^4 \text{ x } 8^{1/3} = (2^4)^4 \text{ x } (2^3)^{1/3}$

$$= 2^{4x4} \text{ x } 2^{3 \text{ x } 1/3}$$

$$= 2^{16} \text{ x } 2^1$$

$$= 2^{16+1}$$

$$= 2^{17}$$

$$= 131,072$$

UNIT 9

STANDARD FORM

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use index notation to write large and small numbers using standard form.

Pupils to understand that in writing a number in standard form, you write one whole number before the decimal point and then write the remaining numbers after the decimal point. For example $3145 = 3.145 \times 10^3$.

Pupils to copy examples in their exercise books.

When numbers become very small or large, we can manage them by writing them in standard form (Radicals). In standard form we write numbers as:

(a number from/less than 10) x (an integer power of 10).

i.e $X \times 10^n$

where $1 \leq X < 10$ and n is an integer

For example, 1 3.82×10^4 is in standard form.

but 25.46×10^5 is not in standard form.

If n is zero, it implies the number is between 1 and 10.

For example, 5.62×10^0

$= 5.62$

If n is negative the number may be less than 1.

For example 3.21×10^{-3}

$= 0.00321$

If n is positive, it implies the number maybe larger than ten.

For example 5.26×10^4

$= 52600$

To write a number in standard form we first write the number from 1 to less than 10 and then determine the number of places the decimal point is being moved.

- If we move the decimal point from right to left, then the power of 10 that is n is positive.
- If we move the decimal point from left to right, then n is negative.

Example 1 Write the following numbers in standard form:

i. 5000
ii. 687.05
iii. 0.00513
iv. 0.0246
v. 325.68

Solution

i. 5000
We write 5.0×10^3 i.e. shifting the decimal 3 spaces from right to left
ii. $687.05 = 6.8705 \times 10^2$
iii. $0.00513 = 5.13 \times 10^{-3}$
The decimal point was shifted 3 splaces from left to right, which gives a negative power of 10.
iv. $0.0246 = 2.46 \times 10^{-2}$
v. $325.68 = 3.2568 \times 10^2$

UNIT 10

EVERYDAY ARITHMETIC

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use/apply BIDMAS to solve word problems.

THE FOUR OPERATIONS

In mathematics, the four operations are ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION.

When solving problems that involve some or all the operations, we must follow the principles of BODMAS OR BIDMAS as the case may require.

Under this unit attention will be paid to how we use the operations in solving word problems.

Number

BIDMAS is the order in which you work out a calculation

B	I	D	M	A	S
r	n	i	u	d	u
a	d	v	l	d	b
c	i	i	t	i	t
k	c	s	i	t	r
e	e	i	p	i	a
t	s	o	l	o	c
s		n	y	n	t
1st	2nd	3rd	4th	5th	6th

Number

EXAMPLES

1) Work out the following without a calculator

(a) $2 + \boxed{3 \times 4}$
$= 2 + 12$
$= 14$

(b) $7 - \boxed{2 \times 6}$
$= 7 - 12$
$= -5$

(c) $3 + 5 \times \boxed{4 \div 2}$
$= 3 + \boxed{5 \times 2}$
$= 3 + 10$
$= 13$

(d) $2 \times 3 - \boxed{4 + 2}$
$= \boxed{2 \times 3} - 6$
$= 6 - 6$
$= 0$

(e) $4 \times 3^2 - \boxed{7 + 2}$
$= 4 \times \boxed{3^2} - 9$
$= \boxed{4 \times 9} - 9$
$= 36 - 9$
$= 27$

B	O	D	M	A	S
r	o	i	u	d	u
a	r	v	l	d	b
c	d	i	t	i	t
k	e	s	i	t	r
e	r	i	p	i	a
t	2nd	o	l	o	c
s		n	y	n	t
1st		3rd	4th	5th	6th

Work out the answers to these and then work out the joke:

W = 6 + 3 × 5 **R** = 3 × 8 + 2
G = 3 + 8 × 2 **I** = 4 + 7 × 3
O = 4 × 7 + 3 **N** = 6 + 5 × 9
P = 6 × 5 + 9 **T** = 14 − 1 × 2
S = 16 − 2 × 7 **Q** = 7 + 8 × 2
U = 5 × 7 − 8 **C** = 22 − 3 × 4
M = 22 − 3 − 4 **L** = 28 − 6 × 2
D = 7 × 2 + 4 **E** = 8 + 7 × 4
A = 32 − 6 × 3 **H** = 9 × 3 + 2

THE JOKE

21 29 14 8 29 14 39 39 36 51 36 18 8 31

8 29 36 39 16 14 51 8 25 51 8 29 36

15 14 8 29 2 10 16 14 2 2 ?

25 8 19 26 36 21

2 23 27 14 26 36 26 31 31 8 2

SUM AND DIFFERENCE

- The sum of numbers is the result obtained when we add the numbers together.
- Difference refers to the result obtained when we subtract the numbers. It is usual that we always subtract smaller numbers from bigger ones.

Example 1 The sum of three consecutive numbers is 33. Find the numbers.

Solution

Let the 1st number be x
So, the 2nd = x+1
And the 3rd = x+2

Since their sum is 33x + (x+1) + (x+2) = 33

$$x + x + 1 + x + 2 = 33$$
$$3x + 3 = 33$$
$$3x = 33-3$$
$$\frac{\cancel{3}x}{\cancel{3}} = \frac{\cancel{30}}{\cancel{3}}$$
$$X = 10$$

Example 2 Find the difference between 33/4 and 22/3.

Solution

$$= \frac{33}{4} - \frac{22}{3}$$
$$= \frac{99 - 88}{12} = \frac{10}{12} = \frac{5}{6}$$

PRODUCT

The product of numbers is the result obtained when the numbers are multiplied.

Example 3.
The product of two numbers is 24. If one of the numbers is ¼, find the other number.

Solution

Let the number be y
So y x ¼ = 24
y/4 = 24
y = 4 x 24
y = 96

Example 4 When the sum of 35 and a certain number is divided by 4, the result is equal to double the number. Find the number.

Solution

Let the number be w
The sum of 35 and a certain number divided by 4:

$$\frac{35 + w}{4}$$

The result is double the number:

$$2w$$

So $\frac{35 + w}{4} = 2w$

$$(35 + w) = (4 \text{ x } 2w)$$
$$35 + w = 8w$$
$$35 = 8w - w$$
$$\frac{\cancel{35}}{\cancel{7}} = \frac{\cancel{7}w}{\cancel{7}}$$
$$W = 5$$

Example 5 Simplify: $\frac{5 \text{ x } 11 \div 3^2}{4}$ (Here the principles of BODMAS or BIDMAS must be applied)

Solution

$$\frac{5 \text{ x } 11 \div 3^2}{4} = \frac{5 \text{ x } 11 \div 9}{4}$$
$$= \{(5 \text{ x } (11 \div 9)\} \div 4$$
$$= 5 \text{ x } 11/9 \text{ x } 1/4$$
$$= 55/36 \text{ or } 119/36$$

Exercise 1 The sum of 8 and a certain number is equal to the product of the number and 3. Find the number.

Exercise 2 The sum of two numbers is 11. The product of the numbers is 30. Find the numbers.

UNIT 11

PERCENTAGES

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to solve problems involving profit and loss.

REVISION: A percentage is a fraction in which the denominator is 100. The symbol % means percentage.

Example: 40% means $\frac{40}{100}$ and 50% means $\frac{50}{100}$

CONVERSIONS

(a) **FRACTIONS TO PERCENTAGES** To convert fraction to percentage, we multiply by 100.

Example 1

Convert the following fractions to percentages.

(i) $\frac{10}{50}$ (ii) $\frac{30}{50}$

Solution:

i) $\frac{10}{50} \times \frac{100}{1} = \frac{1000}{50} = 20\%$

ii) $\frac{30}{50} \times \frac{100}{1} = \frac{3000}{50} = 60\%$

Exercise 1:

Convert the following fractions to percentage i) $\frac{25}{40}$ ii) $\frac{30}{60}$ iii) $\frac{4}{6}$ iv) $\frac{20}{20}$

(b) **TO EXPRESS DECIMALS AS FRACTIONS**

You first convert the decimal to a fraction and then multiply your answer by 100.

Example 2: Convert the following decimals to percentages

(i) 0.62 (ii) 0.683

Solution i) $0.62 = \frac{62}{100} \times \frac{100}{1} = \frac{6200}{100} = 62\%$

ii) $0.683 = \frac{683}{1000} \times \frac{100}{1} = 68.3\ \%$

(c) TO EXPRESS PERCENTAGES AS DECIMALS

To convert a percentage to a decimal we divide by 100.

Example Convert the following percentages to decimals

i) 40% (ii) 1.50% (iii) 25%

Solution i) $40\% = \frac{40}{100} = 0.40$

ii) $1.50\% = \frac{1.50}{100} = 0.0150$

iii) $25\% = \frac{25}{100} = 0.25\%$

CALCULATING PERCENTAGES OF QUANTITIES

Example 4 i) What is 25% of Le 600?

$\frac{25}{100} \times \frac{600}{1} = 25 \times 6 = \text{Le}150$

ii) 20% of a population of 500 people were affected by the COVID 19 disease. How many people were affected?

Solution: (i) Percentage means a quantity out of 100

$25\% = \frac{25}{100}$ and 'of' means multiply by the quantity:

(ii) $\frac{20}{100} \times 500 = 20 \times 5 = 100$

Exercise 2: a) What is 35% of Le 800?

b) What 25% of a population of 100 people?

(e) DECREASE A VALUE BY A GIVEN PERCENTAGE

Example 5: Decrease 140 by 10%

Solution

First method: 140 is 100%, when decreased by 10%, we have 90%

$$90\% \text{ of } 140 = \frac{90}{100} \text{ x } 140 = 9 \text{ x } 14 = 126$$

Second method:

10% of 140

10/100x 140 = 14

Reduce 140 by 14 = 140-14 = 126

Third Method:

First find 10% of 140

10% of 140 = 140 ÷ 10 = 14

10% = 14

90% = 14 x 9 = 126

Exercise 3: Find the following without using a calculator:

a) 10% of 80
b) 25% of 60
c) 70% of 200

Exercise 4

A builder moulds 400 bricks on Saturday and later discovered that 25% of the bricks were faulty. How many bricks were faulty?

PROFIT AND LOSS PERCENTAGES

In the market, the cost price is the price the dealer can buy goods and the selling price is the price at which he sells the goods.

He makes a profit when the selling price is more than the cost price. Alternatively, he makes a loss when the selling price is less than the cost price.

PROFIT = Selling Price – Cost Price

LOSS = Cost Price – Selling Price

$$\text{Profit Percentage} = \frac{\text{Selling Price - Cost Price}}{\text{Cost price}} \times \frac{100}{1} \text{ or } \frac{\text{Profit}}{\text{Cost Price}} \times 100$$

$$\text{Loss Percentage} = \frac{\text{Cost Price – Selling Price}}{\text{Cost price}} \text{ x } \frac{100}{1} \text{ or } \frac{\text{Loss}}{\text{Cost Price}} \times 100$$

Example 6: (i) A trader bought a plasma television at Le 900,000 and sold it at Le 950,000. Calculate the profit percentage

(ii) A chair bought at Le1800 and sold at Le1500. What is the loss percentage?

(iii) A radio was bought at Le 70,000 and sold at a profit of 20%. Calculate the selling price.

Solution

Profit percentage $\frac{\text{Selling Price - Cost Price}}{\text{Cost price}} \text{ x } \frac{100}{1}$

$$\frac{950{,}000\text{-}900{,}000}{900{,}000} \text{ x } \frac{100}{1} = \frac{50{,}000}{900{,}000} \text{ x } \frac{100}{1}$$

$$= \frac{5 \text{ x } 100}{90 \text{ x } 1} = \frac{5 \text{ x } 100}{9} = \frac{50}{9} = 5.55\%$$

(ii) Loss Percentage = $\frac{\text{Cost price-Selling Price}}{\text{Cost Price}} \text{ x } \frac{100}{1}$

$$= \frac{1800 - 1500}{1800} \text{ x } \frac{100}{1} = \frac{300}{1800} \text{ x } \frac{100}{1} = \frac{3}{18} \text{ x } \frac{100}{1}$$

$$= \frac{1}{6} \text{ x } \frac{100}{1} \text{ x } \frac{100}{6} = 16.6\%$$

(iii) Profit = $\frac{20\%}{100} \text{ x } 70{,}000$

= 0.20 x Le70,000 = Le14,000

Selling Price = Cost Price + Profit

Selling Price is = Le70,000 + Le14,000 = Le84,000

Exercise 5

1) If 80kg of groundnut is increased by 40%, what is its new value?
2) What is 45% of 600
3) A dealer sold a textbook for Le800 and made a profit of 25%. At what price did he buy the book?
4) A teacher bought a bicycle at Le50,000 and sold it at Le60,000. What is the profit percentage?
5) Express 55 out of 75 as a percentage.

UNIT 12

SIMPLE INTEREST

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to calculate interest on problems with loans.

SIMPLE INTEREST: Interest is a payment given for saving money. It can also be the price paid for borrowing money. When interest is calculated on the basic sum of money saved or borrowed, it is called SIMPLE INTEREST. Interest is the profit return on investment when money is invested and interest is paid to the investor.

The money used for the investment is called the **PRINCIPAL**. The percentage return is called the **RATE PERCENT**. The amount is the total obtained by adding the interest to the principal.

NOTE: With simple interest, the principal always stays the same, no matter how many years the investment (or loan) may last.

FORMULA

Simple Interest can be calculated using the formula

$I = \frac{PRT}{100}$ that is $I = \frac{P \times R \times T}{100}$ where

P = The Principal (the sum of money saved or borrowed)
R = The Annual rate of interest (given as a percentage)
T = The Time for which the money is (saved or borrowed)

The other derived formulae are:

$T = \frac{100 \times I}{P \times R}$; $R = \frac{100 \times I}{P \times T}$; $P = \frac{100 \times I}{R \times T}$

Examples:

1) Find the simple interest on Le120 for 7½ years at 60% per annum

Solution: $I = \frac{P \times R \times T}{100}$ Where

$$= \frac{\text{Le}120 \times 6 \times 7\tfrac{1}{2}}{100}$$

$$= \frac{\text{Le}120 \times 6 \times 15}{100 \times 2} = \text{Le}54$$

I = Simple Interest
R = Rate Percentage
T = Time (in yrs)
P = Principal

The simple interest therefore is Le54

2) Find the simple interest on Le8,000 invested for 3years at 6% per annum.

Solution: $I = \frac{P \times R \times T}{100}$ Given

P = Le8,000
R = 6%
T = 3 years

$$SI = \frac{8{,}000 \times 6 \times 3}{100} \times 80 \times 6 \times 3 = 1440$$

The simple interest = Le 1,440

3) Calculate the rate at which \$4000 invested for 6years gives an interest of \$4.

