Introduction to Geography

Specific Objectives

By the end of the topic the learner should be able to:

(a) Define the terms Geography and Environment;

(b) Describe the branches of Geography;

(c) Explain the importance of studying Geography;

(d) Explain the relationship between geography and other disciplines.

Content

a.) Definition of:

- ✓ Geography.
- ✓ Environment.

b.) Branches of Geography:

- ✓ Physical geography. ✓ Human Geography.

c.) Importance of studying Geography.

d.) Relationship between geography and other disciplines.

Introduction

Geography is the scientific study of the earth as the home of human kind. The term Geography is derived from the Greek words: Geo and Graphein. Geo means Earth and

graphien means to write, draw or describe. These two words are combined to form Geographein, which means to describe, write about or draw the earth.

Definition of environment

Environment refers to external conditions that surround living things. These conditions influence the behavior or activities of living things.

Environment can be divided into two parts:

i.) Physical Environment

External surrounding which is made up of the features that are not created by human beings a though their presence may have been influenced by human activities.

ii.) Human Environment

Comprises of activities of people on the earths surface.

Branches of Geography

There are two main branches:

i.) Physical Geography

It is concerned mainly with the land forming processes that shape the surface of the earth and the resulting features.

Areas of study under physical geography.

- ✓ The external land forming processes.
- ✓ Weather and climate.
- ✓ Soil and vegetation.
- ✓ The earth and the solar system.

ii.) Human Geography

It involves the study of human activities on the earth's surface.

Areas of study under human geography.

- ✓ Forestry
- ✓ Wildlife, tourism and fishing.
- ✓ Mining, energy and industries.
- ✓ Population and urbanization.
- ✓ Trade, transport and communication.
- ✓ Agriculture.
- ✓ Management and conservation of environment.

iii.) Physical Geography

This aspect gives learners an opportunity to develop practical skills.

Areas of study under practical geography.

- ✓ Map work
- ✓ Photography.
- ✓ Field study
- ✓ Statistics

Importance of studying Geography

i. It is a career subject.

ii. Creates awareness in the people on the significance of management and conservation of environment. iii. One is able to acquire basic skills and knowledge which contribute to local, regional and national development.

iv. Through the study of field work, geography teaches one how to manage time properly by drawing a time schedule and adhering to it.

v. Encourages international awareness, interaction and cooperation.

vi. It enables the learner to understand and appreciate different environmental influences at work on different societies.

vii. We are able to learn and explain the origin of the earth, the solar system and the internal structure of the earth.

Geography and other subjects

Geography relate widely with other subjects as follows.

Chemistry

- ✓ Geography applies Chemistry concepts in studying the chemical composition of rocks and soils.
- ✓ Chemistry concepts are used in Geography to explain chemical changes that occur in rocks/soils.

Physics

- ✓ Physics deal with matter, energy, light, heat, sound, gravity and magnetism while studying the atmosphere;
- ✓ Geography focuses on heat from the sun as it's responsible for movement of air, evaporation or water and distribution of moisture in the atmosphere.
- ✓ Physics is a branch of Science concerned with study of matter and its properties; Physics is important in Geography as it is used to explain how important process such as faulting, folding and vulcanicity happen.

Agriculture

- ✓ Agriculture deals with farming and involves the growing of crops and the rearing of livestock.
  Geography studies the distribution of agricultural activities and how factors like relief, climate and soils affect them.
- ✓ Also looks at both the positive and negative impact of agriculture on the environment.

Biology

- ✓ This is the study of living things. A branch of biology called ecology dals with how living things relate to each other and the environment.
- ✓ Biogeography which is a branch of geography is quite similar to ecology as it deals with the distribution of plants and animal life on the earth and their relationships to climate, soil, relief and other factors.

Meteorology and climatology

- ✓ Meteorology is the study of atmospheric conditions of a given place at a specific time while climatology is the study of weather.
- ✓ Geography as a discipline deals with all the elements of weather and the distribution of different climatic zones of the world.

Civil engineering

- ✓ This is the branch of science that deals with the buildings and maintenance of structures like roads, bridges, railways, airports, dams and drainage systems.
- ✓ Geographical knowledge on landforms, rocks and soils are important before these structures are constructed.

Mathematics

- ✓ This is the branch of science that deals with numbers, quantity and space. Mathematics helps geographers to simplify and interpret numerical data.
- ✓ Mathematical techniques in arithmetic and statistics are used by geographers to calculate averages, distances population densities and sizes and reading charts and graphs.
- ✓ Through mathematics a geographers is able to identify the relationship between different geographical phenomena of the world.

Geology

- ✓ Geology is the study of materials (rocks, soils, etc.), which make up the earth and their changes during the history of the world.

- ✓ All these aspects are also dealt with in physical geography.

Economics

- ✓ Economics deals with the production, distribution and consumption of goods and service.
- ✓ Economics is related to geography in that economic development is based on natural resources like land, vegetation, minerals and animal life.
- ✓ Geographers are interested in providing a description of the type , location and distribution of natural resources while Economists provide details on how the resources should be used to generate income.

History

- ✓ History is the study of past events on a time basis thus it deals with past and current events and the people's way of life.
- ✓ Geographers requires historical knowledge to know how the earth was formed, the distribution of people and their past economic activities.

Demography

- ✓ This is the statistical study of human population. It deals with the general characteristics of a given population which includes, the number of people living in an area, their ages, composition by gender, birth and death rates.
- ✓ All this aspect is also covered in population geography which deals with the study of population distribution and changes in population structure.

Medicine

- ✓ This is the science of treating and understanding diseases. It deals with diseases, their causes and possible cures.

  Medical geography explores the factors that influence the distribution of pest and diseases, how these factors affect human activities on earth.

End of topic

Did you understand everything?
If not ask a teacher, friends or anybody and make sure you understand before going to sleep!

Past KCSE Questions on the topic

1. What is practical geography? (2mks)

2. Name two branches of geography

   (2mks)

3. Name any three study areas in human geography

   (3mks)

4. Define the term environment (2mks)

5. Explain three reasons for importance of studying geography

(3mks)

6. Name five human features

(3mks)

7. What is habitat (2mks)

8. List six disciplines related to geography

(6mks)

9. Differentiate between each of the following:

- Democracy and population geography
- Economics and economic geography

(4mks)

10. Name two Greek words from which term geography originate

(2mks)

CHAPTER TWO

THE EARTH AND THE SOLAR SYSTEM

Specific Objectives

By the end of the topic the learner should be able to:

(a) Define the solar system;

(b) Explain the origin of the earth;

(c) Explain the effects of rotation and revolution of the earth;

(d) Describe the structure of the earth.

Content.

a.) Definition and composition of the solar system.

b.) Origin, shape, size, and position of the earth in the solar system

c.) Rotation and revolution of the earth and their effects.

d.) Structure of the earth:

- ✓ The atmosphere
- ✓ The hydrosphere
- ✓ The lithosphere/crust
- ✓ The asthenosphere/mantle
- ✓ The barysphere/centrosphere

Definition of the solar system

The solar system is made up of the sun with the nine planets orbiting around it. The solar system includes the sun, its planets and satellites, billions of meteoroids and thousands of comets.

Members of the solar system

- ✓ The planets.
- ✓ Heavily bodies – asteroids
  - Comets
  - Meteors
  - Meteorites
  - Satellites such as the moon

Note:

The solar system does not include other stars.

Origin of the solar System

The two theories that are commonly used to explain the evolution of the solar sytem are:

a.) Passing start theory.

b.) Nebular cloud theory.

Passing star theory

- ✓ The theory was advanced by Jeans and jeffreys.
- ✓ They suggested that a star that a star with greater gravitational pull than the sun passed close by the sun drawing off a stream of material in form of a gas.

- ✓ This material spit cooled and condensed to form the planets set in orbit by the passing star.
- ✓ The moons and other heavenly bodies moving around the sun were formed to have been formed in the same way.

Weakness of the theory

- ✓ Chances of another star approaching the sun are minimal.
- ✓ High temperature material drawn from the sun or from the star would disperse rather than condense.
- ✓ It does not explain where the sun and the passing star came from.

Nebula Cloud Theory

- ✓ It starts that the solar system could have been formed from a cloud or nebular of gas and dust.
- ✓ As the nebula rotated, it flattened into the disc with a high concentration of material at its centre. The flattening out was due to the centrifugal force.
- ✓ In the outer sections of this disc, some substances such as methane and ammonia condensed while some like hydrogen and helium remained as gas.
- ✓ This outer rings formed the planets like Jupiter, Saturn, Uranus and Neptune.
- ✓ Near the centre of the nebula, temperatures were much higher and the planets were formed by the accumulation of the particles bumping into each other and growing into sizes large enough to exert gravitational attraction to each other.

- ✓ Continued accumulation and the condensation of these gases led to the formation of other planets.
- ✓ At the same time, the sun continued to shed off most of its gases hence reducing its rate of rotation to about once in 25 days.
- ✓ Due to the high temperatures, most volatile gases were probably swept outward.

Weakness of the theory

- ✓ The origin and causes of the nebula are not explained.