Solution: $R = \frac{100 \times I}{P \times T}$ where

I = \$4
P = \$4000
T = 6 years

$$: R = \frac{100 \times 4}{4000 \times 6} = \frac{4}{40 \times 6} = \frac{4}{240} = 0.0166\%$$

4) What is the rate at which Le2000 invested for 4months gives an interest of Le60?

Solution $R = \frac{100 \times I}{P \times T}$

Where I = LE60, P= Le2000
$T = \frac{4\text{months}}{12} = \frac{1}{3}$ yr.

$$: R = \frac{100 \times 60}{2000 \times 0.33} = \frac{6}{2 \times 0.33} = \frac{6}{0.66} = 9.09$$

R = 9.1%

(5) What sum of money must we invest to give Le300 simple interest at the rate of 60% per annum and the time is 2 years?

Solution: $SI = \frac{P \times T \times R}{100}$

Where R = 6%
T = 2yrs
I = Le 300

$$P = \frac{100 \times 300}{6 \times 2\text{yrs}} = \frac{30000}{12} = \text{Le } 2{,}500$$

The money invested is Le 2,5 00 (Principal)

The amount = Principal + Interest = Le 2500 + Le 300
= Le 2530

Exercise 1
Find the simple interest on the following

i) Le300 for 4yrs at 8%
ii) Le520 for 5yrs at 7%
ii) Le225 for 4yrs at 9%

AMOUNT

The amount is the sum of the principal and the interest that is. A= Principal + Interest.

Example 1
Find the simple interest and amount on N120 for 7½ yrs at 6% per annum

Solution

$$SI = \frac{P \times T \times R}{100} = \frac{120 \times 6 \times 7\frac{1}{2}}{100} = SI = N54$$

In the example above, the principal is N120 which makes an interest of N54.
Therefore amount = N120 + N54 = N174

Example 2

Find the amount of Le343.20 in 5yrs at 6½% per annum.

Solution

$$I = \frac{P \text{ x } R \text{ x } T}{100} = \frac{\text{Le}343.20 \text{ x } 6\tfrac{1}{2} \text{ x } 5}{100}$$

$$= \frac{343.20 \text{ x } 13 \text{ x } 5}{100 \text{ x } 2} = \frac{85.8}{4} = \frac{\text{Le } 429}{4} = 111.54$$

Amount = Principal + Interest

= Le 343.20 + Le 111.54 = Le 454.74

Exercise 2

Find the amount of the following investment

1. Le 500 for 1yr at 6%
2. N 800 for 1yr at 8%
3. $400 for 3yrs at 6%
4. Le700 for 2yrs at 7½%

UNIT 13

COMPOUND INTEREST

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use compound interest to calculate total interest over a number of years.

Pupils to copy examples in their books and ensure to remember the appropriate formula for a specific question.

Simple Interest

This is the interest accumulated over a certain period

When money is saved with simple interest the interest is paid at regular intervals and the principal remains the same.

With **compound interest**, the interest is added to the principal at the end of each interval.

Thus, the principal increases and so the interest becomes greater for each interval. Most saving's schemes give compound interest, not simple interest.

Example 1: Find the compound interest on Le600 for 2yrs at 8% per annum

Solution: 1^{st} year: $I = \frac{P \text{ x } T \text{ x } R}{100} = \frac{600 \text{ x } 8 \text{ x } 1}{100}$

$= \text{Le } 48$

Amount at the end of 1^{st} year = Le 600 + 48

= Le 648

2^{nd} year: $I = \frac{P \text{ x } T \text{ x } R}{100} = \frac{648 \text{ x } 8 \text{ x } 1}{100}$

$= 6.48 \text{ x } 8 \text{ x } 1$

$= \text{Le } 51.84$

Amount at the end of 2^{nd} year = Le 648 + Le 51.84

= Le 699.84

Compound interest = Le 699.8 – Le 600 = Le 99.84 or

Compound interest = Le 45 + Le 51.84 = Le 99.84

Example 2:
Mr. Sankoh borrow Le2000 from Mr. Jajua at the rate of 5% compound interest. How much does Mr. Jajua receive after 4 years?

Solution: First year = Principal	Le 2000
Interest = $\frac{5 \times 2000}{100}$	Le 100
2nd year = Principal	Le2,100 (2000 +100)
Interest $\frac{5}{100} \times 2100$	Le 105
3rd year = Principal	Le 2205
Interest $\frac{5}{100} \times 2205$	Le 110.25
4th year = Principal	Le 2315.25
Interest = $\frac{5 \times 2315.25}{100}$	Le 115.76
Total amount =	Le 2431.01

Answer: Mr. Jajua receives Le 2431.01 after 4 years.

UNIT 14

EXCHANGE RATES MONEY

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to convert the Sierra Leone LEONES to sterling or dollars.

WEST AFRICAN CURRENCIES

Nigeria	100 kobo (k)	= 1 Naira (N)
Ghana	100 pesewas (p)	= 1 Cedi (C)
Sierra Leone	100 cents (c)	= 1 Leone (Le)
The Gambia	100 bututs (b)	= 1 Dalasi (D)
Liberia	100 cents (c)	= 1 Dollar ($)

French speaking countries – France CFA (undivided)

Other Countries

Britain	100 pence (p) = 1 Pound (£)
USA	100 cents (c) = 1 Dollar ($)

EXCHANGE RATE

The exchange rates fluctuates that is, rises or falls. At the time of going to the press £1 sterling was equivalent to the following

The Gambia	D 4.00
Ghana	¢ 4.85
Liberia	$ 1.77
Nigeria	N 1.18
Sierra Leone	Le 2.18

French speaking countries 592 for CFA

The following table gives the exchange rates between the English-speaking countries of West Africa.

	D	¢	$	N	Le
D1	1.00	1.21	0.44	0.30	0.55
¢1	0.82	1.00	0.36	0.24	0.45
$1	2.26	2.74	1.00	0.67	1.25
N1	3.39	4.11	1.50	1.00	1.85
Le1	1.83	2.22	0.81	0.54	1.00

Note: As already mentioned exchange rates changes from day to day. The above rates may only be taken as approximations for practice purposes.

COPY INTO YOUR BOOKS

Country	Exchange rate for £s sterling
Australia	2.82 Australian dollars
European countries	1.58 euros
Switzerland	2.32 Swiss francs
South Africa	16.34 rand
Turkey	2520000 New Turkish lira
U.S.A	1.55 US dollars

CHANGING TO A FOREIGN CURRENCY

FOREIGN CURRENCY = HOME CURRENCY x EXCHANGE RATE

Example

Amadu is going to Spain on a holiday to watch Real Madrid FC and changes £200 to euros. How much euros does he get?

STEP 1: FIND THE EXCHANGE RATE IN THE TABLE

STEP 2: INSERT AMOUNTS INTO THE FORMULA

FOREIGN CURRENCY = BRITISH CURRENCY x EXCHANGE RATE

AMOUNT OF EUROS = £200 x 1.58

AMOUNT OF EUROS = € 316

£200 = €316

Change £150 into Australian Dollars	**£150 × 2.82**	**$423**
Change £390 into US Dollars	**£390 × 1.55**	**$604.50**
Change £250 into Euros	**£250 × 1.58**	**€395**
Change £1500 into rand	**£1500 × 16.34**	**24510 rand**
Change £500 into Swiss Francs	**£500 × 2.32**	**1160 Swiss Francs**

Exercise

Exchange Rates (£1 =) QUESTIONS

1.	Europe	1,15 Euros	Japan	125.97 Yen
2.	Australia	1.57 Dollars	India	57.23 Rupees
3.	USA	1.52 Dollars	S. Africa	10.63 Rand

4.	Change £450 To USA Dollars	Change £700 to Rupees
5.	Change £620 to Yen	Change £500 to Rand
6.	Change £350 to Euros	Change £250 to Australia Dollars

UNIT 15

REVIEW OF AREAS AND PERIMETERS OF TRIANGLES AND QUADRILATERALS

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to recall and use the formulas for the area and perimeter of 2D shapes.

A polygon of four sides is called a quadrilateral for example: (i) Square (ii) Rectangle (iii) Rhombus (iv) Trapezium (v) Parallelogram

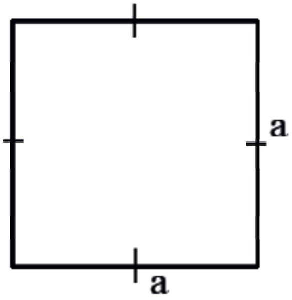
PERIMETER:

The word comes from two Greek words "Per" meaning round and meter meaning to measure.

Therefore, perimeter means "to measure round". The distance round the edge of a shape.

Examples

a) **Square**

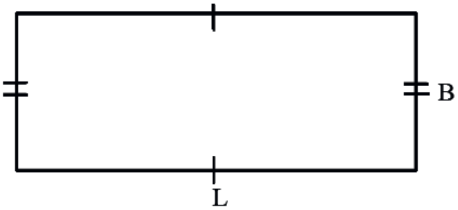


All sides are equal

Area (A) = a^2 (a x a)

Perimeter = P = a + a + a

b) **Rectangle**

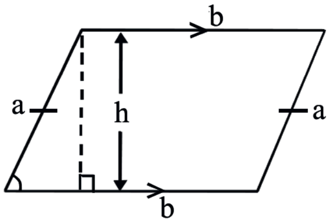


Two opposite sides are equal

Area (A) = LB = L x B

Perimeter (P) = 2 (L + B)

c) Parallelogram

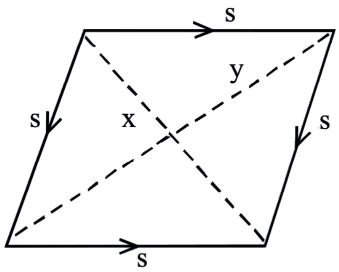


Opposite sides are equal and parallel

Area (A) = Bh

Perimeter (P) = 2(a + b)

d) Rhombus

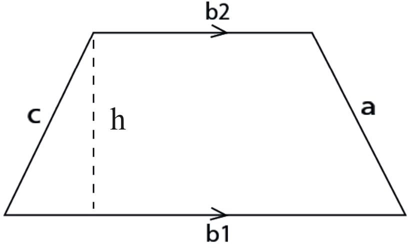


All four sides are equal, and the opposite sides are parallel

Area(A) = ½xy

Perimeter(P) = 5 + 5 + 5 + 5 = 45

e) Trapezium

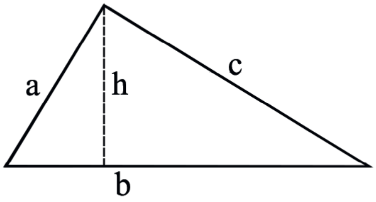


Has one parallel side.

Area (A) = $\frac{1}{2}(b_1 + b_2)h$

Perimeter (P) = $a + b_1 + b_2 + C$

f) Triangle



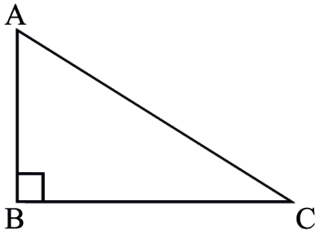
A shape with three sides or a polygon with 3 sides.

Area(A) = ½base(b) x h or ½bh or ½xbxh

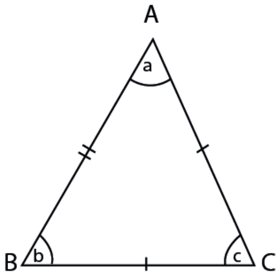
Perimeter = a + b + c

TYPES OF TRIANGLES

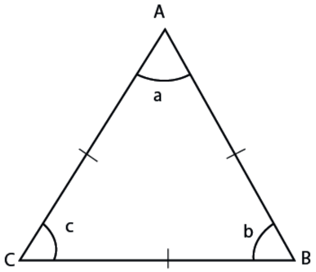
i) **A Right-Angle Triangle**: The longest side is opposite to the right angle which is 90^o



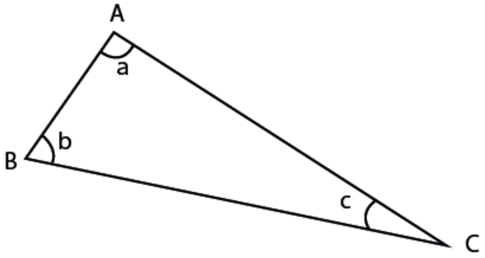
ii) **An Isosceles Triangle**: Two sides of this triangle are the same and the base angles are equal.



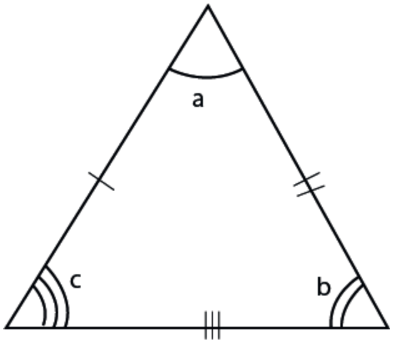
iii) **Equilateral Triangle**: All the three sides and angles are equal. Equal. Hence all the angles are equal



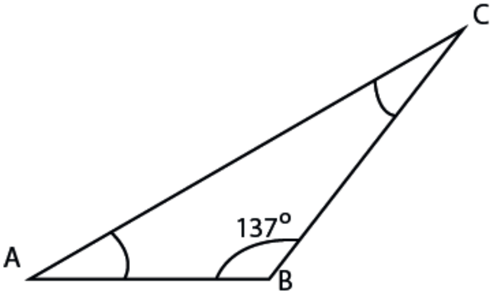
iv) **Scalene Triangle**: All the three sides are different; so are its angles.



v) **Acute Angle Triangle**: Each angle for this triangle is less than 90o

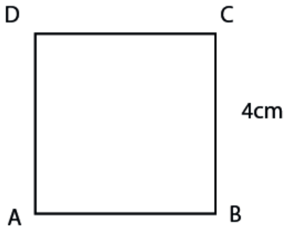


vi) **An Obtuse Angle Triangle**: One of the angles is greater than 90°



Calculate the area of the following figures

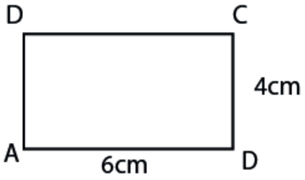
EXAMPLE 1



Area = L x B = 4cm x 4cm = $16cm^2$

Perimeter = 4cm + 4cm + 4cm + 4cm = 16cm

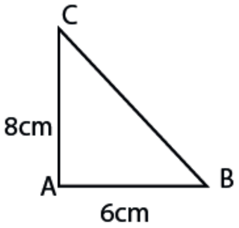
EXAMPLE 2



Area = L x B = 6cm x 4cm = $24cm^2$

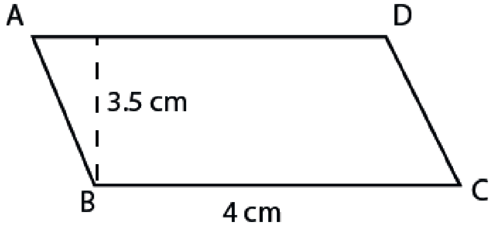
Perimeter = 6cm + 4cm + 6cm + 4cm = 20cm

EXAMPLE 3



Area = ½bh = ½ x 6 x 8 = $24cm^2$

EXAMPLE 4



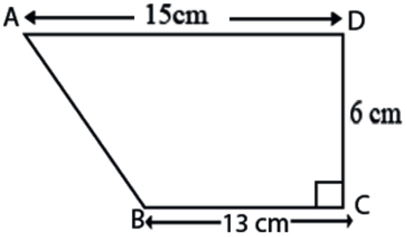
A parallelogram Area = bh

b = 4cm $\qquad$ A = $4 \times \frac{7}{2} = 14\text{cm}^2$

h = 3½ cm

EXAMPLE 5

Calculate the area of the figure below

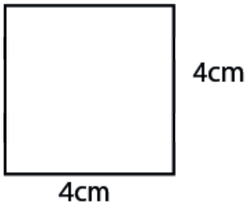


The figure is a Trapezium DC is perpendicular to BC. Therefore, DC is the distance between AD and BC Area of Trapezium = ½ (15+13) x 6 = ½ (28) x 6

= 14 x 6 = 84cm^2

EXAMPLE 6

Find the perimeter of a square with sides 4cm.



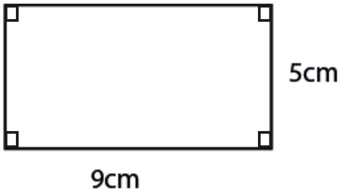
P = 4 + 4 + 4 + 4 + 4 = 16cm

Or 2(4 + 4)2 (8) = 16cm

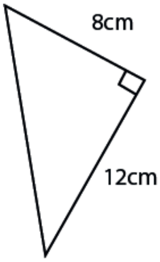
Exercise 1

1) The area of a rectangle is 220cm^2. If the width is 25cm. find its length.
2) What is the area of a parallelogram whose base is 7cm long and its vertical height is 4cm?
3) Calculate the area of the following shapes.

(i)



(ii)



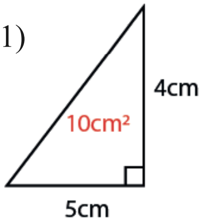
*exercise not yet taught

7. The area of a triangle is 76.85cm^2. If its height is 10.6cm. what is the length of the base of the triangle?

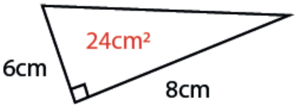
Exercise 2

Calculate the area of the following shapes. In Q9, calculate the shaded area.

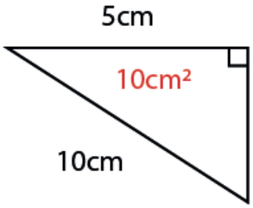
(1)



(2)

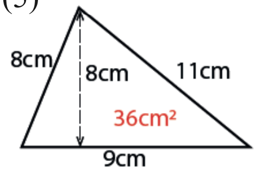


(3)

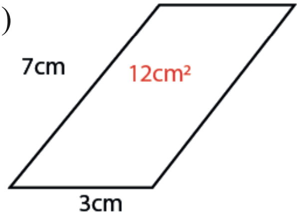


(4)

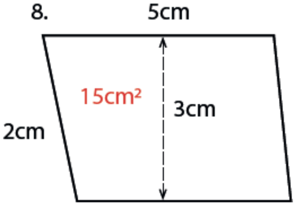
(5)



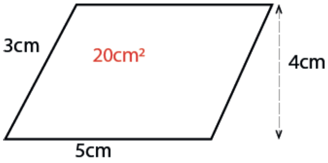
(6)



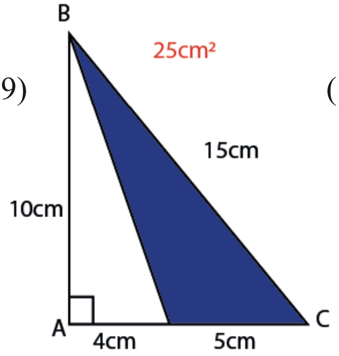
(7)



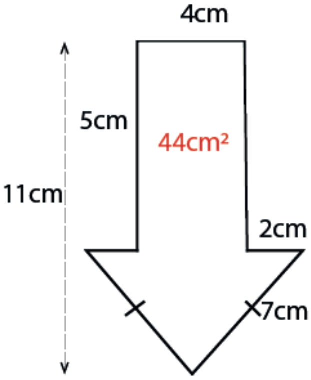
(8)



(9)



(10)



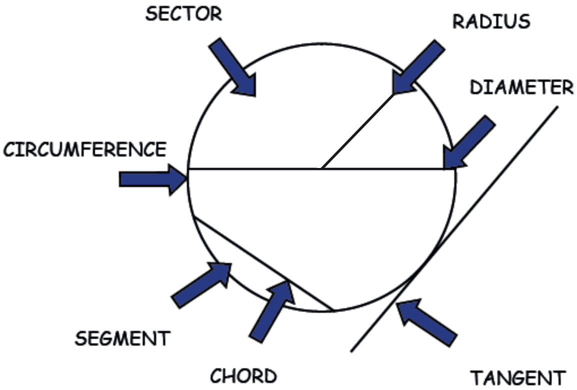
UNIT 16

AREA AND CIRCUMFERENCE OF CIRCLES

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use formulas to calculate the area and perimeter/circumference of circles.



Note:π is an appropriation for a special number represented by the Greek Letter π (Pi).

For any circle π = circumference ÷ diameter

Since the length of the diameter is double the radius, $C = 2\pi r$.

Therefore the approximated value is $\pi \frac{22}{7}$. Alternatively, we sometimes use 3.142.

Example 1 Find the area of a circle of radius 8cm.

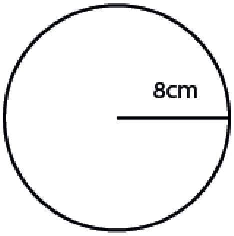
Solution:

Area = πr^2

$A = \frac{22}{7} \text{ x } 8^2 = \frac{22}{7} \text{ x } 8 \text{ x } 8$

$\frac{22}{7} \text{ x } 64 = \frac{1408}{7}$

Area = 201cm



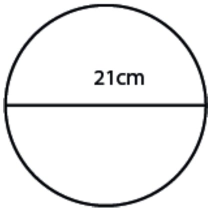
Example 2 Find the Circumference of a circle with diameter 21cm.

Using $\pi = \frac{22}{7}$

Circumference = πd

$C = \frac{22}{7} \text{ x } 21 = \frac{462}{7}$

Circumference = 66cm



Example 3 The radius of a circle is 7cm.

(a) What is the length of its diameter?
(b) What is the length of its circumference?

Solution (a) Diameter = 2 x radius
Radius = 7cm
Diameter = 2 x 7 = 14cm

(b) Circumference = $2\pi r = 2 \times \frac{22}{7} \times 7$
$\frac{44}{7} \times 7 = 44$cm

Example 4 The circumference of a circle is 176cm.
Find (a) radius (b) diameter

Solution: (a) Circumference = $2\pi r$
$\therefore 176\text{cm} = 2 \times \frac{22}{7} \times r$
$176 \times 7 = 2 \times 22 \times r$
$\frac{176 \times 7}{2 \times 22} = r$
$\therefore\ r = \frac{1232}{44} = 28$cm

Therefore, the radius = 28cm

(b) Diameter = 2r
Where r = 28cm
$\therefore\ 2 \times 28 = 56$cm

Example 5
What is the radius of a circle with area 616cm^2? $\pi = \frac{22}{7}$

Solution: Area = πr^2
$\therefore 616 = \frac{22}{7} \times r \times r$
$616 \times \frac{22}{7} = r \times r$
$r = \sqrt{(28 \times 7)} = \sqrt{(4 \times 7 \times 7)}$
$r = \sqrt{(2 \times 2 \times 7 \times 7)}$cm
$r = 2 \times 7$
$\therefore$ radius =14cm

Exercise 6
Calculate the area of the following circles:

1. Radius is 3 cm.
2. Diameter 10 cm

4) Find the diameter of a circle whose circumferences are (i) 34.4m (ii)18.5cm
5) *Find the circumferences of a circle whose radius is 6cm?
6) *If the area of circle is 144cm^2. Find its radius

UNIT 17

VOLUMES AND SURFACES OF 3D SHAPES: TRIANGULAR PRISMS, CUBOIDS AND CUBES

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to apply formulas to calculate total surface areas and volumes of 3D shapes.

Volume is the measure of space occupied by a solid. Volume can be equated to the amount of material used to make the solid if the solid is not hollowed.

Capacity is the measure of the amount of content a container can hold. If the container is made of thin metal, its volume is equivalent to its capacity.

Volume is measured in cubic units. In the metric system litre is the unit used for measuring capacity and pints, quarts and gallons are units in the imperial system used for measuring capacity.

The cross-section of a solid shape is the shape found when the solid is cut through parallel to its end face.

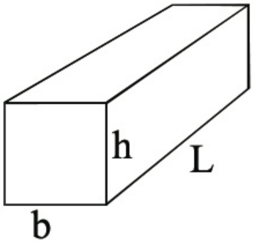
Prism: Any solid with a constant cross-section is a prism.

Cylinder: Is a circular prism whose cross-section is a circle.

Therefore, Volume of a Circular Prism = Volume of Cylinder
= Area of circular end face x Height
= Area of cross-section x Height

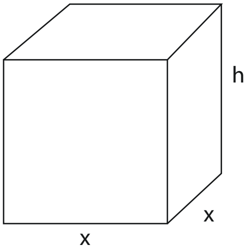
A cuboid is a rectangular prism whose cross-section is a rectangle.
Note: The volume of a prism is the product of the area of its cross-section and its height.

(a) **Cuboid (Rectangular Tank)**



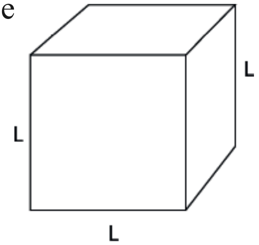
Surface Area = 2Lb + 2Lh +2bh
= 2(Lb +Lh + bh)
Volume = L x b x h

(b) Box with square base



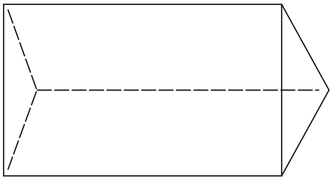
Surface Area = $2x^2 + 4$ x h;
When top opens
Area = $x^2 + 4$ x h
Volume(v) = x^2h

(c) Cube



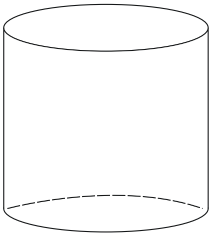
Surface Area = $6L^2$; when top opens
Area = $5L^2$
Volume(v) = L^3

(d) Prism



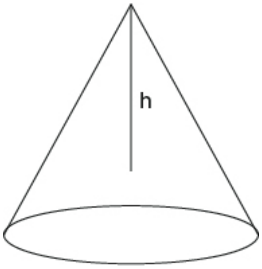
Surface Area (A) = bh + 2ls + lb
Perimeter of Cross-section x Length of Solid + (Total Area of Solid)
V = Ah (AL) Where A = Area

(e) Cylinder (Milk Tin)



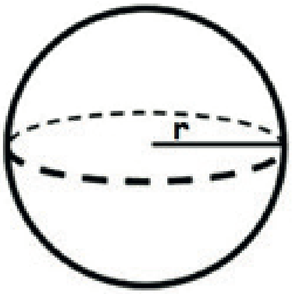
Curved Surface Area
$A = 2\pi r(r + h)$
When top opens
$A = \pi r^2 + 2\pi L = \pi r(r + 2h)$
Volume(V) = πr^2h

(f) Cone (funnel)



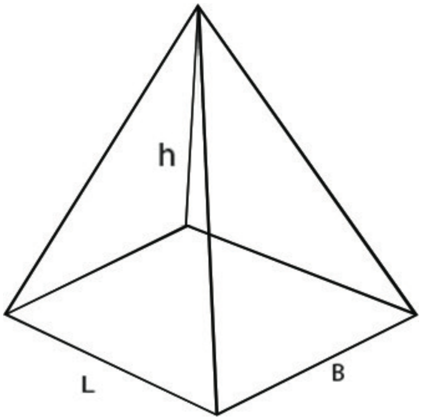
Curved Surface Area
$A = \pi r^2 + 2\pi rL = \pi r(r + L)$
$V = \frac{1}{3}\ \pi r^2h$

(g) Sphere (Earth)



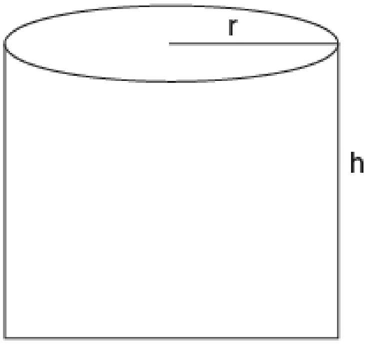
Surface Area A = $4\pi r^2$
V = $\frac{4}{3}$ πr^3

(h) Pyramid



Sum of the area of the triangle forming the side plus the area of the base
V = $\frac{1}{3}$ Lbh i.e.
V = ½ x L X b x h

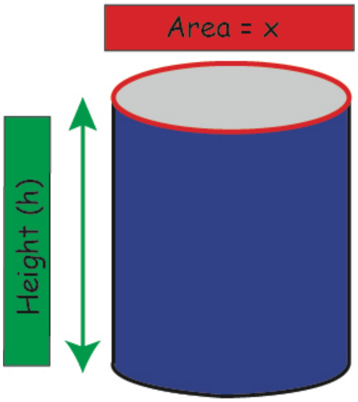
(i) Hemisphere



Surface Area
A = $2\pi r^2$ and V = $\frac{2}{3}$ πr^3

Area and Volume

LO: Calculate the volume of cuboids and cylinders



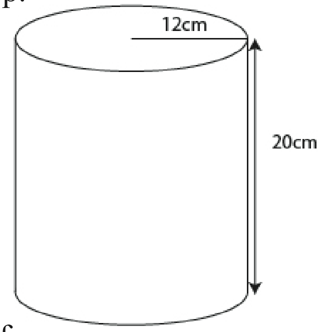
Volume of a Cylinder = Area of Circle x Height

Area and Volume

LO: Calculate the volume of cuboids and cylinders

Volume of a prism = area of cross section x length

Calculate the volume of this cylinder. Give your answer to 1 d.p.



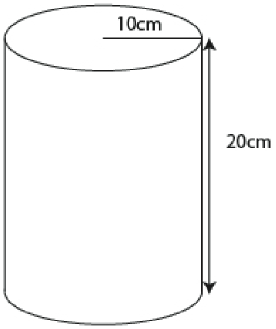
Area of cross-section = $\pi \times 12^2$

$= 452.389..\ \text{cm}^2$

Volume = $452.389.. \times 20$

$= 9047.8\ \text{cm}^3$

Calculate the volume of this cylinder. Give your answer to 3 s.f.