Composition of the solar systems

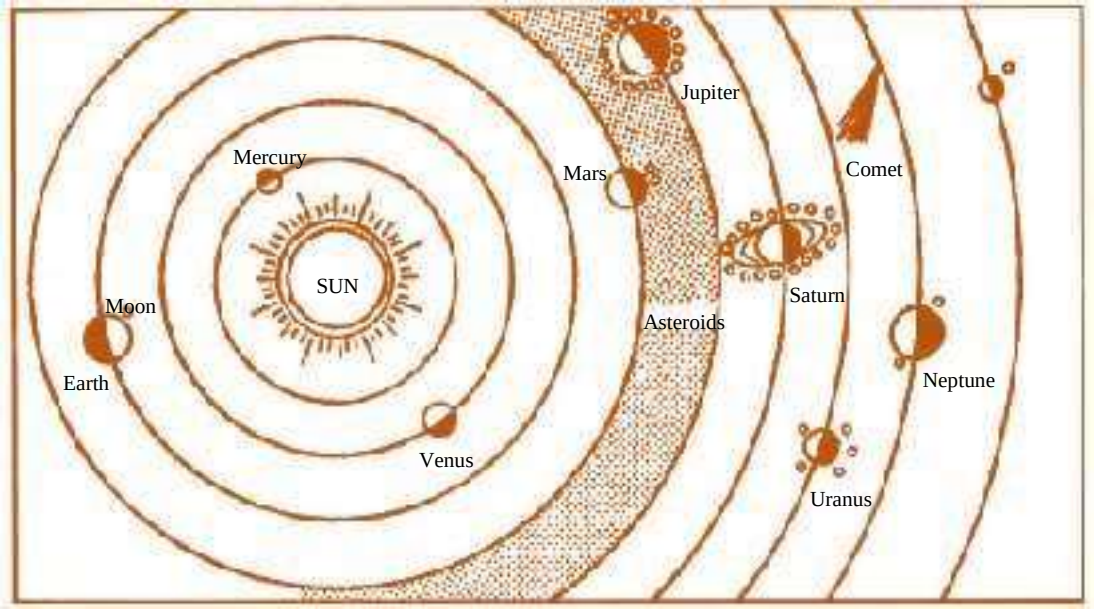
The study of the heavily bodies is known as Astronomy. The solar system is made up of the following:

- ✓ The sun
- ✓ The planets
- ✓ Asteroids
- ✓ Comets
- ✓ Meteors
- ✓ The moon

The sun

- ✓ The sun is actually, a star.

- ✓ It is a yellow colored star of moderate size among the billions of stars in the Milky Way.
- ✓ It rotates on its own axis in an anti – close wise direction.
- ✓ Formed of very hot gases mainly hydrogen 70%.
- ✓ The sun is a heated star. The temperature at the centre of the sun is about 150,000,000° Celsius and at the surface it is about 6,000° Celsius.
- ✓ It is the source of light and heat of the earth but also of other planets and satellites. The earth would have been eternally dark without sun light.



The planets

Planet is a Greek word for wanderer or one who is constantly moving.

- ✓ There are nine planets in the universe moving around the sun in the same direction.
- ✓ The sun maintains a strong pull of gravity that keeps all the planets in their orbits.

The nine planets starting from the one nearest to the sun are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.

Facts about the planets

- ✓ Mercury is the smallest while Jupiter is the largest.
- ✓ All the planets have moons moving around them except for Mercury and Venus.
- ✓ Asteroids are small bodies moving around the sun and occupy the spaces between the orbits.

Mars

- ✓ Referred to as the red planet because when observed from the earth using a telescope it always appears to be red in color.
- ✓ It has two moons revolving around it.

Jupiter

- ✓ It is the fifth planet and the largest planet in the universe.
- ✓ Rotates on its own axis at a very faster speed.
- ✓ Keep on charging in color from time to time.

- ✓ Has thirteen rings.

Saturn

- ✓ It is the sixth planet and second largest.
- ✓ It has three rings around it, the middle ring being the largest and brightest.
- ✓ It has eight moons/planets.

Neptune

- ✓ It is the eighth planet and very similar in size ,color and character to Uranus.

Pluto

- ✓ It is the farthest away from the sun.
- ✓ The temperature is very cold.

Asteroid

These are small planet – like objects also known as the planetoids.

Comets

These are heavenly bodies revolving around the sun in their own orbits with a head and a tail.

Meteors

Meteors are small heavily bodies that enter the earth's atmosphere from the universe at very fast speeds.

Meteorites

These are meteors that pass through the atmosphere, fail to burn up and land on the surface of the earth as large rocks.

Moon

The moon is a natural satellite meaning it has no light of its own.

The origin of the earth.

Many scientist believes that the earth could have been formed approximately 4600 million years ago.

- ✓ A hot mass of gases was thrown off the sun.
- ✓ These gases cooled to form a liquid.
- ✓ The heavier materials collected at the centre to form a core of heavy liquid metal.
- ✓ Around this core collected less and less heavy materials to form the mantle and the crust.
- ✓ As the cooling continued, the outer part of the earth hardened faster to form the crust.

The size of the Earth

- ✓ The circumference of the earth is about 40,000 km.
- ✓ The circumference reduces from the equator to the poles because the earth is not shaped like a perfect sphere.
- ✓ The diameter of the earth at the equator is longer than the polar diameter.

The shape of the Earth

- ✓ The earth is a sphere which is slightly flattened at the poles and such a sphere is called geoid/oblate spheroid.
- ✓ The slightly flattened poles are as a result of the rotation of the earth on its axis.
- ✓ This movement as also caused the bulge at the equator.

Forces involved in the formation of the earth's shape

Centripetal force

It pulls the North Pole and the South Pole towards each other thus flattening areas at the poles.

Centrifugal force

It results in the bulging of the earth at the equator due to variation in rotation towards the equator

Force of gravity

It attracts objects on the earth's surface and materials within the earth towards its centre hence making the earth to have a spherical shape.

Proofs that the earth is spherical

i.) Circum-navigation of the earth surface shows that you always end up at the point you started.

ii.) Approaching ship from the shore always start with the smoke, the gradually the body. If the earth was flat the whole ship could be seen at once.

iii.) The earth rotates from west to east. The sun appears earlier in the east than in the west and if the earth was flat the whole of it could receive light at the same time.

iv.) During the eclipse of the moon, the shadow of the earth appears spherical.

v.) The earth's surface is always circular when standing on a very high tower or when in an airplane.

vi.) Since all other planets, the moon and the sun are round when viewed through a telescope, the earth must also be round since it's also a planet.

vii.) Photographs taken by satellite at great distance away from the earth shows that the earth is round.

Rotation of the earth and its effects

Rotation of the earth is the movement of the earth on its own axis in an anticlockwise direction from west to east once in every 24 hours.

Effects of rotation

- ✓ Causes day and night.
- ✓ It causes difference of one hour between meridians 15^0 apart.
- ✓ It causes deflection of wind and ocean currents.
- ✓ It causes variation in the speed of air masses.
- ✓ It causes the rising and falling of ocean tides.

Revolution of the Earth and its effects

Revolution of the earth is the movement of the Earth around the sun on its own orbit and it takes 362 $\frac{1}{4}$ days.

It can also take 366 days to make one complete revolution around the sun in every leap year. A leap year occurs after every four years.

Effects of movement of the earth round the sun

- ✓ Causes the four seasons.
- ✓ Causes lunar eclipse.
- ✓ Causes the Varying lengths of day and night.
- ✓ Changes in the position of the midday sun at different times of the year

This causes the following, Summer solstice, winter solstice and equinoxes.

Characteristics of summer solstice

- ✓ Day time is longer than night time at latitudes beyond the equator
- ✓ The hours of day time increase from the tropics towards the poles
- ✓ Occurs on 21st June when the sun is overhead at mid – day along the tropic of Cancer.

Characteristics of winter solstice

- ✓ Occurs 22nd December when the sun is midday along the Tropic of Capricorn.
- ✓ The sun is visible for only a few minutes when it appears above the southern horizon.

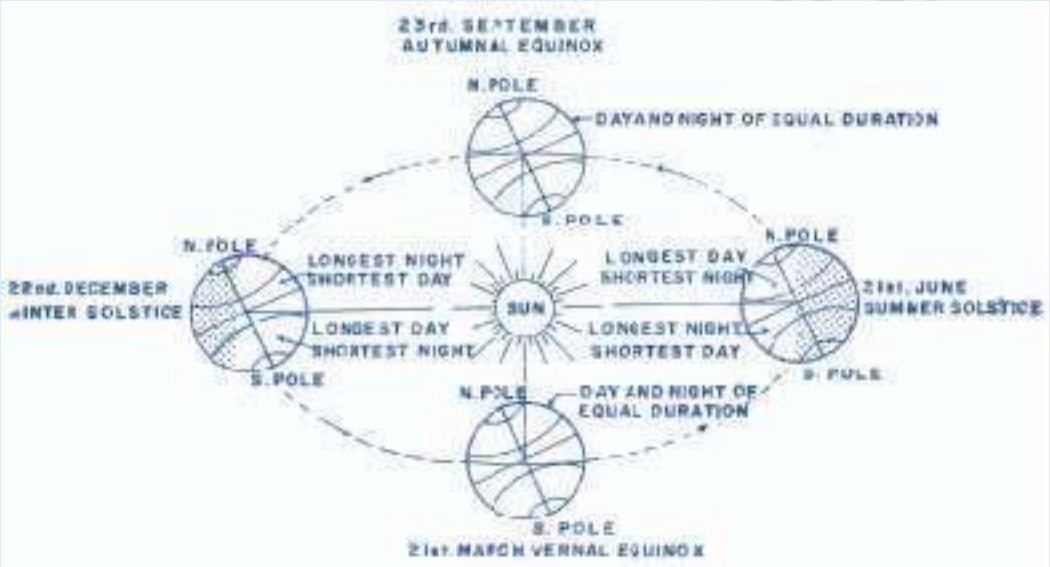
Characteristics of equinox's solstice

- ✓ Occurs on 21st March and 23rd September.
- ✓ The sun rises in the east and sets in the west.
- ✓ Equal hours of days and nights.