Area of cross-section = $\pi \times 5^2$

$= 78.539..\ \text{cm}^2$

Volume = $78.539.. \times 12$

$= 943\ \text{cm}^3$

Examples

(1) A rectangular tank is 76cm long, 50cm wide and 40cm high. How many litres of water can it hold?

Solution: $V = Lbh = 76cm \times 50cm \times 40cm$

$V = 152000cm^3$

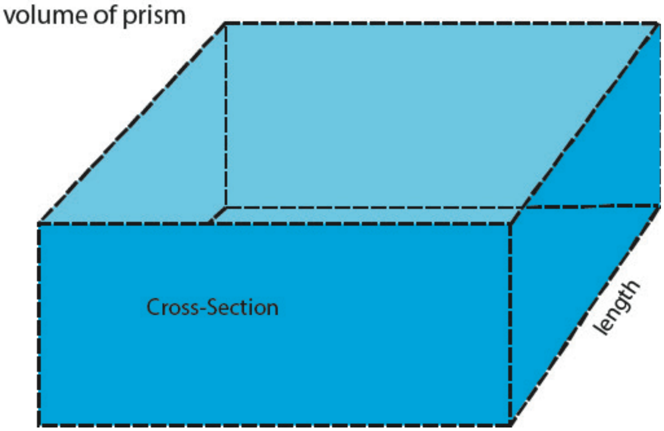
$1000cm^3 = 1$ Litres

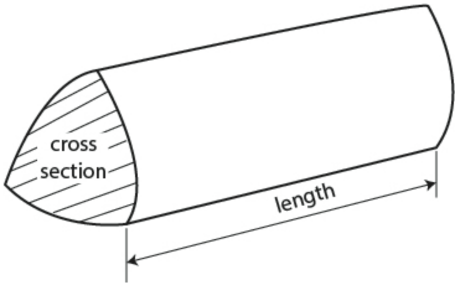
∴ $\therefore \mathbf{152000cm^3} = \frac{152000}{1000} = \mathbf{152\ Litres}$

Prism – A shape with uniform cross-section. If you cut off a slice from a prism, its shape is the same across the whole prism.

Volume of a prism

Volume

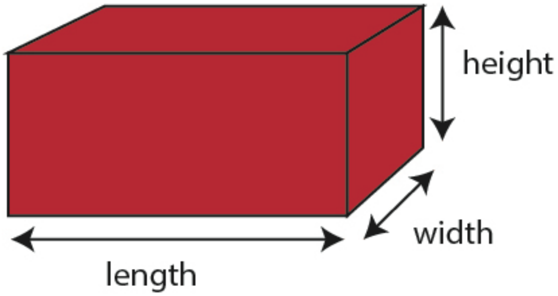




VOLUME IS THE SPACE
IN SIDE A 3D SHAPE

Volume of cuboid = Area of rectangle × **Length**

Volume

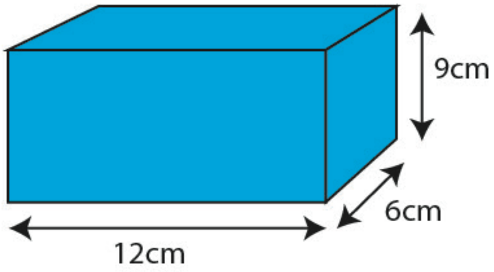


Volume of a cuboid = L × W × H

Examples

Find the volume of the cuboids below in cm^3

1)



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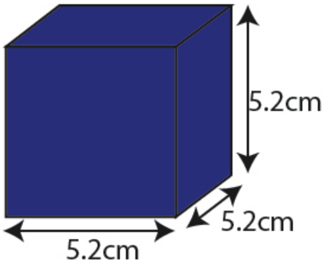


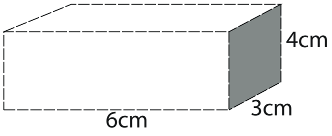
Answers

Volume = 12 x 6 x 9 = 648 cm^3

Volume = 5.2 x 5.2 x 5.2 = 140.608 = 140.6cm^3

Find the volume of the following cuboids.

1.



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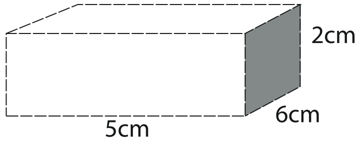

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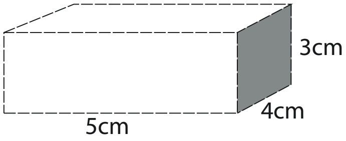

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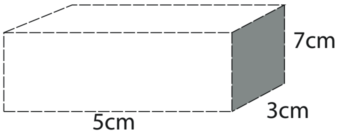

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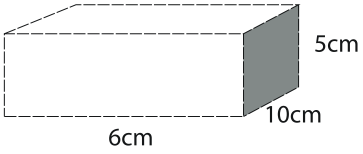
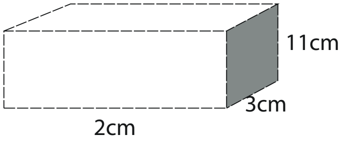


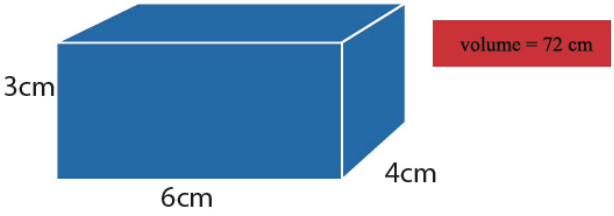
6.



Calculating a Missing Length with Given Volume

Sometimes in an exams, you will be asked to find a missing length of a cuboid with a given volume.

Example



$3 \times 4 = 12$
$72 \div 12 = 6$

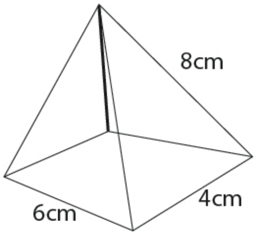
Step 1 - multiply the two given values.
Step 2 - divide the volume by the answer you got when you multiplied the two values.

Pyramids

A pyramid 8cm high stands on a rectangular base 6cm by 4cm. Calculate the volume of the pyramid.

Volume = $\frac{1}{3}$ Lbh

V = $\frac{1}{3}$ x 6 x 4 x h = 64cm^3



Exercises

1) Find the volume of a circular prism 10ft long if the radius of the cross-section is 7ft. Use $\pi = 3\frac{1}{7}$.

2) A triangular prism is 20cm long. The triangular face has a base 8cm long and the perpendicular height to the base is 7cm. What is the volume of the prism?

3) Find the height in metres of a pole if the volume of wood used to make the pole is 200cm^3 and the area of the cross-section is 154cm^2.

UNIT 18

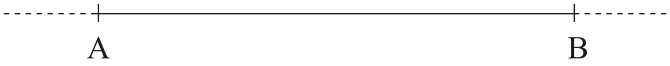
GEOMETRICAL CONSTRUCTIONS

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to bisect lines and angles.

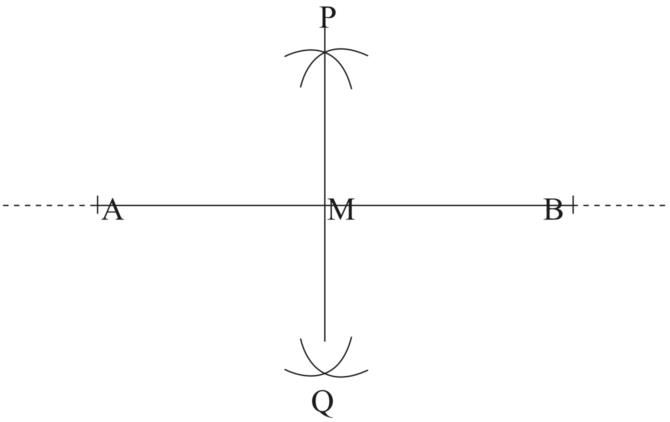
A) To Bisect a Straight-Line Segment



The line segment AB is the part of the line between A and B including the points A and B.

To bisect the line segment AB means to divide it into two equal parts.

Draw a straight line through P and Q so that it cuts AB at M.

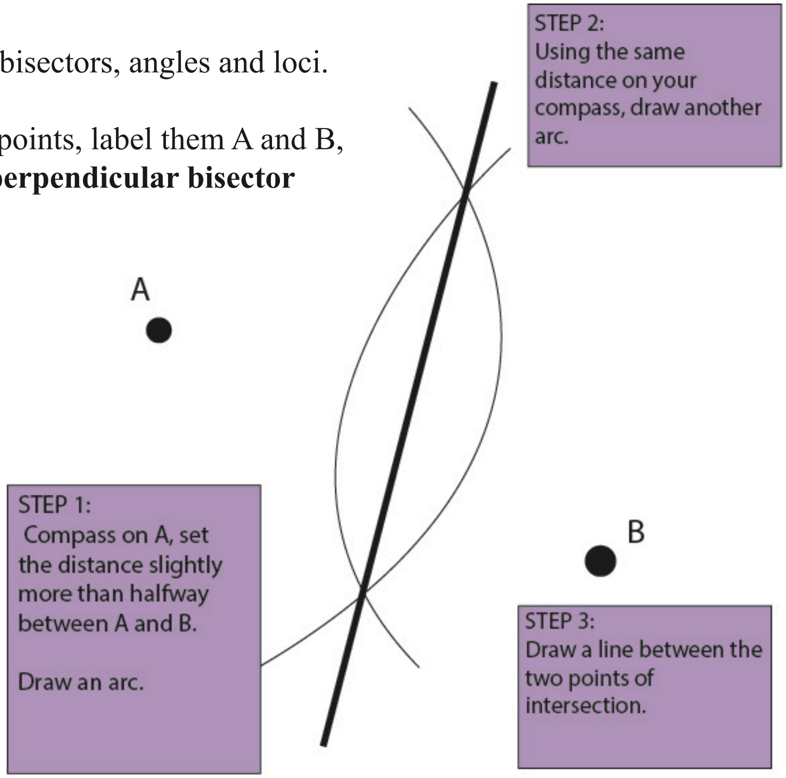


M is the midpoint of AB. PQ meets AB perpendicularly. PQ is the perpendicular bisector of AB. Use a ruler and protractor to check that AM = MB and $\Delta AMP = \Delta BMP = 90^O$

Constructions

LO: Construct bisectors, angles and loci.

Draw any two points, label them A and B, and find their **perpendicular bisector**



STEP 2:
Using the same distance on your compass, draw another arc.

STEP 1:
Compass on A, set the distance slightly more than halfway between A and B.

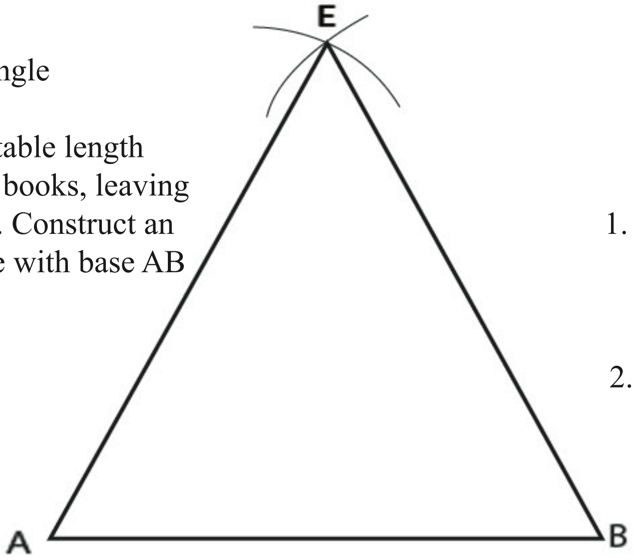
Draw an arc.

STEP 3:
Draw a line between the two points of intersection.

Construction

a. Equilateral Triangle

Draw a line of suitable length (e.g. 7cm) in your books, leaving some space above. Construct an equilateral triangle with base AB

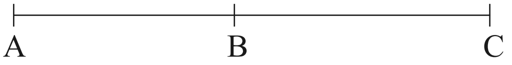


Method

1. Draw two arcs with the same length AB, with centres A and B.
2. Join points A and E to the arc to form the equilateral triangle.

B) To Construct an Angle of 90^O

Given a point on a straight-line AC



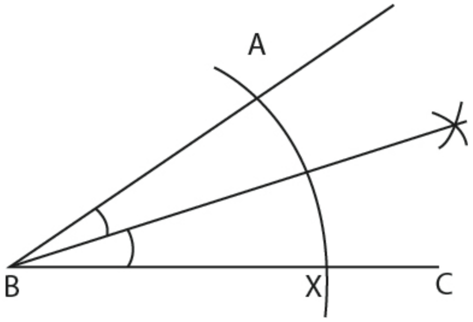
Method
B should be midpoint of AC.
With A and C as centres, construct two arcs with the same length.

Draw a perpendicular line to join the point of intersection of the two arcs and point B.

You are required to construct a line BR through B such that ΔRBA = ΔRBC = 90^O

C) To Construct an Angle of 30^O

30^O is ½ of 60^O. To construct an angle of 30^O, first construct an angle of 60^O and then bisect it as shown below.



Use a protractor to check the data above.
Exercises: Use ruler and a pair of compasses only in this exercise

1) Draw any angle < = ABC. Use the above method to construct the bisector of ΔABC. Use a protractor to check your result.
2) Construct angles of $90^O$and 45^O.

UNIT 19

PYTHAGORAS THEOREM

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use Pythagoras theorem to solve problems.

TEACHER’S GUIDE

Teachers to carefully review area of a square which is related to Pythagoras theorem. To understand that finding the hypotenuse, you add the two lengths. But finding any of the short sides, you subtract.

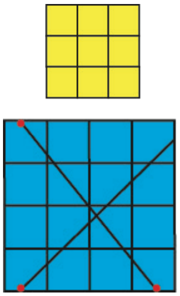
PUPIL'S GUDE

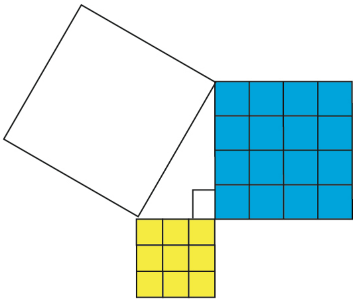
Pupils to learn how to draw a right-angle triangle. To calculate the hypotenuse, you add two lengths that are squared. To find any short side, hypotenuse squared minus the square of the short side.

Pythagoras theorem

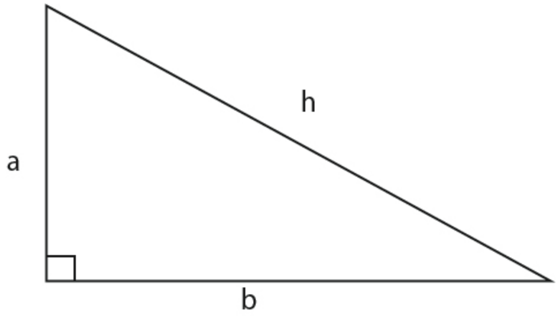
LO: Use the theorem to find a missing side in a right angled triangle

Draw a 3cm, 4cm, 5cm right-angled triangle
with a square on each side.
Cut out another 3cm by 3cm square.
Cut out another 4cm by 4cm square
and cut it into 4 pieces exactly as shown.
Use these five pieces to fit in the 5cm by 5cm
square to demonstrate Pythagoras' theorem.





In a right angled triangle the longest side opposite the right angle is called the HYPOTENUSE.

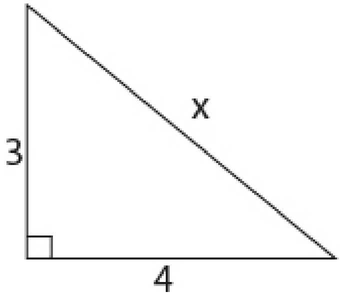


The side h being the longest is called the hypotenuse side. If "a" and "b" are the lengths of the side which make up the right angle, then $h^2 = a^2 + b^2$.

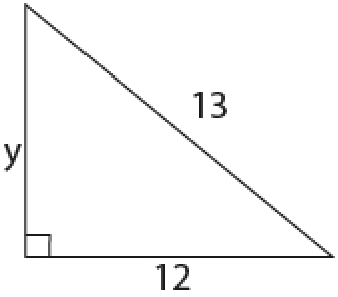
The theorem therefore states that, "In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides forming the right angle".

Example 1
Find the values of the sides marked with letters.

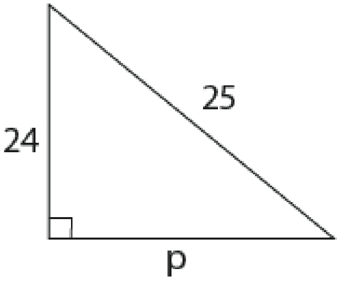
1.



2.



3.



Solution

$x^2 = 3^2 + 4^2$
$x^2 = 9 + 16$
$x^2 = 25$
$x = \sqrt{25}$
$x = 5$

Solution

$13^2 = y^2 + 12^2$
$169 = y^2 + 144$
$169 – 144 = y^2$
$y^2 = 25$
$y = \sqrt{25}$
$y = 5$

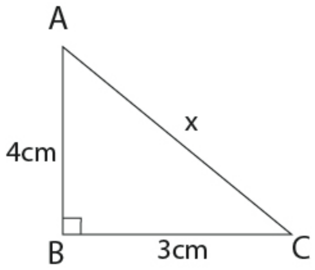
Solution

$25^2 = P^2 + 24^2$
$625 = P^2 + 576$
$625 – 576 + P^2$
$P^2 = 49$
$P = \sqrt{(49\ )}$
$P = 7$

Example 2

Calculate the length of the sides marked x in the right angle triangles.

1.



Solution

$AB^2 + BC^2 = AC^2$

$4^2 + 3^2 = x^2$

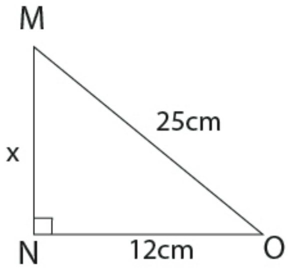
$16 + 9 = x^2$

$25 = x^2$

$x = \sqrt{25}$

$x = 5cm$

2.



Solution

$MN^2 + NO^2 = OM^2$

$x^2 + 12cm^2 = 25cm^2$

$x^2 + 144 = 625$

$x^2 = 625 - 144$

$x^2 = 481$

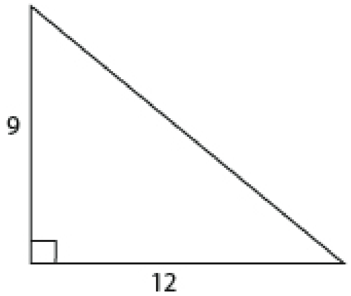
$x = \sqrt{(481)}$

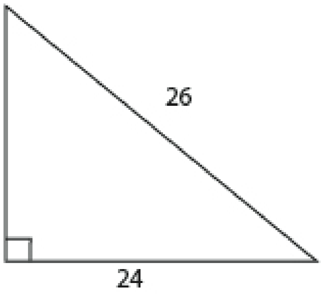
$x = 21.9317$

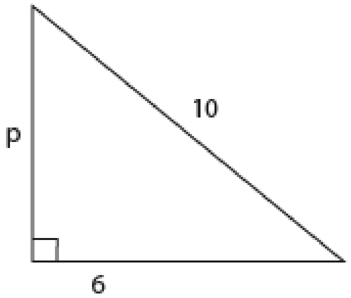
Exercise 1

Calculate the length of the sides marked x in the right-angle triangles below

1





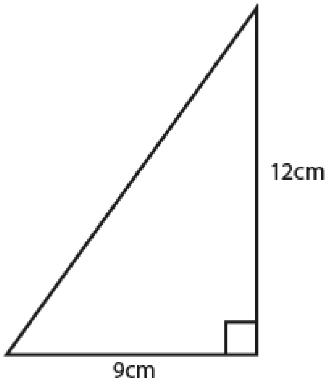


Exercise 2

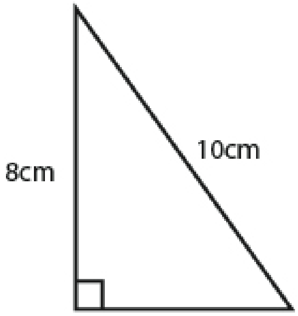
Pythagoras' Theorem

LO: Use the pythagoras theorem to find a missing side in the following right angled triangle.

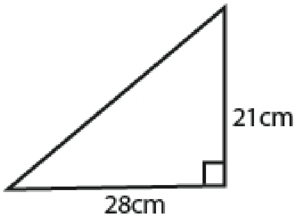
a



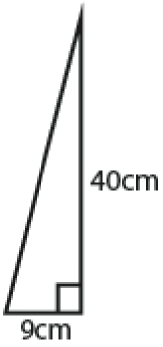
b



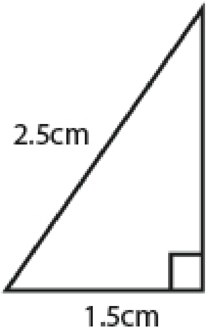
c



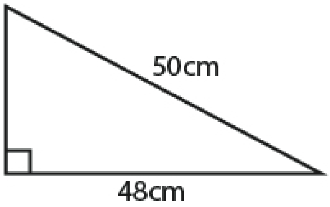
d



e



f



Exercise 3

1 A triangle has the same area as a square. If the area of the triangle 144cm^2, what is the length of one side of the square.

UNIT 20

CONGRUENCY TRIANGLES

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to use the properties of similar triangles to show that they are congruent.

TEACHER'S GUIDE

Teachers to ensure the concepts of AAS, SAS RAS are clearly explained to students clearly.

PUPIL'S GUIDE

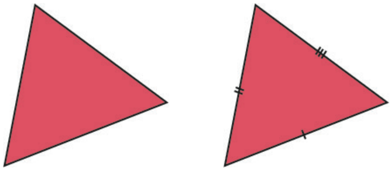
Pupils to draw the shape in order to see the similarities between two triangles.

Geometric Proof

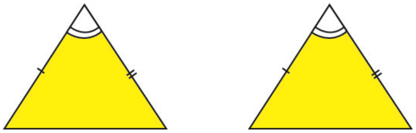
LO: Use geometric facts to prove statements.

Two triangles are congruent if they satisfy one of four sets of conditions:

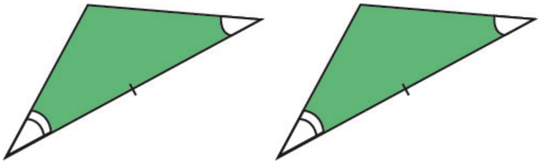
SSS: three sides the same



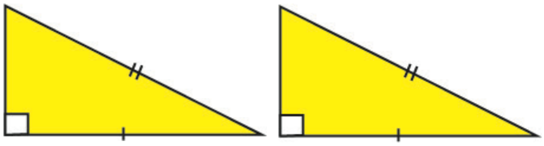
SAS: two sides and the included angle the same



ASA: two angles and the included side the same



RHS: right-angled triangles with hypotenuse and one other side the same

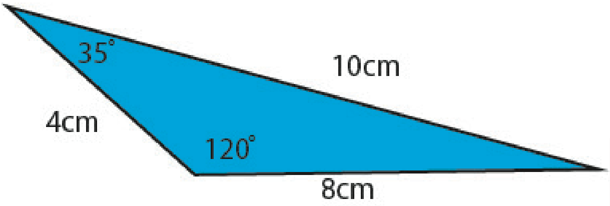


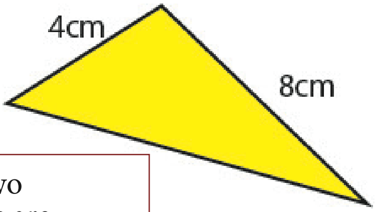
Congruent triangles are triangles that are similar in all respects. Such triangles are the same sizes with identical dimensions. For triangles to be congruent, any one of the following conditions must be satisfied.

- All corresponding sides are equal (SSS)
- Two pairs of corresponding sides and the included angles are equal (SAS)
- Two pairs of corresponding angles are a pair of sides are equal (AAS)
- One pair of sides and a pair of corresponding side are equal for right angles triangle (RHS).

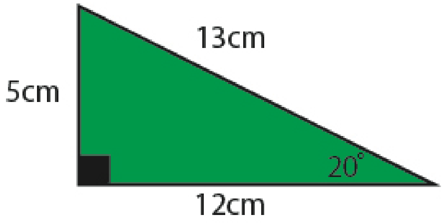
Examples

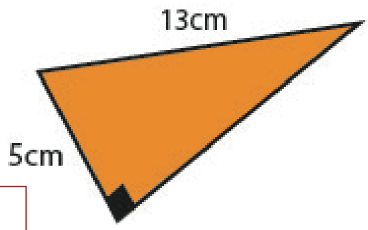
Congruency





These two triangles are congruent because of AAS

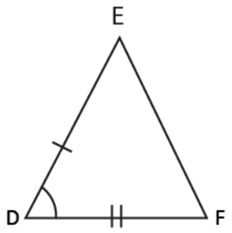


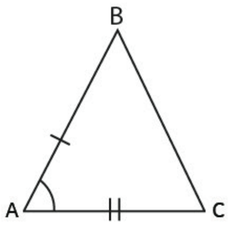


These two triangles are congruent because of RHS

Examples

1.





D F A C

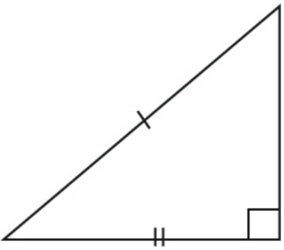
Solution

In

Δ DEF ΔABC, two sides the same and the included angle of both triangles are equal. This condition abbreviated as (SAS).

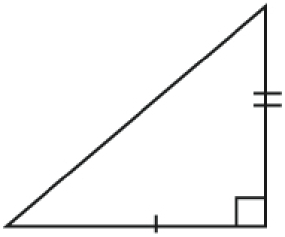
Therefore ΔDEF = ΔABC, SAS (side angle side).

Example 2

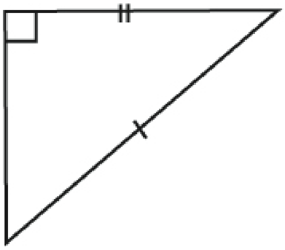


Which of the triangles below (i) (ii) and (iii) is/are congruent to the above given triangle.

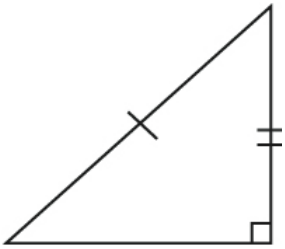
(i)



(ii)



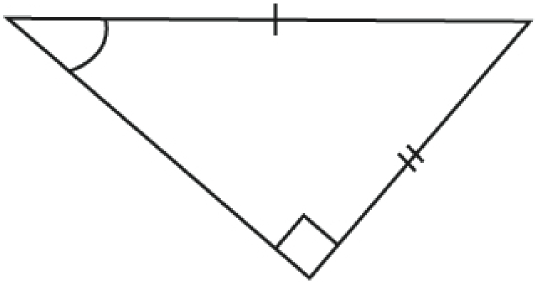
(iii)



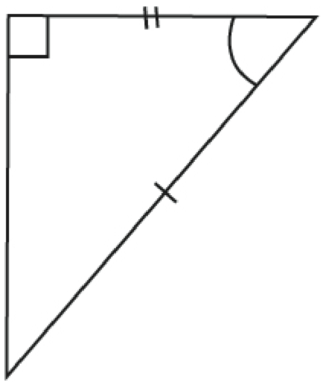
Solution (ii) and (iii) are congruent.

Exercise 1

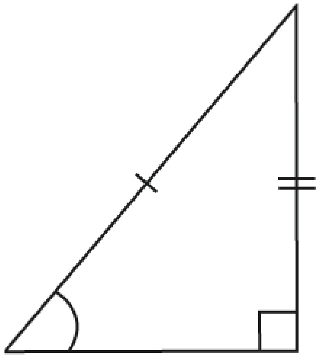
Which of the triangles (i) (ii) and (iii) is congruent to the given triangles.



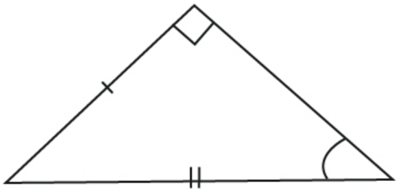
(i)



(ii)



(iii)



UNIT 21

MONEY AND USE

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to carry out calculations involving money problems.

TEACHER'S GUIDE

Teachers to use the column method for addition, subtraction and multiplication.

PUPIL'S GUIDE

Pupils to use the column method for adding, subtracting and multiplying numbers.

This involves the everyday uses of money.

Example I: A farmer collected 364 oranges from his farm on Monday, 2684 on Tuesday, 2560 on Wednesday, 3114 on Thursday, and 782 on Friday. He packs them in sacks of 300 oranges, to send them to Freetown by lorry. How many sacks does he fill?

Solution: Total number of oranges collected
= 3647 + 2684 + 2560 + 3114 + 782 = **9504**

b. 300 oranges fill one sack.

Solution: $\therefore \frac{9504}{300} = 31$ sacks

Example 2: if a dozen of onions cost Le 3,600 what is the cost of 9 dozen onions?