The four seasons

There are four main seasons namely:

- ✓ The spring
- ✓ Summer
- ✓ Autumn
- ✓ Winter

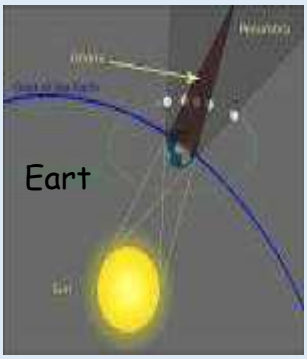


(b) The diagram below shows the internal structure of the earth.

Causes lunar Eclipse

- ✓ An eclipse is a shadow that results when the sun's rays are blocked from reaching the earth or moon's surface.
- ✓ The lunar eclipse occurs when during the revolution of the earth, the earth lies in between the sun and the moon.

- ✓ This casts the shadow of the earth onto the moon.



Note:

Since the moon's orbit is inclined, partial lunar eclipses are experienced more often than total eclipses.

Sometimes lunar eclipse pass unnoticed because they happen at night when many people are asleep.

The solar eclipse

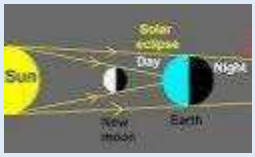
- ✓ Occurs as a result of the revolution of the moon around the earth whereby the moon lies between the sun and the earth.
- ✓ This casts the moon's shadow unto the earth.
- ✓ The shadow has two parts:
  - Umbra
  - Penumbra

Umbra

This is the darkest part.

Penumbra

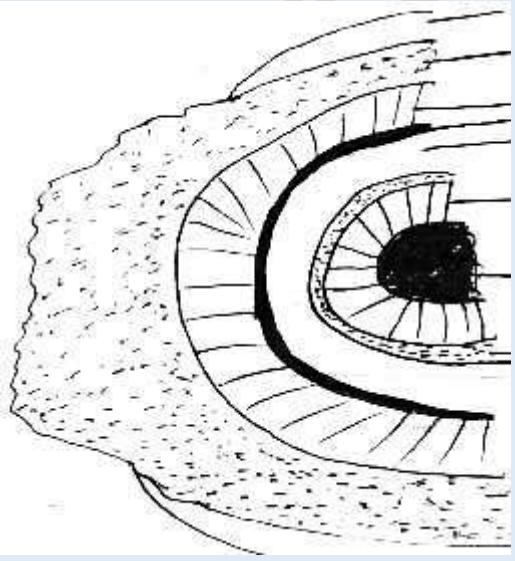
This is the lightest part.



The structure of the Earth

- ✓ It consist of a series of layers both internal and external that vary in composition and thickness.
- ✓ The internal layers are:
  - Lithosphere
  - Asthenosphere
  - Barysphere
- ✓ The external layers are:
  - The atmosphere
  - The hydrosphere

The structure of the earth



Hydrosphere

Sial

Sima

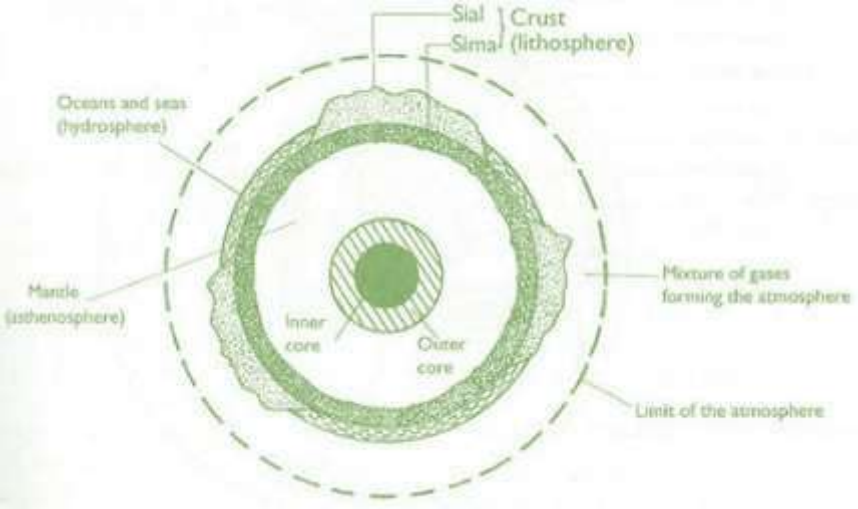
Mohorovicic/ moho discontinuity

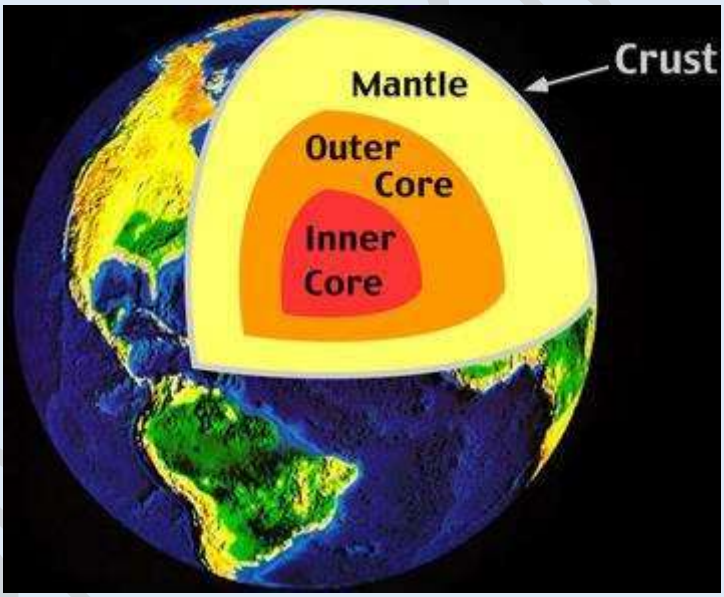
Mantle

Outer core

Inner core

Gutenberg discontinuity





External structure of the Earth

Atmosphere

- ✓ It is an envelope of transparent and odorless gases held to the earth by gravitational attraction.

- ✓ It consist of four main layers.
- ✓ The layers of the atmosphere from the earth's surface upwards are :
  - Troposphere
  - Stratosphere
  - Mesosphere
  - Thermosphere

Hydrosphere

- ✓ The part of the earth's surface covered by water mases. E.g. the oceans, rivers, lakes and swamps.

Internal structure of the earth

Lithosphere or crust.

- ✓ This is the outer shell of the solid earth made up of variety of rocks.
- ✓ Composed of series of plates which are in constant motion.
- ✓ It also consist of the continental and oceanic crust.

Note:

- The continental crust is also called SIAL.
- This is because it consist of mainly silica SI and aluminum AL.

State ***three*** characteristics of sial.

- *Forms the continental crust/upper crust.*
- *Consists mainly of silica and aluminum*
- *Sial is made up of light rocks/2.7g/cc / floats on sima.*

- *Sial is made up of granitic/ sedimentary/ metamorphic rock*
- *Contains 75% of the total gaseous mass of the atmosphere*
- *90% of water vapor found in this layer.*
- *Sial is made up of rigid/brittle rocks.*

- The oceanic crust consist mainly of basaltic rocks averaging between 6 – 10 km.
- The layer is also known as SIMA because it consist mainly of Silicon and Magnesium.
- It forms the oceanic basins and is therefore referred as the oceanic layer.
- The crust is separated from the mantle by a discontinuity known as Mohorovicic discontinuity.

Composition of the mantle.

- ✓ It is made up of two parts / upper mantle and lower mantle.
- ✓ Lower mantle is viscous fluid.
- ✓ Upper mantle is elastic solid. Semi-molten.
- ✓ Dominant mineral is olivine / ferromagnesian silicate.
- ✓ The mantle has an average density of 3.0 - 4.0 gms/cc.
- ✓ The mantle and the core are separated by a layer of discontinuity called Gutenberg discontinuity.

The Barysphere/Core/Centrosphere

- ✓ Composed of very dense rocks made up of nickel and iron.
- ✓ It is divided into two zones:
  - The outer core.
  - The inner core.

Characteristics of the outer core

- ✓ The outer core is composed of molten rock material.
- ✓ It is made up of iron and nickel.
- ✓ It is about 2100 km to 2890 km thick.
- ✓ It has temperatures ranging from 37000C to 5,0000C.
- ✓ It has an average density of 10.0gm / cc to 12.3gm/cc.

Characteristics of the inner core.

- ✓ It is solid.
- ✓ Composed of hard rocks.