Solution: If 1 dozen = Le 3,600
Therefore 9 dozen = Le 3600 x 9
= Le 32,400

Exercise

1. Mr. Dauda has 13500 fruits trees in his garden. Two thirds of them are mango trees, the rest are orange trees. How many orange trees does he have?
2. Mr. Sankoh sold his house for one and half million Leones. He gave thirty-five thousand Leones to his son, fifty thousand to his wife and twenty-five thousand Leones to his business partner. How much did he keep for himself?

3a. The cost of a pen in a shop is Le 500 what is the cost of 12 pens bought at the same price?

b. If a customer pays Le 15,000, how many pens will be given to him?

UNIT 22

TRIGONOMETRY RATIOS

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to calculate the missing sides and angles of the right-angled triangle.

TEACHER'S GUIDE

Teacher to make clear pupil's understanding of opposite, adjacent and hypotenuse with one angle given inside the right-angle triangle.

PUPIL'S GUIDE

Students to copy examples set and complete the task set at the end of the unit.

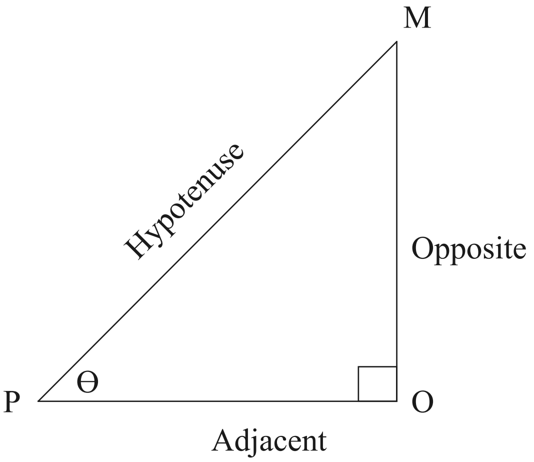
Sin, cosine and tangent of angles

For a right-angled triangle, the following can be defined.

$$\text{Sine } \Theta° = \frac{\text{Opposite}}{\text{Hypotenuse}} = \frac{|MO|}{|MP|}$$

$$\text{Cosine } \Theta° = \frac{\text{Adjacent}}{\text{Hypotenuse}} = \frac{|PO|}{|PM|}$$

$$\text{Tangent } \Theta° = \frac{\text{Opposite}}{\text{Adjacent}} = \frac{|MO|}{|PO|}$$



NOTE:

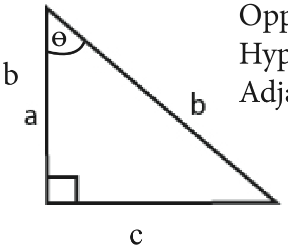
Opposite side of a right-angle triangle is the side facing the given angle.
Hypotenuse is the longest side.
Adjacent is the side joining the given angle and the right angle.

Example 1: Identify which of the letters in the triangle below are:

a. Opposite
b. Hypotenuse
c. Adjacent

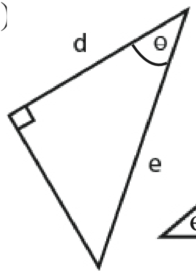
(i)

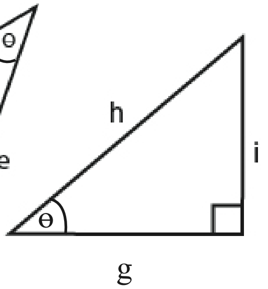
Opposite = c
Hypotenus = b
Adjacent = a



Opposite = f
Hypotenus = e
Adjacent = d

(ii)

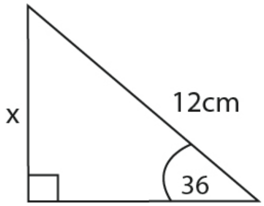




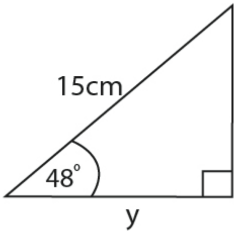
Opposite =i
Hypotenus = h
Adjacent = g

Example 2: Find the values of the side marked with letters.

(i)



(ii)

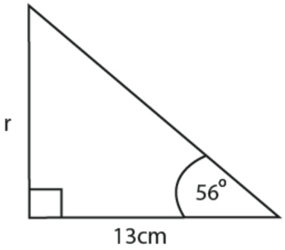


Solution

$\frac{\text{Sin } 36}{1} = \frac{x}{12}$
$x = 12 \sin 36$
$x = 12 \text{ x } 0.5878$
$x = 7.0536$
$x = 7.1$ cm (1dp)

Solution

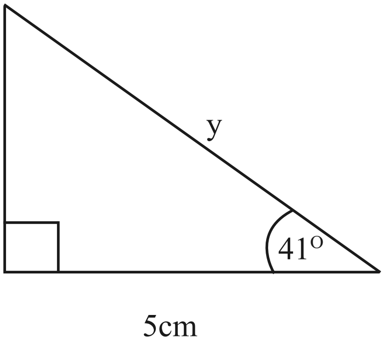
$\frac{\text{Cosine } 48^0}{1} = \frac{y}{15}$
$y = 15 \cos 48$
$y = 15 \text{ x } 0.6691$
$y = 4.668$
$y = 4.7$cm (1dp) (iii)



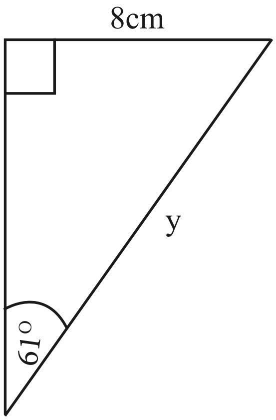
$\frac{\text{Tan } 56}{1} = \frac{r}{13}$
$r = 13 \tan 56$
$r = 13 \text{ x } 1.483$
$r = 19.27$
$r = 19.3$cm (1dp)

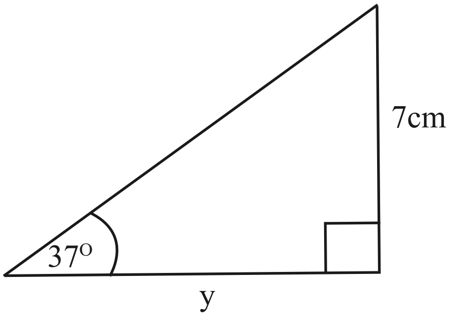
Exercise 1 Find the length of the sides marked y in the right angled triangle below.

(i)



(ii)





UNIT 23

ALGEBRA

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils should be able to: Expand and factorise simple expressions.

TEACHER'S GUIDE

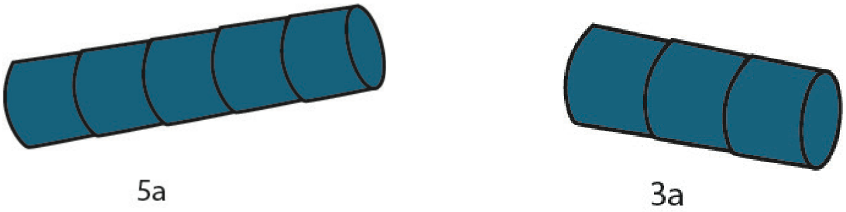
Teacher to use examples to explain key words: expression, simplify, term and like terms.

PUPIL'S GUIDE

Pupils to work independently in order to be able to self-assess their work.

Like Terms

A term is part of an expression
Like terms contain the same letter
You can simplify an expression by collecting like terms



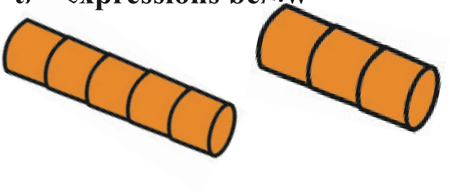
The total length = $5a + 3a = 8a$

5a and **3a** are like terms
They can be combined, or collected together

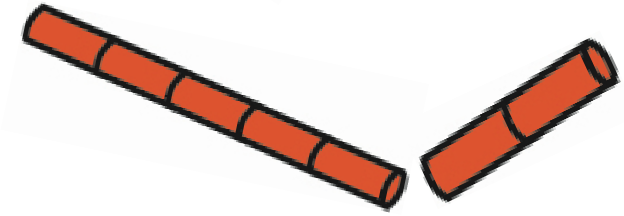
Exercise 1

Simlify th expressions below

- 1a) $5x + 3x =$



- 1b) $5y + 2y =$



- 1c) $4z + 2z + z$

Like Terms

2.
Simplify each of the following

a) $2n + 3n + n$

b) $4p + 2p - p$

c) $8q - 2q - 3q$

d) $5t + 3t + 4t$

e) $7r - 5r - r$

Example

Expanding and factorising brackets

1. Remove bracket and simplify

a. $5(a + 2) = 5a + 10$

b. $3 (x – 4) = 3x – 12$

c. $5 (a + 2) +4 (a + 1)$

d. $2 (3x - y) +3 (x + 2)$

e. $6 (4x + y) -7 (3x + 5y)$

Solution
5a + 10 + 4a + 4
5a + 4a + 10 + 4
9a + 14

d. 2 (3x – y) +3 (x + 2)

Solution
6x – 2y + 3x + 6y
6x + 3x = 2y + 6y
9x + 4y

e. 6 (4x + y) – 7 (3x + 5 y)

Solution
24x + 6y – 21x – 35y
24x – 21x + 6y – 35y
3x – 29y

2. Factorize the following
   a. ac – bc – ad + bd

Solution
c (a – b) d (a – b)
(a – b) (c - d)

b. xy – 4y – 5x + 20

Solution
y (x – 4 – 5 (x- 4)
(x – 4) (y – 5)

Exercise 1

Expand the following brackets and simplify

(1) 3 (x – 5y) (2.) 4x (2y + 3) – 3y (x + 8) (3.) 3 (x + y – 2)

(4.) 5p (3qr + s)

UNIT 24

LINEAR EQUATIONS

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson pupils will be able to solve problems involving linear equations.

TEACHER’S GUIDE

Teachers to engage pupil's in working through the examples. Give them some time to provide solutions to some of the questions.

PUPIL'S GUIDE

Pupils to remember to use the idea of collecting like terms.

Examples

Example 1

Solve $4x = 28$

Solution

" 4 times a number is 28"

The letter is multiplied by 4, so we must divide 28 by 4

So $x = 28 \div 4$

$x = 7$

Example 2

Solve $\frac{x}{6} = 3$

Solution

" A number divided by 6 is 3"

The letter is divided by 6, so we must multiply 3 by 6.

So $x = 3 \times 6$

$x = 18$

UNIT 25

CHANGE OF SUBJECT AND SUBSTITUTION

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson pupils will be able to make a variable the subject of the formula and then substitute a number to get the result.

TEACHER'S GUIDE

Teacher to go through the examples slowly for pupils to understand change of subject.

PUPIL'S GUIDE

Pupils to practice the examples and complete the exercises set.

Example 1

Change the subject in the following to make "a" the subject

Solution

$v = u + at$

$v - u = at$

$\frac{v - u}{t} - a$

Example 2

Change the subject in the following to make "p" the subject

Solution

$pk + q = h$

$pk = h - q$

$p = \frac{h - q}{k}$

Example 3

a. Make x the subject of the relation.

$\frac{x - 1}{m} + \frac{y}{n} = 2$

b. Given that $n = \frac{mk}{ec}$, make c the subject

Solution

a. $\frac{n(x-1)+my}{mn} = 2$

$\frac{nx-n+my}{mn} = 2$

$nx - n + my = 2mn$

$nx = 2mn - my - n$

$x = \frac{2mn - my - n}{n}$

b. $n = \frac{mk}{ec}$

$nec = mk$

$\frac{nec}{ne} = \frac{mk}{ne}$

$C = \frac{mk}{ne}$

Example 4

Make "m" the subject of the relation.

$h = \frac{mt}{d+p}$

Solution

$\frac{h}{I} = \frac{mt}{d+p}$

$mt = h(d+p)$

$\frac{mt}{t} = h\,\frac{(d+p)}{t}$

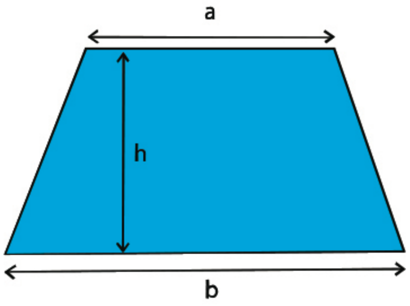
$m = h\,\frac{(d+p)}{t}$

Exercise 1

1. Make x the subject of the relation $\underline{2x} + 4y = 10$
2. Make x the subject: $x + y = 9$
3. Make t the subject of the relation $k = \frac{t-3}{t-9}$

SUBSTITUTION

The formula for the area of a trapezium is: $A = \frac{(a + b)h}{2}$



Find the area of a trapezium when a = 5, b = 9 and h = 3

$A = \frac{(a + b)h}{2}$

$A = \frac{(5 + 9)3}{2}$

$A = \frac{14 \times 3}{2}$ $\quad A = \frac{42}{2}$ $\quad A = 21$

Examples

1. If a = 5, b = 4 and c = 3, evaluate the following.
   (a) 3a + 6 (b) 5 + ab (c) a + bc (d) 5ab + 6bc (e) 4a + 6

Solution

(a) 3a + 6	(b) 5 + ab	(c) a + bc	(d) 5ab + 6bc	(e) 4a + 6
= 4 (5) + 6	= 5 + 5 x 4	= 5 + 4 x 3	= 5 (5)(4) + 6 (4)(3)	= 4 (a) + 6
= 15 + 6	= 5 + 20	= 5 + 12	= 100 + 72	= 4 x 5 + 6
= 21	= 25	= 17	= 172	= 20 + 6
				= 26

Exercise 2

1. Evaluate the following expressions given that
   a = 5, b = 2, c = 3, u = 4 and v = -3

   1. (a x c) (2) (u – v) (3) $\frac{3 + a}{3} + \frac{u + c}{3}$ (4) (a – b) (u – v)

UNIT 26

QUADRATIC EQUATIONS
(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to solve problems with quadratic equations.

TEACHER'S GUIDE

Teacher to start with quadratic equations with the coefficient of x^2 term equal to 1. Teacher should introduce the key words, product and sum.

PUPIL'S GUIDE

Pupils to work independently with support of the teacher.

A quadratic expression is one obtained from the product of two linear expression in the same variable.

Solve the following quadratic equations.

1. $x^2 – 8x + 16 = 0$

Solution

$x^2 – 5x + 6$

$x^2 – 2x – 3x + 6$

$(x^2 – 2x) – (3x – 6)$

$x(x – 2) – 3(x – 2)$

$= (x – 2) (x – 3)$

$= x = 2$ or $x = 3$

2. $x^2 + 9x + 20 = 0$

Solution

$x^2 + 4x + 5x + 20 = 0$

$x (x + 4) + 5 (x + 4) = 0$

$(x + 4) (x + 5) = 0$

either

$x + 4 = 0$ or $x + 5 = 0$

$x = -4$ or $x = -5$

3. $3x^2 - 2x - 8 = 0$

Solution

$3x^2 - 2x - 8 = 0$

$3x^2 + 4x - 6x - 8 = 0$

$x (3x + 4) - 2 (3x + 4) = 0$

$(3x + 4) (x - 2) = 0$

Either $3x + 4 = 0$ or $x - 2 = 0$

$x = \frac{4}{3}$ or $x = 2$

4. $x^2 + 2x - 8 = 0$

Solution

$x^2 - 2x + 4x - 8 = 0$

$x (x - 2) + 4 (x - 2) = 0$

$(x - 2) (x + 4) = 0$

either $x - 2 = 0$ or $x + 4 = 0$

$x = 2$ or $x = - 4$

Exercise

1. $a^2 + 7a + 12 = 0$
2. $x^2 - 10x + 21 = 0$
3. $y^2 + 8y + 7 = 0$

UNIT 27

INEQUALITY

(35 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to solve problems involving inequalities.

TEACHER’S GUIDE

Teacher to advise students to use a ruler and pencil to draw straight lines.

PUPIL'S GUIDE

Pupils to work through the exercises and ensure they draw a line graph for every question.

NOTATIONS

The symbols $<$, $\leq$, $>$ and $\geq$ are used to express inequalities (things that are not equal).

$<$ ⟶ Less than
$>$ ⟶ Greater than
$\leq$ ⟶ Less than or equal to
$\geq$ ⟶ Greater than or equal to

$x < 3$ means …………………… $2 < x$ means …………………………

$x \leq 5$ means …………………… $-1 \leq x$ means …………………………

$x > 4$ means …………………… $10 > x$ means …………………………

$x \geq -3$ means …………………… $6 \geq x$ means …………………………

$2 < x < 7$ means …………………………

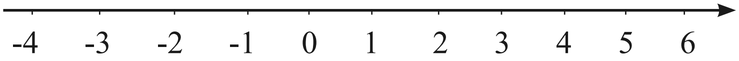
$1 \leq x \leq 9$ means …………………………

Inequalities on number lines

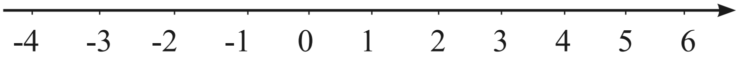
It is possible to represent inequalities on a number line.

EXERCISE 2

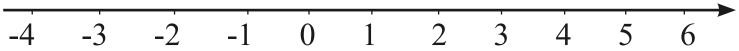
1. The inequality $x < 5$ can be represented as



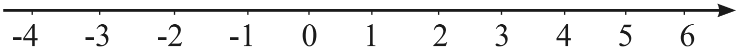
2. The inequality $x \geq 2$ can be represented as



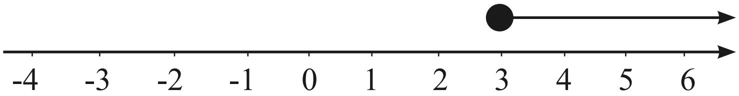
3. The inequality $1< x < 4$ can be represented as



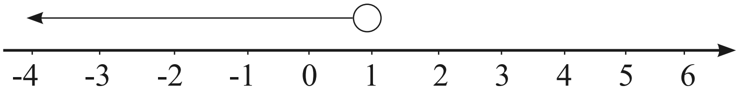
4. The inequality $-2 \leq x \leq 3$ can be represented as



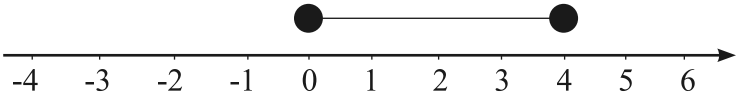
5. The inequality represented in the diagram is



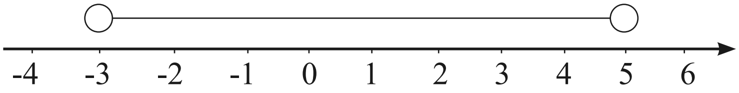
6. The inequality represented in the diagram is



7. The inequality represented in the diagram is



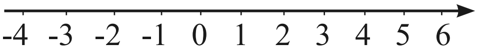
8. The inequality represented in the diagram is



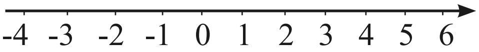
EXERCISE 3

1. Represent each inequality on the number line.

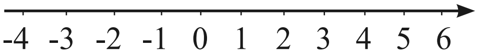
(a) $x < 4$



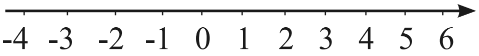
(b) $x \geq 1$



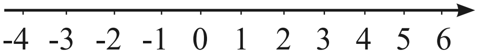
(c) $x > 0$



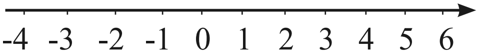
(d) $x \leq 3$



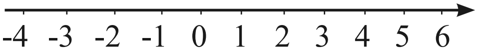
(e) $x \geq -2$



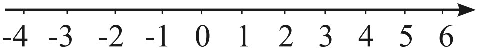
(f) $x < 2$



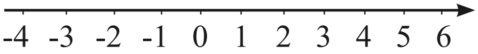
(g) $1 < x$



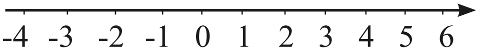
(h) $4 \geq x$



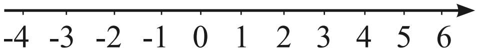
(i) $1 < x < 5$



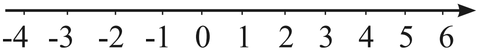
(j) $0 \leq x \leq 3$



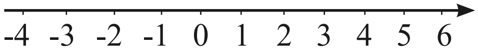
(k) $-3 \leq x \leq 2$



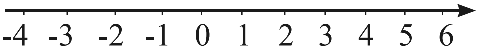
(l) $-1 < x < 4$



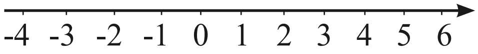
(m) $2 < x \leq 5$



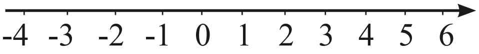
(n) $0 \leq x < 3$



(o) $-2 \leq x < 1$

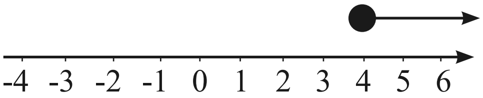


(p) $-3 < x \leq -1$

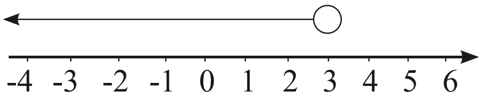


2. Write down the inequality represented in each part.

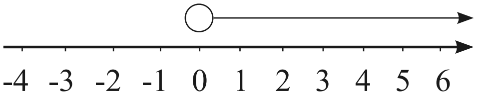
(a)



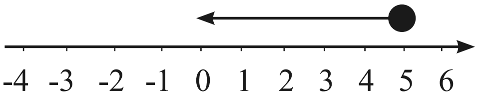
(b)



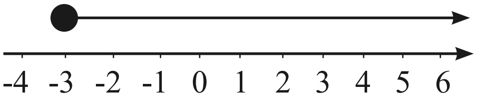
(c)



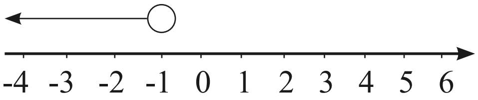
(d)



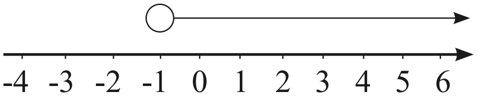
(e)



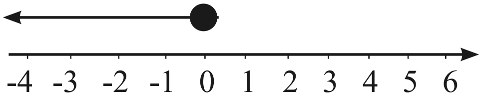
(f)



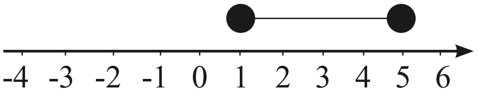
(g)



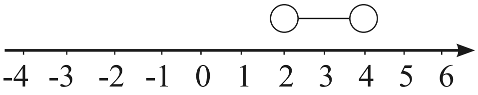
(h)



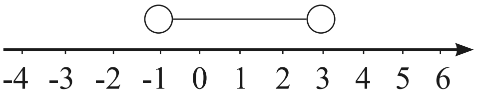
(i)



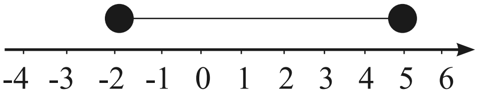
(j)



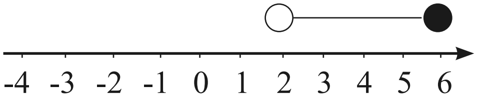
(k)



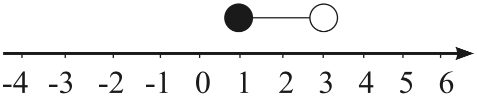
(l)



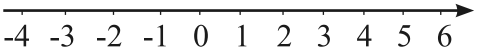
(m)



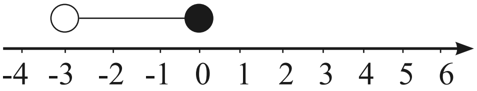
(n)



(o)



(p)



UNIT 28

COLLECTION AND PRESENTATION OF DATA

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to represent data on a graph.

TEACHER'S GUIDE

Teacher to guide through on how to draw bar graphs, histogram and pie charts.

PUPIL'S GUIDE

Pupils to practice representing data on graphs.

NOTE:

1. Data can be organised and clearly presented in many ways. These include the following.
    a. Rank order list – where data is placed in numerical order from highest to lowest.
    b. Frequency table – where the number of times a particular event happens is recorded in a table. (Frequency means the number of times something happens.)
2. Data can also be represented in a graph, or picture. Examples include the following.
    a. **Pictogram** – where pictures or drawings represent data.
    b. **Bar chart** – where the length or height of a bar is proportional to the data.
    c. **Pie chart** – where the size of the sector of a circle is proportional to the data.

Frequency Table

Frequency means the number of times something happens in the table below, for example, three students got grade A.

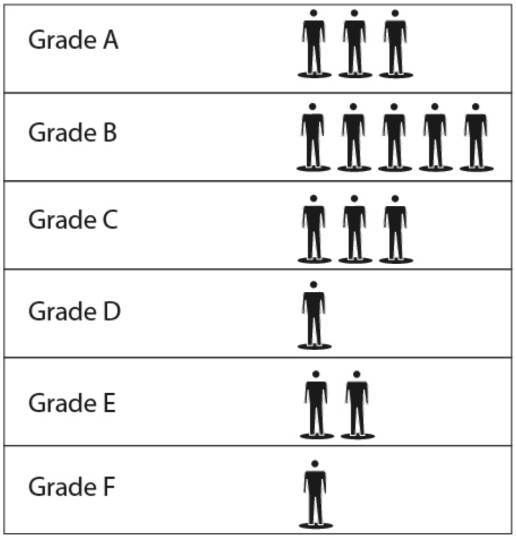
Grade	A	B	C	D	E	F
Frequency	3	5	3	1	2	1

that is, the frequency of grade A is three.

PICTOGRAM

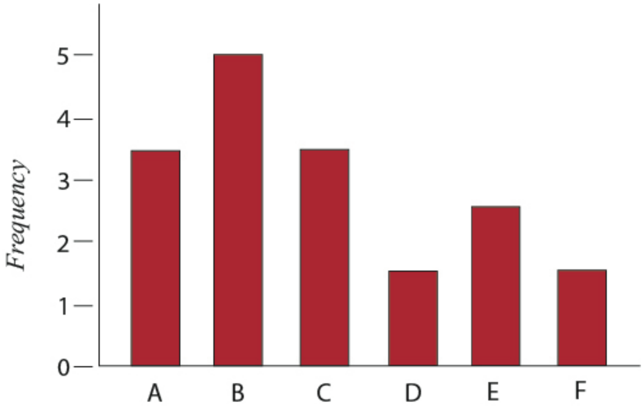
A pictogram uses pictures or drawings to give a quick and easy meaning to statistical data.

In the pictogram below each pin figure represents a student who gets the grade shown.



BAR CHART

A bar chart is very like pictogram. The number of pupil's who get each grade is represented by a bar instead of a picture. The bars have the same width and usually have equal spaces between them. The height of each bar below represents the frequency of that grade.

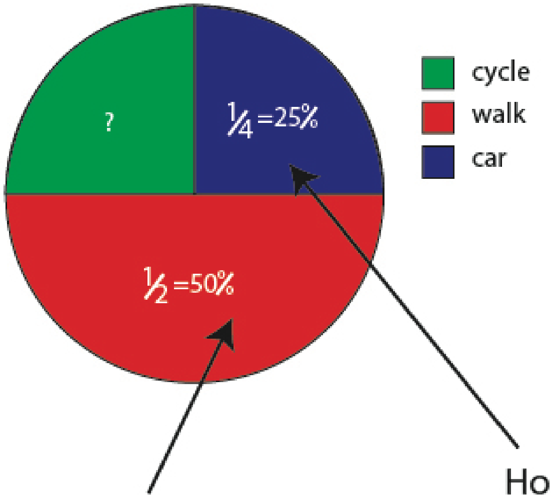


PIE CHART

A pie chart is a graph in the shape of a circular pie. In the circle the total of student (15) make up the whole pie of 360°. Each piece of the pie is a sector of the circle. The size of each sector represents the number of students who get the grade shown in that sector.

Here is a pie chart.

1. A pie chart is a visual chart used to display data.
2. Its is usually circular and is split up into different sections (like a pie).
3. Pie charts are normally in either percentages (25%) or fractions (1/2).
   This is a pie chart showing how 40 children travelled to school.



What fraction is this piece of the whole circle (pie)?

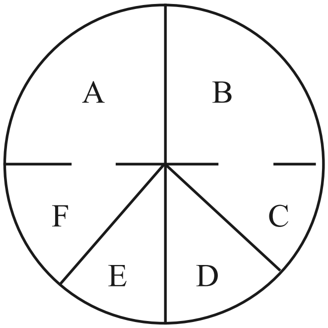
How about this piece?

Now we look at how many people were surveyed.

How many children...
Cycled?
Walked?
Were drove?

How do we know how many children did what?

Grade	A	B	C	D	E	F	Total
Frequency	3	5	3	1	2	1	15
Angle at centre	72°	120°	72°	24°	48°	24°	360°



The angles are calculated on the basis of simple ratio for example:

Angle for grade A = $\frac{360°}{15}$ x 3 = 72°

Or $\frac{3}{15}$ x 360 = 72°

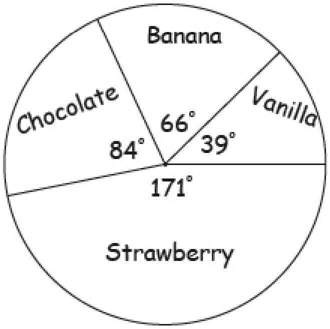
Grade B = $\frac{5}{15}$ x 360 = 1200

Handling Data

LO: Construct pie charts

Ice-cream Sales	
Vanilla	13
Banana	22
Chocolate	28
Strawberry	57
Total	**120**

The information in the pie chart shows sales of 120 ice-creams sold from an ice-cream van one Saturday afternoon in the summer. Calculate the number of each type sold



Vanilla = 39/360x120 = 13

Banana = 66/360x120 = 22

Chocolate = 84/360x120 = 28

Strawberry = 171/360x120 = 57

Averages

Finding Mode, Median, Mean and Range

Mode The value that occurs the most

Median The middle value when the values are put in order from smallest to biggest

Mean $\dfrac{\text{Sum of all values in the set}}{\text{Number of values in the set}}$

(sometimes referred to as the "average")

Range Biggest value- smallest value

Note: Putting the values in order from smallest to biggest will make it easy to work out your averages!