Reasons why the interior of the earth is still hot.

- ✓ The overlying rocks generate a lot of pressure that create heat on the rocks beneath.
- ✓ During the formation of the earth, the outer part cooled faster than the interior thus trapping the heat beneath.
- ✓ Through radio activity, materials beneath collide creating friction that generates heat.

End of topic

Did you understand everything?
If not ask a teacher, friends or anybody and make sure you understand before going to sleep!

Past KCSE Questions on the topic

1. (a) State two effects of the rotation of the earth

(2mks)

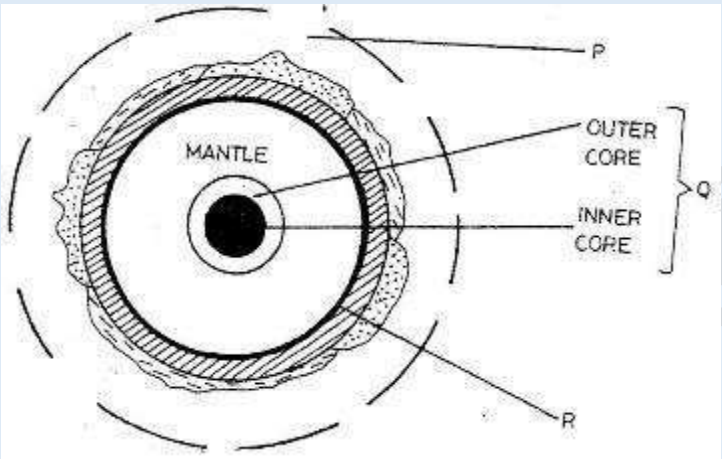
(i) Which movement of the earth is represented by the diagram?

(1mk)

(ii) Give two effects of the movement represented by the diagram

(2mks)

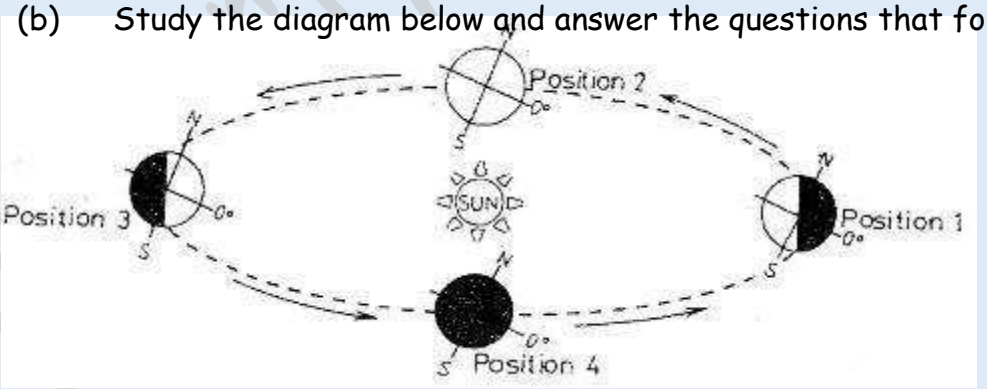
2. The diagram below represents the structure of the earth. Use it to answer question



(a) Name

(i) The parts marked P and Q

(b) Study the diagram below and answer the questions that follow



(2mks)

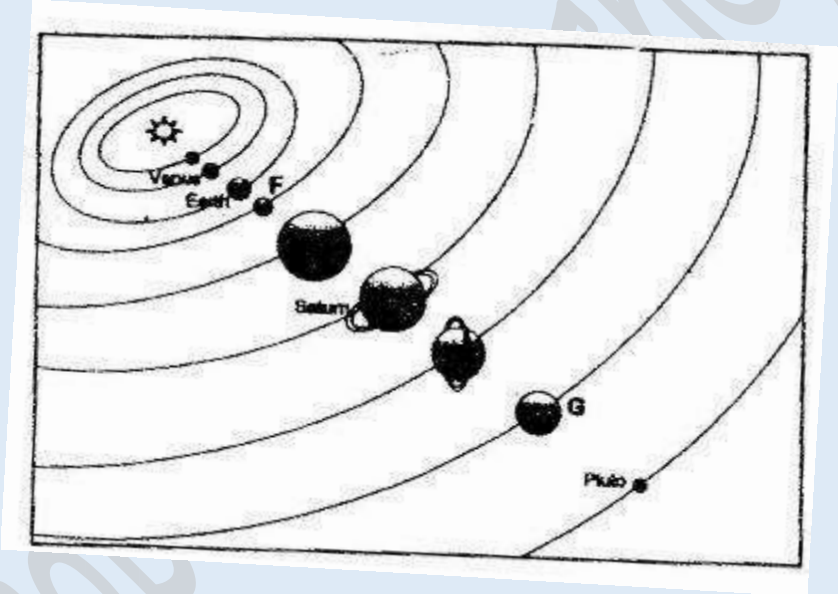
(ii) The discontinuity marked R

(1mk

(b) State three characteristics of the mantle

(3mks)

3. The diagram below shows the composition of the solar system



(a) Name the planets marked F and G

(2mks)

(b) State three effects of the rotation of the earth on its axis

(3mks)

4. a) What is the solar system?

b) Use the diagram below to answer the questions that follow.

i) What type of eclipse is represented by the diagram?

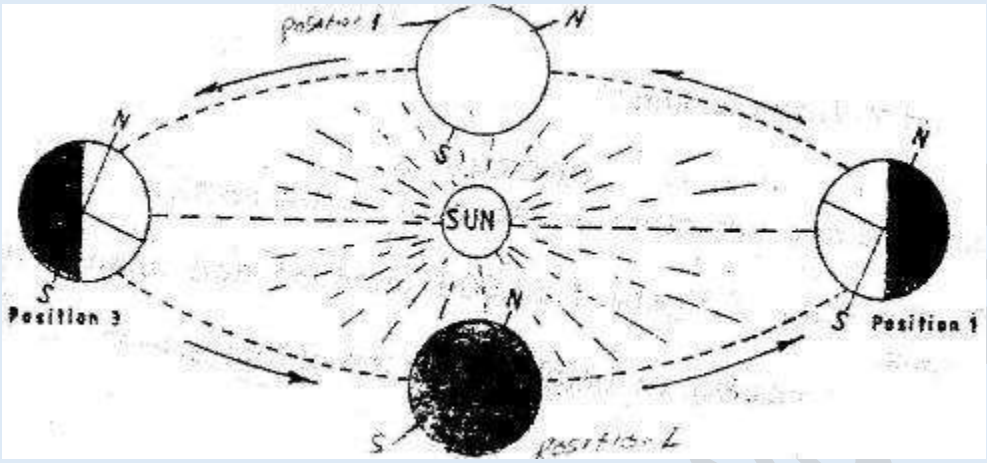
ii) Name the features marked L and M

5. (a) (i) Give the two dates in a year during which the number of hours of darkness is equal in both the north and south poles.

(ii) Why do the lengths of days and nights vary from one part of the earth to another?

(iii) Apart from the sun name other heavenly bodies.

(b) The diagram below shows the revolution of the earth around the sun. Use it to answer the questions that follow



(i) If the earth takes 366 days to make a complete revolution during a leap year, how long will it take to move from position 1 to position 4?

(ii) What season is experienced in the southern hemisphere when the earth is in Position 1?

6. Define the following,

i. Solar system
ii. Galaxy

iii. Star

iv. Asteroids (6mks)

7. Differentiate between the following

(a) Dateline and international dateline

(b) Meteors and Meteorite.

(6mks)

8. State three differences between solar eclipse and lunar eclipse.

(2mks)

9. State four factors that support life on planet earth.

(4mks)

10. (a) List four effects of earth rotation.

(4mks)

(b) At Nairobi on longitude 37°E local time is 1 p.m. What time would it be at Sarissa on longitude 41 °E?

(4mks)

11. (a) Define equinox.

(2mks)

(b) State characteristics of summer solstice.

(4mks)

12. The earth is inclined to the ecliptic plane at an angle of..... and the axis is also inclined at an angle ..... to perpendicular line.

(4mks)

13. Fill in the table from (a) - (f)

(10mks)

Property s/Layer	Major constituent	Thickness	Density	Temperatur e
Outer crust	(a)	iii. 16-24 kms	(b)	

Inner crust	ii. Magnesium	S (c)	2.8-30 gms/cc	
Asthensophere	i. Iron	2900 kms	(d)	5000 C
Centrosphere	ii. Nickle	(e)		(f)

14. State three weaknesses of the passing star theory.

(6mks)

15. Differentiate between hydrosphere and atmosphere.

(4mks)

16. Planet ... 1... is seventh planet from the sun and is greenish in colour. Planet ...2... takes shortest time to revolve round the sun about 88 earth day. Planet ...3... and ...4... are referred to as twin planets. Planet ...5... takes about 11.86 earth years to revolve round the sun. All the planets have satellite orbiting round them except planet ...6... and ...7...

(7mks)

17. Explain reasons for flattening and bulging of earth.

(4mks)

18. State characteristics of winter solstice

(4mks)

19. Differentiate between summer solstice and winter solstice.

(4mks)

20. (a) What is an eclipse?

(2mks)

21. Apart from planets name other heavenly bodies.

CHAPTER THREE

WEATHER AND CLIMATE

Specific Objectives

By the end of the topic the learner should be able to:

(a) Distinguish between weather and climate;

(b) State the elements of weather;

(c) Explain the conditions necessary for siting a weather station,

(d) Use instruments to measure elements of weather;

(e) Analyze and interpret data on weather conditions,

(f) Describe the structure and composition of the atmosphere;

(g) Explain the factors that influence weather and climate;

(h) Describe the characteristics of climatic regions of Kenya;

(i) Describe the characteristics of major climatic regions of the world;

(j) Account for the causes of aridity and desertification;

(k) Explain the effects and possible solutions to aridity and desertification, discuss the causes and impact of climate change on the physical and human environment;

(1) Carry out field study on a weather station.

Content

a.) Distinction between weather and climate.

b.) Elements of weather.

c.) Factors to consider in siting a weather station.

d.) Instruments for measuring weather elements.

e.) Recording and calculating weather data.

f.) Structure and composition of the atmosphere.

g.) Weather forecasting.

h.) Factors influencing weather.

i.) Factors that influence climate.

j.) Distribution and characteristics of climatic regions of Kenya and the world.

k.) Causes, effects and possible solutions to aridity and desertification.

l.) Causes and impact of climate change on physical and human environment.

m.) Field w o r k - a study based on a weather station.

Meaning of weather

Weather is the condition of the atmosphere for a short period of time usually a day.

Elements of weather

These are a number of factors or conditions of the atmosphere. They include the following:

- ✓ Temperature

- ✓ Humidity
- ✓ Precipitation
- ✓ Air pressure
- ✓ Winds
- ✓ Sunshine
- ✓ Cloud cover.

Temperature

- ✓ This is the degree of sensible heat within the atmosphere. The temperature is caused by radiant heat received from the sun.
- ✓ The process of transmission of sun's energy in the form of short wave is called insolation/solar radiation.
- ✓ Radiation is the process by which energy is propagated or transferred through a medium by means of wave motion.

The amount of solar radiation reaching the earth is determined by the following factors:

- ✓ The intensity of the sun's radiation in the space and the earth's average distance from the sun.
- ✓ The area and nature of the surface on which the rays falls.
- ✓ The inclination/angle of the surface on which the sun's rays fall.
- ✓ The position of the earth on its orbit which produces different seasons.
- ✓ The transparency of the atmosphere.

Note;

Lines drawn on a map showing places with the same temperatures are called Isotherms.

The atmosphere is heated through three main process:

- Radiation
- Conduction
- Convection

Radiation

- ✓ All bodies emit/radiate energy in the form of waves called electromagnetic waves.
- ✓ This energy travels outward from its source, spreading equally in all directions.
- ✓ The intensity of radiation depends on:
  - Size of the body emitting it
  - Temperature of the body emitting it
- ✓ Radiation does not require a medium hence it can travel through a vacuum.
- ✓ The earth emits heat by long-wave radiation called terrestrial radiation which is invisible.

Note:

The main difference between solar and terrestrial radiation is that solar radiation is by short wave and is partly visible as the sunlight we see.

Conduction

- ✓ This is the transfer of heat through matter without moving it.
- ✓ It is the transfer of heat energy though motion, from one molecule to another.
- ✓ Air in the atmosphere is heated by direct contact with the earth.

Convection

- ✓ This is the transfer of heat by mass movement of fluid.
- ✓ Convection in the atmosphere takes place when air is heated by the earth and becomes less dense.
- ✓ The colder dense air above the surface descends down to replace the warm rising air.
- ✓ The colder air on reaching the surface in turn becomes heated and rises.
- ✓ This movement of lighter air upwards and dense air downward creates cycles called convectional currents.

Humidity

- ✓ This is the amount of water vapor in the atmosphere

Significance of variations in humidity

i.) The amount of water vapor in a given volume of air is an indication of the atmosphere's potential capacity to hold moisture.

ii.) Water vapour regulates the heat loss from the earth.

iii.) The amount of water vapour determines the amount of energy stored in the atmosphere for the development of storms.

Note:

When the atmosphere contains maximum amount it can hold, it is said to be saturated.

The temperature at which air becomes saturated is known as dew point.

Absolute Humidity

This is the actual amount of water vapour in given volume of air at a particular temperature expressed in gm/m^2.

Relative humidity

This is the ratio between absolute humidity of a given mass of air and the maximum amount of water vapour that it can hold at the same temperature.

Precipitation

- ✓ Precipitation is the forms of moisture, which fall from the atmosphere to the earth's surface.
- ✓ The amount of water in the atmosphere comes from evaporation of water from:

- The grounds
- Open water bodies
- Plants through Evapo-transpiration

Major forms of precipitate

- Dew

- Frost
- Snow
- Mist and fog
- Rainfall

Dew

- ✓ Forms at night when the air in the lower parts of the atmosphere gets cooled and the water vapour in it condenses into droplets which are then deposited on objects.

Conditions necessary for the formation of Dew

The air should be calm so that it can remain in contact with the ground long enough to be cooled below its dew point.Unless that temperature has been reached, dew cannot be form.

- ✓ Day time should be warm to accelerate evaporation and thus provide a lot of water vapour in the air.
- ✓ A cloudless night accelerates the rate at which the earth losses the heat gained during the day.

Frost

It refers to tiny ice crystals deposited on objects on the ground.

Snow

This is the precipitation that falls in the form of flakes of numerous tiny ice crystals.

Mist and Fog

Mist is a mass of tiny water droplets suspended immediately above the ground.

- ✓ It forms when air is called below dew point but the resultant water droplets remain suspended.
- ✓ This causes obscurity or cloudiness which reduces visibility to between one and two kilometers.

Fog

Fog is denser and visibility is less than one kilometer but formed in the same way is dew.

Main types of fog

i.) Radiation fog – This forms when air in contact with the ground is cooled as a result of terrestrial radiation.

ii.) Advection fog – This form a result of warm moist air passing over a cooler land or water surface.

iii.) Hill fog – Forms on a low sheet of cloud on hills as a result of moist air stream advancing inland from the sea.

iv.) Frontal fog – This forms at points where cold air masses meet with warm air masses. The cold air causes moisture in the warm air to condense and form fog.

v.) Steam fog – A fog associated with cold air passing over the surface of Warm air.

Rainfall

A form of precipitation from the clouds in the form of drops of water. Lines drawn on a map to show areas receiving the same amount of rainfall are called isohytes.

Air that condenses to form rainfall may be made to rise in three different ways:

i.) When winds blow over a mountainous region.
ii.) When hot air rises by convectional currents.
iii.) When warm air rises over cold air.

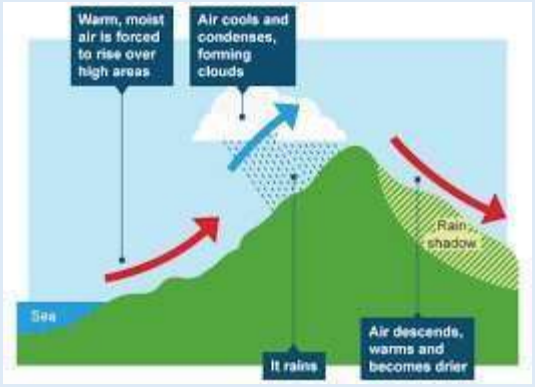
Types of rainfall

Relief/orographic rain

Relief rain occurs in areas where onshore winds rise over hilly or mountainous regions lying parallel to the coast. It also occurs in areas where moist air is forced to ascend relief features far from water bodies. The rainfall is experienced in Kenyan highlands and the rift valley.

Formation

- ✓ A water body/ sea lake is heated causing evaporation.
- ✓ Moist air from the sea is forced to ascend up a hill/ mountain size.
- ✓ Forced ascent leads to cooling of air.
  The moisture in the air condenses forming clouds.
- ✓ Rain falls mainly on the windward side of the hill/ mountain



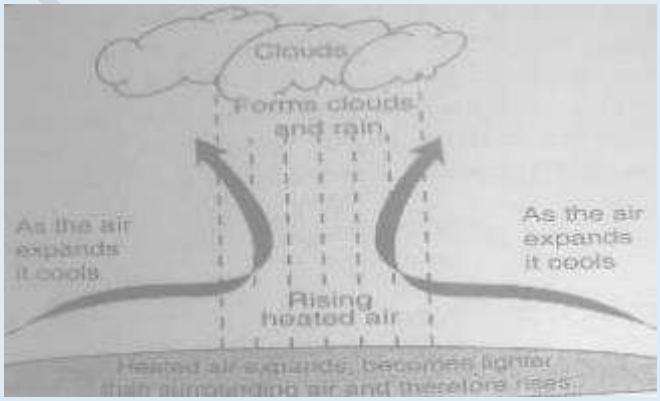
Convectional Rainfall

Experienced in areas around the equator which get intense heating from the sun.