Example:

4, 9, 4, 6,10,6,3,5,4, 9

Arranged in order

3, 4, 4, 4, 5, 6, 6, 9, 9, 10

Mode = 4

Median = 3, 4, 4, 4, 5, 6, 6, 9, 9, 10

If there are 2 numbers left in the middle, add them up and divide by 2!

So median= (5 + 6) /2 = 5.5

MEAN = (3 + 4 + 4 + 4 + 5 + 6 + 9 + 9 + 10) ÷ 10 = 6
RANGE = 10 – 3 = 7

Exercises

1) The set of values shows the number of goals scored by a school football team in their first 10 matches: 2, 4, 1, 0, 2, 3, 2, 6, 2, 4

Find: a) Mode = c) Median =

a) Mean = d) Range

Find the mode, mean, median and range for each set of values given:

2) 7,2,5,3,8,5,5

Mode =

Median =

Mean =

Range =

3) 1,7,2,5,3,1,1,4

Mode =

Median =

Mean =

Range =

4) 6,9, 9,1,5

Mode =

Median =

Mean =

Range =

UNIT 29

PROBABILITY

(70 minutes)

LEARNING OUTCOME:

By the end of the lesson the pupils will be able to solve problems involving simple probability.

TEACHER’S GUIDE

Teacher to carefully explain the probability scale ranging from zero to one (0 - 1).

PUPIL'S GUIDE

Pupils to copy the probability scale in their exercise books.

The probability that an event will happen is a number between 0 and 1.

The probability for an event which is **CERTAIN = 1**

The probability for an event which is **IMPOSSIBLE = 0**

Probability can be expressed as a fraction, a decimal or a percentage.

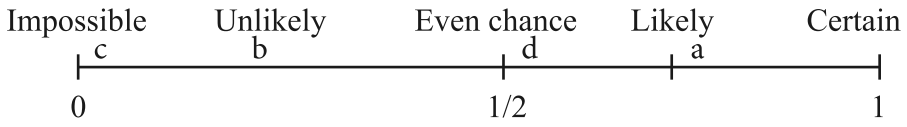
The Probability scale

Probability is a measure of how likely or unlikely an event is to occur.

Usually written as fractions, but can be written in any form **equivalent** to that fraction. Eg 3/4 = 0.75 = 75%

Can be anywhere between 0 (impossible) and 1 (certain):

For example



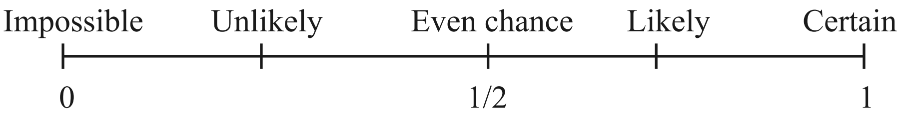
a) an event with a probability of 3/4 would be described as **likely**

b) an event with probability of 1/4 would be described as **unlikely**

c) an event with probability of 0.01 would be described as **very unlikely**

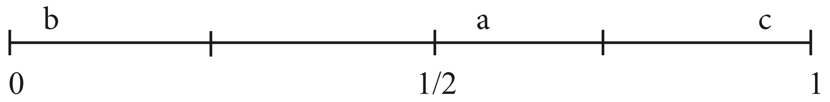
d) an event with probability of 1/2 would be described as **even chance**

1. Complete this probability scale using the key words given



Key words:
Even chance
Likely
Impossible
Certain
Unlikely

2. Label the events described below on the probability scale:
   a) The chance of getting an even number when rolling a dice.
   b) The chance of winning the National Lottery.
   c) The chance of rain in March.



3. Describe an event that you think has a probability scale:
   a) 0.3 ....
   b) 1 ....

   c) 0.8 ....

Probability of an event

The probability of an event occuring is defined as:

$$\text{Probability} = \frac{\text{Number of desired outcomes}}{\text{Number of possible outcomes}}$$

For example,
the probability of rolling an even number on a fair dice
Desired outcomes are even numbers 2,4 and 6 (**three** of them)
Possible outcomes are the numbers 1 to 6 (**six** of them)
so Probability = $\frac{3}{6}$, which simplifies to $\frac{1}{2}$

For example,
Mr Conteh puts all the pupils' names in a hat and picks one at random. What is the probability that he will pick an SS2 student?

FORM	PUPILS
JSS 1	22
JSS 2	16
JSS 3	28
SS1	29
SS2	15
SS3	20

Desired outcomes are any SS2 picked (**15** of them)
Possible outcomes are any pupil (**130** of them)
so probability = $\frac{15}{130}$, which simplifies to $\frac{3}{26}$

Exercises

1. Bob picks a tile randomly from a bag containing tiles numbered 1 to 10. Write down the probability that the number he picks is:

   a) 7 b) 4 or less c) Odd d) A multiple of 3

2. A survey is conducted of pupils' favourite footbal team:

Team	Spurs	Man Utd	Liverpool	Arsenal
No of Pupils	12	8	4	6

John picks a pupil at random to ask more questions.
Write down the probability that the pupil he picks supports:

a) Liverpool b) A London team c) Not Liverpool

P (Liverpool) = 4/30 = 2/15 = 0.4

P (London Team = Spurs + Arsenal) = 18/30 = 3/5 = 0.6

3. A bag contains 20 coloured balls, some red and some blue.
   Abu knows that the probability of picking a red ball is 2/5.
   How many red balls are there?

Probability using tables

Example

In a game, two fair dice are rolled, and a score is found by multiplying the number obtained together.

a) Show the possible outcomes in a table
b) Use your completed table to find the probability of getting a score of 12
c) Use the table to find the probability of getting a score of 23 or more

Solution

a)

Dice A

Dice B

	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

$$\text{Probability} = \frac{\text{Number of desired outcomes}}{\text{Number of possible outcomes}}$$

b) **4** outcomes out of **36** give a score of 12

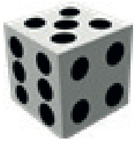
$$\text{Probability} = \frac{4}{36} = \frac{1}{9}$$

c) 6 outcomes out of **36** give a score of 23+

$$\text{Probability} = \frac{6}{36} = \frac{1}{6}$$

Exercises

Dice



1. A fair dice is rollled
   What is the probability of rolling:

   (a) a6 (b) a3

   (c) a2 or 3 (d) an even number

   (e) number greater than 2

2. A fair dice is rolled.
   What is the probability of rolling:

   (a) a1 (b) a 2,3 or 4

   (c) a3 or 5 (d) a number less than 2

3. A fair dice is rolled.
   What is the probability of rolling:

   (a) a1 or 3

   (b) a2,3,4 or 5

UNIT 30

INTERNET SKILLS

The use of the internet and computers to aid students learning.

There are several mathematics resources available for students online but could be expensive for some our students who live in the remote areas of Sierra Leone. For those pupils who can access the internet they could use the following websites like bbc bitesize, Mymaths, myimaths.

ANSWERS

UNIT 10

1) 4
2) 5, 6

UNIT 11 EX 1

A)280 B) 25 C

UNIT 12 Ex 1

i)96 ii)182 iii)81

Exercise 2

a)8 b)15 c)140

Exercise 2

1)530 2)864 3)472 4)805

UNIT 14

$6.80, 78101.4 Yen, Euro 402.50, 40061 Rupees, 5315Rand, 392.5 Australian dollars

Unit 15

1)8.8cm 2) 28cm^2 3 i)10.95cm 3 ii) 5.9cm 4) 113cm^2 5) 6.8cm

6 i) 45cm^2 6 ii) 48cm^2 7) 7.25cm

UNIT 16

1) 28.28cm^2 2) 78.57cm 3) 153.9cm^2

UNIT 17

1) 1539.4cm^3 2) 560cm^3 3) 1.3cm

UNIT 19

Exercise 1

1) 8 2) 10 3) 15

Exercise 2

a) 15m b) 6cm c) 35cm d) 41cm e) 2cm f)14

Exercise 3

12cm

UNIT 20

ii and iii

UNIT 21

1) 4500 Orange trees
2) Le 1,390,000
3a) Le 6000 (3b) 30 pens

UNIT 22

i) 6.6 ii) 9 .1cm iii) 9.3cm

UNIT 23

1) $3x - 15y$
2) $5xy + 12x – 24y$
3) $3x + 3y - 6$
4) $15pqr + 5ps$

UNIT 24

a) $x = 24$
b) $y = 17$
c) $x = 8$

UNIT 25

1) $x = 5 – 2y$
2) $x = 9 – y$
3) $t = \frac{9k - 3}{k - 1}$

UNIT 26

1) $a = -3$ or -4
2) $x = 3$ or 4
3) $y = -1$ or -7

Exercise 1

1. $x + 7 = 18$
2. $g - 5 = 9$
3. $15 - h = 9$
4. $17 = b + 11$
5. $4y = 12$
6. $4a = 20$
7. $7a = 35$
8. $\frac{x}{12} = 4$

Answers:
1. $x = 11$
2. $g = 14$
3. $h = 6$
4. $b = 6$
5. $y = 3$
6. $a = 5$
7. $n = 40$
8. $x = 48$

Solve the following linear equations with brackets.

a. $13 - 6a = 1$ b. $2 (x + 5) = 18$ c. $5 (a + 2) = 4 (a - 1)$ d. $2(x + 3 = 7$

Solution

a. $- 6a = 1 - 13$
$- 6a = - 12$
$- 6a = - 12$
$- 6 \quad 6$
$a = 2$

b. $2x + 10 = 18$
$2x = 18 - 10$
$2x = 8$
$2 \quad 2$
$x = 4$

c. $5a + 10 = 4a - 4$
$5a - 4a = -4 - 10$
$a = -14$

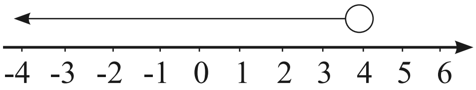
d. $2x + 6 = 7$
$2x = 7 - 6$
$2x = 1$
$2 \quad 2$

EXERCISE 2 Solve the following liner equations

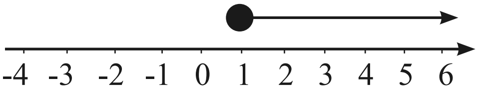
a. $5(x - 4) = 4(x + 1)$
b. $2 (y - 2) + 3 (y - 7 = 0$
c. $15 = 3 (x - 3)$

Answers

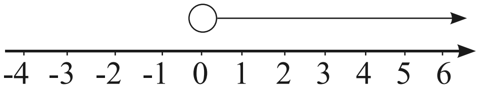
1. (a)



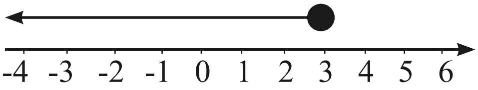
(b)



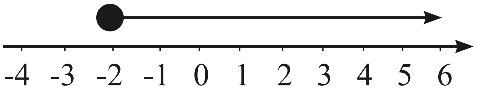
(c)



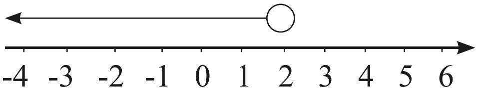
(d)



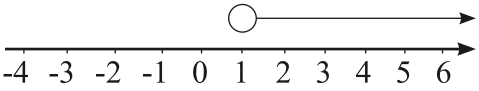
(e)



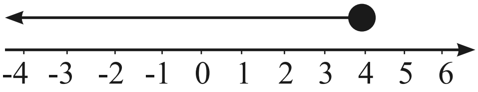
(f)



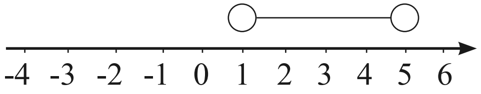
(g)



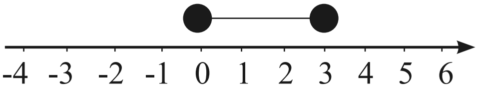
(h)



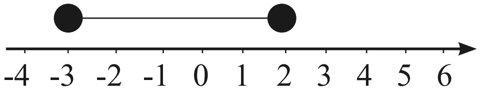
(i)



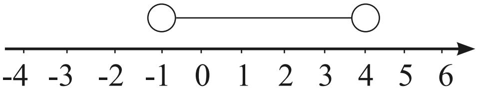
(j)



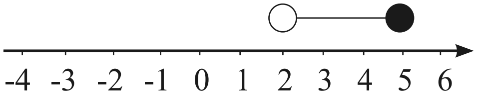
(k)



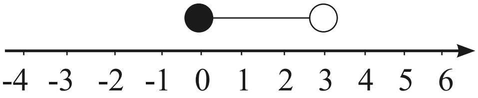
(l)



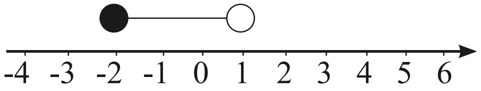
(m)



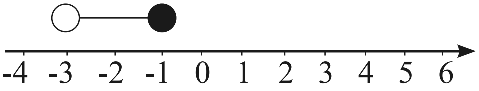
(n)



(o)



(p)



2. (a) $x \geq 4$

(b) $x < 3$

(c) $x > 0$

(d) $x \leq 5$

(e) $x \geq -3$

(f) $x < -1$

(g) $x > -1$

(h) $x \leq 0$

(i) $1 \leq x \leq 5$

(j) $2 < x < 4$

(k) $-1 < x < 3$

(l) $-2 \leq x \leq 5$

(m) $2 < x \leq 6$

(n) $1 \leq x < 3$

(o) $-4 \leq x < 3$

(p) $-3 < x \leq 0$

Answers

Dice

1. A fair dice is rolled.
What is the probability of rolling:

(a) 6 =1/6 (b) 3 =1/6

(c) 2 or 3 =1/3 (d) even number =1/2

(e) number greater than 2 =2/3

2. A fair dice is rolled.
What is the probability of rolling?

(a) 1 =1/6 (b) 2,3 or 4 =1/2

(c) 3 or 5 =1/3 (d) number less than 2 =1/6

3. A fair dice is rolled.
What is the probability of rolling?

(a) 1 or 3 =1/3 (b) 2,3,4 or 5 =2/3

(c) 7 = 0 (d) number less than 10 =1.