E.g. Lake Victoria and coastal regions

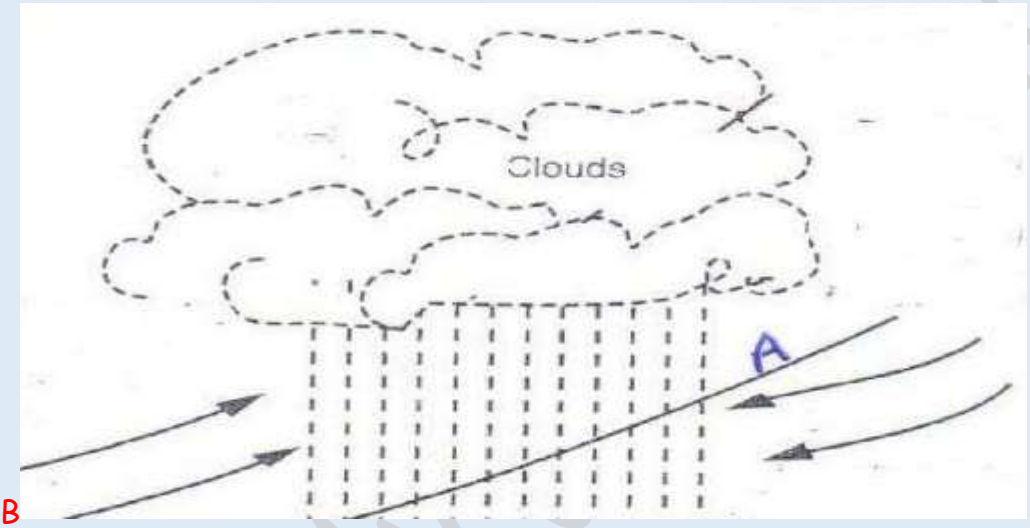
Formation

- ✓ When warm air is heated, it rises in the form of convectional currents.
- ✓ When this air reaches higher in the atmosphere, the moisture in it condenses to form clouds which later fall as rain.
- ✓ It falls mainly in the late afternoons usually accompanied by thunder and lightning.
- ✓ It falls in large drops thus its torrential.
- ✓ It last for a short time.
- ✓ Sometimes accompanied by ice pellets known as hailstones.



Cyclonic Rain/frontal

- ✓ When warm moist air is forced to rise over cold air.
- ✓ The moisture in it is cooled and condenses to fall as cyclonic rainfall.
- ✓ The point where the two air masses meet is called a frontal zone.
- ✓ It is usually very heavy and is accompanied by thunder and lightning.



B Cold air sinks

Warm moist lighter air rises above cold air

below warm air

A - This line represent the plane separating warm air from cold air.

Air pressure /atmospheric pressure

Air pressure is the weight exerted by the atmosphere on the surface of the earth. Pressure decreases with increase in altitude. Lines on a map connecting places with the same air pressure are called isobars.

Factors influencing atmospheric pressure on the earth's surface.

- *The altitude of a place on the earth's surface.*
- *The amount of temperature*
- *The rotation of the earth*

Winds

- ✓ Wind is a moving air over the earth's surface.
- ✓ Air moves from areas of high pressure to those of low pressure.

Types of winds

i.) Land and sea breeze

ii.) Katabatic and anabatic

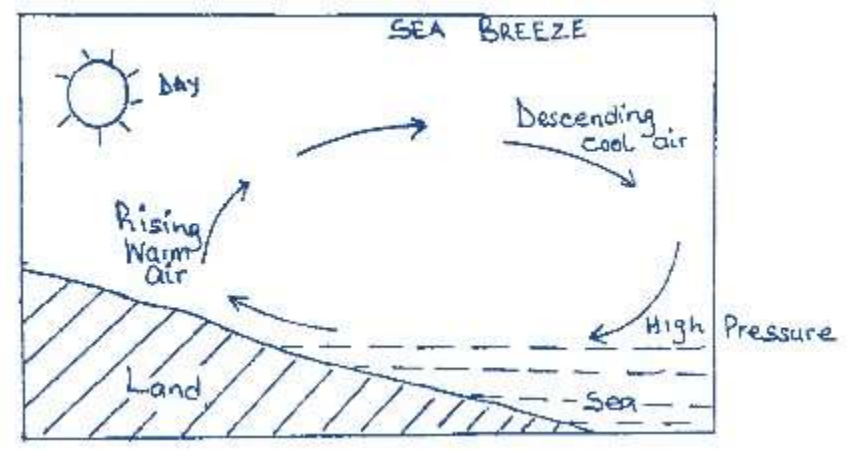
iii.) Chinook

Sea breeze

This is the movement of cool air from the sea to the land during the day.

Formation of sea breeze.

- ✓ During the day the land heats faster than the sea.
- ✓ The air over the land rises.
- ✓ Cooler air from the sea blows towards the land to replace the rising air
- ✓ The cool air from the sea is called sea breeze



What causes sea breeze.

- Differences in atmospheric pressure between the land and the sea, the land has a lower pressure.

- Differences in temperature between the land and the sea, land is warmer.

Effects of sea breeze,

- It lowers the high temperature on land (cooling effect).

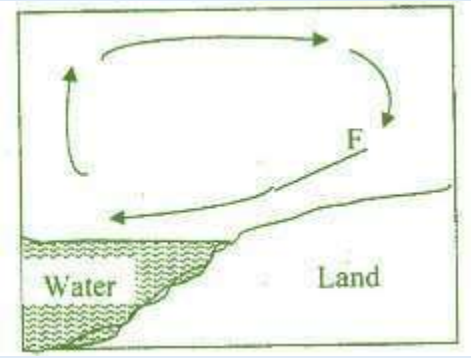
- It might lead to convectional rainfall,

Land breeze

This is the movement of cold air from the land to the sea at night.

Formation of Land breeze

- ✓ During the night the sea is relatively warmer than the land since the land losses heat faster.
- ✓ The air over the water being warmer rises while the cooler dense air from the land flows in to replace the rising air.
- ✓ This causes land breeze.



Sunshine

This is the direct rays of sunlight received on the surface of the earth. Places of same sunshine intensity on a map are joined by lines referred to as isohels.

Factors affecting sunshine intensity and duration

i.) Latitude

ii.) Aspect

iii.) Cloud cover.

Cloud Cover

A cloud is a mass of tiny visible particles of water or ice which is formed by condensation.

Ways in which clouds are classified

- ✓ According to the altitude of their bases.
- ✓ Their appearance/structure.
- ✓ Their formation

Types of clouds

Cirrus clouds

- ✓ Thin, feather-like.
- ✓ Ice crystals.
- ✓ High altitudes.
- ✓ Patches or bands

Stratus

- ✓ Gray, low bases.
- ✓ Sheet-like.
- ✓ Usually associated with low.
- ✓ pressure systems

Cumulus

- ✓ Convective currents.
- ✓ Flat bases Dome-shaped tops.
- ✓ Rain not likely

Cumulo -nimbus

- ✓ They are big, dense, heavy masses of cloud.
- ✓ Causes heavy rains or thunderstorm.
- ✓ Darker at the base and sometimes white at the sides.

Other types of clouds.

Cirro – stratus

- ✓ Thin sheets covering the whole of the sky.
- ✓ Have a milky appearance.
- ✓ Give rise to haloes when the sun or moon shines through them.

Cirro – cumulus

- ✓ White clouds consisting of white ice crystals.
- ✓ Have a thin base.
- ✓ Globular in appearance or arranged in ripples.

Alto – stratus

- ✓ Uniform in layers and contain water droplets.

- ✓ Forms sheet of grey – white color.
- ✓ They are transparent.

Alto - cumulus

- ✓ Uniform sheets of thin flakes or flattened globular masses arranged in lines/waves.
- ✓ Vary considerably in thickness and shape.

Strato – cumulus

- ✓ Loose in structure with large globular masses frequently arranged in groups, lines or undulated formations.
- ✓ They are big but vary greatly in sizes and shape. ✓ They are grey or grey – white in color.

Nimbo – stratus

- ✓ A rain cloud.
- ✓ Shapeless, dark –grey and dense.
- ✓ Spreads all over the sky in low uniform layers.

A weather Station

This is a place where the elements of weather are observed, measured, and recorded.

Factors for siting a Weather station

These factors are to be considered when siting a weather station:

i.) It should be in an open place with free flow of air.

ii.) Away from barrier e.g. trees.

iii.) Should be on a fairly level ground..

iv.) The site should be free from flooding.

v.) The site should provide a wide view of the surrounding landscape and the sky.

vi.) The area should be secure.

Instruments for Measuring Elements of Weather

Instruments that they are likely to be found in a weather station:

- ✓ Thermometer - temperature
- ✓ Rain gauge - rainfall
- ✓ Hygrometer - humidity
- ✓ Barometer – air pressure
- ✓ Anemometer - wind
- ✓ Sunshine recorder – duration and intensity of sunshine.
- ✓ Wind vane – wind direction

Some of these instruments are placed in a wooden weather box known as Stevenson screen. Which provides the thermometers with free flow of air and shade.

Instruments found in Stevenson Screen are:

- ✓ Maximum thermometer.
- ✓ Minimum thermometer.
- ✓ Six's thermometer.
- ✓ Hygrometer.

Note:

Why Stevenson screen is painted white

- So that it can reflect direct heat from the sun.

Has Louvers

- To allow free flow of air in and out of it. In order to obtain room temperature

It is raised about 121 centimeters above the ground

- To prevent contact with direct radiation from the earth's surface.

Measurement of temperature.

Temperature is measured using various thermometers.

- ✓ Maximum thermometer
- ✓ Minimum thermometer

- ✓ Six's thermometer – combined maximum and minimum thermometer.

Maximum and minimum thermometer to measure the maximum and minimum temperatures

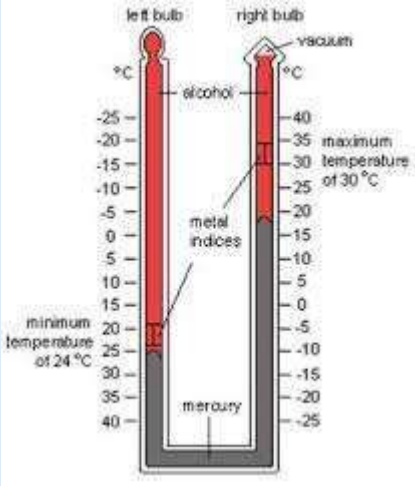
When temperature rises, the mercury expands, pushing the metal index along the tube. When temperature falls, the alcohol contracts and pulls the metal index along the tube

How a maximum thermometer works 3mks

- ✓ When temperature rises the mercury in the bulb is **heated and expands**. √ ½
- ✓ The mercury flows towards the bulb, as it moves forward; it **pushes the metallic** index in the capillary tube. √ ½
- ✓ When the highest temperature of the day is reached and it begins to cool, the **mercury contracts and withdraws towards**√ ½ the bulb. The metallic index is left at the position it was pushed to.
- ✓ The point of the index which was in√ ½ contact with the mercury **indicates the highest** temperature reached during the day.
- ✓ After the reading is taken, the index is set by **placing a magnet on the glass**√ ½ and gently moves it towards the bulb. The index is dragged until it touches the mercury.

The Six's Thermometer

- ✓ For the Six's thermometer (U-shape maximum and minimum thermometer), the temperatures are obtained by reading the values indicated at the bottom of the metal index (indicators).



- ✓ After taking the readings, the thermometer is reset using a magnet.

The readings of the minimum and maximum temperatures are useful for the calculation of the following:

Mean daily temperature/ Diurnal temperature range – It is obtained by finding the average between the maximum and minimum temperatures recorded during the day/24 hours.

$$\frac{Daily\ maximum\ temperature + Daily\ minimum\ temperature}{2}$$

The Diurnal Range of temperature – The difference between the maximum and minimum temperatures recorded in a day (24hours).

Diurnal range of temperature = Daily maximum temperature minus daily minimum temperature

Mean monthly temperature – This is the average temperatures of the month.

Mean monthly temperature = $\frac{sum\ of\ mean\ tempreatures\ for\ that\ month}{number\ of\ days\ in\ that\ month}$

Mean annual temperature – sum of mean monthly temperatures in the year divided by 12.

Mean annual temperature = $\frac{sum\ of\ mean\ monthly\ tempreatures}{12}$

Annual temperature range – This maximum temperature minus minimum temperature recorded in a year.

Measurement of humidity/psychromotor

Humidity is measurement by a wet and dry bulb thermometer known as thermo – hygrometer.

- ✓ The difference between the two thermometer readings is used to calculate relative humidity using a humidity table.
- ✓ If the temperature is saturated there is no evaporation hence the temperature readings on both thermometers remain the same.
- ✓ This means that the relative humidity is 100%.

Note:

When the difference is small, it means that the relative humidity is high but when the difference is large, it means that the relative humidity is low.

Relative humidity

Relative humidity refers to the ratio between water vapour actually present in the air and its capacity to hold water vapour at a given temperature.

It is called using the following formula:

$$\frac{Absolute\ Humidity}{The\ maximum\ amount\ of\ water\ the\ air\ could\ hold\ at\ the\ same\ temperature} \times 100\%$$

Example

If the air at $20^0\ c$ contains $8.26/m^2$ and the given air can hold a maximum of 17.117 gm/m^2 at $20^0\ c$ then the relative humidity would be

$$\frac{8.26}{17.117}\ x\ 100 = 48\%$$

Relative humidity depends on both the absolute humidity and temperature. If the moisture remains constant then the relative humidity will decrease as temperature rises and will increase as temperature falls.

Hygrometer is also used to measure relative humidity.

Measurement of rainfall

- ✓ A rain gauge is used to measure the amount of rainfall.
- ✓ The rain gauge is sunk into the ground and its top being 30cm above the ground level.
- ✓ To avoid surface run off and splashing of water during rainfall.

- ✓ The funnel at the top will direct rain water into the cylindrical container containing a glass jar which will collect the rain water.
- ✓ The collected rain water will be emptied into a measuring cylinder which will give the amount of rainfall in millimeters for the clay.

From rainfall figures it is possible to calculate the following:

Daily rainfall - the amount of rain that falls over 24 hours.

Mean monthly rainfall – obtained by adding all the total monthly rainfall figures for a year and dividing them by 12.

The mean annual rainfall – Obtained by adding total annual rainfall usually for a period of 35 years and dividing by 35.

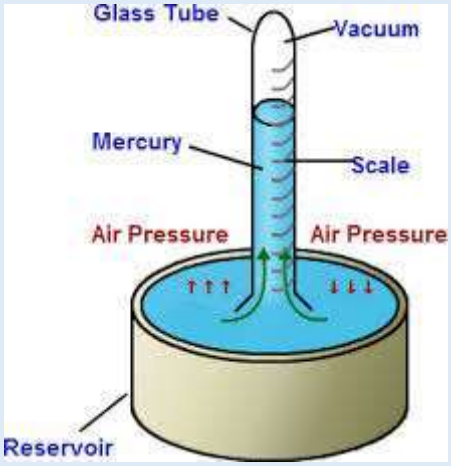
Measuring of Air pressure

Atmospheric pressure is measured in millibars using an instrument known as barometer. There are two types of barometers:

- Mercury barometer
- Aneroid barometer

Mercury Barometer

The height of the mercury column is a measure of the air pressure.



Aneroid barometer

- ✓ The aneroid barometer consist of an air tight metal box which is a partial vacuum.
- ✓ The box responds to changes in pressure by expanding when the pressure falls.
- ✓ Collapse slightly when pressure increases.
- ✓ These movements are conveyed by a series of levers to a pointer.

Advantage of aneroid barometer

It can record changes in atmospheric pressure as they occur during the day.

Measurement of wind

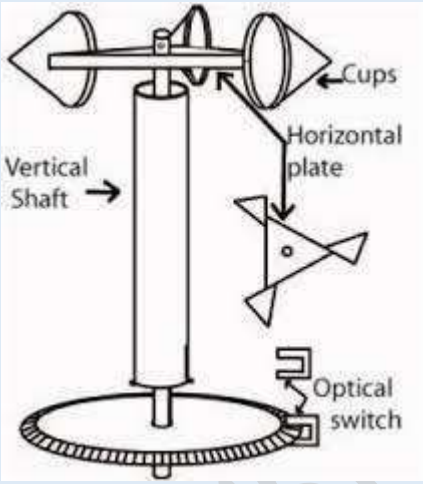
- ✓ The instrument used to determine wind direction is wind vane.
- ✓ When the wind blows, the arm swings until the pointer faces the direction of the wind.
- ✓ The arrow points the direction in which the wind is coming from.

Wind sock

- ✓ A windsock is also used to determine wind direction.
- ✓ It points to the direction the wind is blowing to.
- ✓ It is commonly found in air strips

Anemometer

- ✓ It measures the speed of wind in kilometers per hour or in nautical miles.



Measurement of Sunshine.

- ✓ Sunshine is measured using an instrument called sunshine recorder

- ✓ It records the duration and intensity of sunshine.

The atmosphere

The atmosphere is a thin layer of gases surrounding the earth and held by the earth's gravitational pull.

The structure of the atmosphere

The atmosphere consist of four main zones namely:

a.) Troposphere

b.) Stratosphere

c.) Mesosphere

d.) Thermosphere/ionosphere.

Characteristics of the troposphere.

- ✓ Most weather phenomena occur in this layer.
- ✓ Contains the weather making constituent/life supporting layer.
- ✓ Temperature decreases with increase in altitude (positive lapse rate)/ rate of 6.5^0C per 1000m.
- ✓ Pressure falls with increase in height.
- ✓ Rises to about 15km above the surface of the earth.
- ✓ Contains most of the atmospheric water vapour, cloud, dust/pollutants
- ✓ There is a layer of discontinuity between the atmosphere and the stratosphere called the tropopause.
- ✓ In this zone there is no change in temperature with increase in height. Hence it experiences zero lapse.

Characteristics of Stratosphere

- ✓ Layer above the tropopause.
- ✓ Contains very little dust and water vapor, hence no clouds are found in this layer.
- ✓ Temperature increases with increase in altitude a process known as negative lapse rate.
- ✓ There is steady increase in temperature caused by the over concentration of Ozone gas.
- ✓ Winds are light in the lower part but increases with height.
- ✓ Pressure falls as the air is dry.

- ✓ Stratosphere is a protective shield against meteorites that usually burn out as they enter the earth's gravitational field.
- ✓ The upper limit of the stratosphere is marked by the stratopause .A layer of discontinuity between the stratosphere and mesosphere.

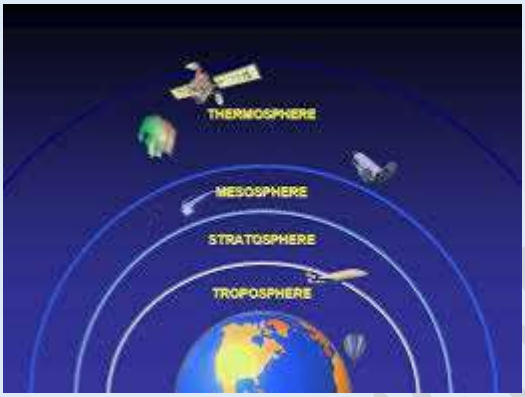
Mesosphere

- ✓ Lies above the stratosphere.
- ✓ Experience temperature decrease with increase in height hence it has a positive lapse rate.
- ✓ Temperature fall quickly as there is no water vapor, cloud dust or ozone to absorb incoming radiation.
- ✓ The area experiences the atmospheric lowest temperature and strongest winds.
- ✓ The layer of discontinuity between the mesosphere and the upper most layer of the atmosphere is called mesopause.

Thermosphere /ionosphere

- ✓ Contains electrons and ions that influence radio waves.
- ✓ Temperature rises rapidly with height perhaps reaching 1500^0 c.
- ✓ This is due to an increasing proportion of atomic oxygen in the thermosphere.

The structure of the atmosphere



The composition of the atmosphere

- ✓ The atmosphere is a mixture of oxygen with inert gases such as argon

Gas	%
Nitrogen	78
Oxygen	20
Water vapour	1
Argon	0.94
Carbon dioxide	0.03

Note:

Inert gases such as neon, helium, krypton and xenon are found in negligible percentages

Ozone layer absorbs the shorter ultra – violet rays from the sun. This is important to human life as exposure to such radiation may cause skin cancer and other forms of ailments.

Apart from water vapor name two other substances that are suspended in the atmosphere.

Gases such as – carbon dioxide and oxygen.

- ✓ Air (wind) -
- ✓ Clouds
- ✓ Pollen grains and smoke/dust particles

Weather forecasting

Weather forecasting is the prediction of weather situation for a given place within a short period of time like an hour, a day, a week, a month or a year.

Methods of weather forecasting

Methods of weather forecasting are grouped into three:

- Ancient
- Weather lore methods
- Modern methods

Problems of weather forecasting

- Inaccurate data
- Defective instruments
- Personnel with limited skills
- Vagaries of nature such as earthquakes

Significance of Weather Forecasting

- Determines times for sea and air travel.
- Determine time when sporting activities take place.
- Determines the fishing activities and habits in the area.
- Help determine suitable clothing for the day.
- Help plan farmers calendar of activities.
- Help plan suitable housing.

Factors influencing weather

a.) Cloud cover and humidity

- ✓ Clouds determine the amount of solar radiation reaching the earth's surface and the amount leaving the earth's surface. This determines temperature conditions.
- ✓ Day temperatures are moderated by clouds.
- ✓ Areas of thick rain clouds have high rainfall.

b.) Altitude

- ✓ This is the height above the sea level.
- ✓ Temperature vary with height above the sea level of a place above sea level.
- ✓ This means that highlands experience cooler temperatures than low-lands.
- ✓ Pressure decreases with rise in altitude.

c.) Humidity

- ✓ Very humid air absorbs heat during the day and retains it during the night.

d.) Aspect

- ✓ This is the direction a slope faces in relation to incoming solar radiation.
- ✓ Because of direct sunshine the sun facing slopes are warmer than the opposite slopes which face away from the sun.

e.) Inter-tropical convergence zone

- ✓ This is a zone of low pressure lying within the tropics, that is, between $23\frac{1}{2}^0$ north and south.
- ✓ Since it is a convergence zone for southeast and northeast trade winds, it causes heavy rainfall wherever it passes.
- ✓ It is associated with convectional rainfall and thunder- storms.

f.) Latitude

- ✓ Areas around the equator re hotter than areas in temperate lands which are warmer than the poles.
- ✓ This is because at lower altitudes the sun's rays cover a shorter distance and pass through reflection, absorption and scattering by the lower latitudes.
- ✓ Equally the sun's rays strike the lower latitudes at right angles hence cover a smaller area leading to greater heat concentration.

g.) Nearness to water bodies

- ✓ They facilitate the development of land/sea breezes through creation of pressure difference.
- ✓ The air currents from such water bodies also lowers the temperature of the surrounding areas and may increase precipitation by supplying extra moisture content through evaporation.

CHAPTER ONE

STATISTICAL

Specific Objectives

By the end of the topic the learner should be able to:

(a) Define the term statistics;

(b) Identify types and sources of statistical data;

(c) Identify and describe methods of collecting and recording data;

(d) Analyses, interpret and present statistical data using appropriate graphical methods;

(e) Explain the advantages and disadvantages of each method of data presentation.

Content

a.) Definition of statistics.
b.) Types of statistical data.
c.) Sources of statistical data
d.) Methods of collecting data.
e.) Methods of recording data.
f.) Analysis of data by working out arithmetic mean, median, mode, percentage, range.
g.) Statistical analyses, interpretation and presentation by use of Line graphs, Bar graphs, Polygraph (combined line and bar graphs), Wind rose', Comparative/group line and bar graphs, cumulative bar graphs, proportional circles, pie charts, divided bars/rectangles, population pyramids and Age-Sex pyramids.
h.) Analysis and interpretation o f dot and choropleth maps.
i.) Discussion of the advantages and disadvantages of each method of data presentation.

Definition of statistics

- ✓ Statistics refers to the facts and figures collected and arranged in a systematic manner.
- ✓ Statistics may be regarded as an art or a science, which is concerned with the interpretation of numerical information.

Statistical Data

This refers to the actual facts and figures collected from various areas and arranged in an organized manner

Statistical Methods

These are techniques of collecting, recording, analyzing, presenting and interpreting statistical data with a view to drawing valid and useful conclusions from them.

Types and Sources of Statistical Data

Statistical data are categorized into two main types:

- Primary data
- Secondary data

Primary Data

- ✓ These include all the facts and figures collected first hand through different methods like:
  - **Oral interview**
  - **Direct observation**
  - **Questionnaire**
- ✓ The data has not been documented therefore it can be said to be original data.

Secondary Data

- ✓ These includes all the facts and figures collected and recorded in textbooks, journals, statistical abstracts and other written materials.
- ✓ The sources of secondary data are called secondary sources.
- ✓ Sources of secondary data include:

- Textbooks
- Statistical abstracts
- Census reports
- Geological reports
- Newspapers

Characteristics of secondary data

Discrete - It is non – continuous over time and may be given in whole numbers. Examples of discrete data include the number of population in a specified country e.g. 10 people, 1000 people.

Note:

In discrete data there is no decimals or fractions it only has whole numbers.

Continuous – This kind of data is continuously distributed over time for example data about temperatures, distance, population growth etc. The values also contains decimals and fractions. 10.5 km, 2.67%.

Methods of Data collection

The main methods of data collection include:

a.) Questionnaire

- ✓ It uses questions to gather information.
- ✓ It consist of a list of questions related to the topic being researched on.

Types of questionnaire

- Personal Interview Questionnaires.
- Rigid Questionnaire

Advantages

i. The researcher is able to seek clarification of unclear response by asking supplementary questions.
ii. The researcher is able to win the respondents trust and dispel any fears that the respondents might have.
iii. Direct contact with respondents provides the researcher with an opportunity to gauge the accuracy of the answers given.
iv. Direct contact with respondents provides the researcher with an opportunity to gauge the accuracy of the answers given.
v. Comparisons can be made easy because similar questions are used for all the respondents.
vi. They are useful sources of first-hand information.
vii. Rigid questionnaires when posted to the respondents reduce fieldwork expenses.

Disadvantages

i. Travelling expenses inflate research costs.
ii. A lot of time is also lost in movement.
iii. The questionnaire may not be effective where the respondent is illiterate or where there is a language barrier.
iv. Mailed questionnaires usually bring back insincere and inaccurate responses especially where opinion questions are involved.
v. Questionnaires when mailed may never reach the respondent.

b.) Interviews

✓ It is a direct discussion between the researcher and the respondent when they meet face to face or indirect when they converse over the phone.

Advantages of interviews

i. The researcher is able to seek clarification for ambiguous responses.
ii. They provide an instant source of information.
iii. They can be used to extract information from illiterate people.
iv. Direct contact with the respondents enables the researcher to estimate the accuracy of the responses.
v. The researcher is in a position to dispel any fears from the respondent and therefore ensures that truthful answers are given.

Disadvantages of interviews

i. Susceptible to bias

ii. Time consuming compared to other data methods.
iii. May be seen as intrusive to the respondent.
iv. Language barrier may arise.

c.) Observation

This method involves direct visual observation of the geographical phenomena.

Advantages of observations

i. It provides reliable data.
ii. It saves time.
iii. It provides first hand data.

Disadvantages of observation

i. This method is subjective since it is based on personal observations.
ii. Very expensive due to travelling cost.
iii. It is affected by weather conditions.
iv. Visual impairment may limit the effectiveness of this method.
v. It may not be possible to collect data on past activities.

d.) Taking measurements

Data can be obtained in the field using measurements such as pacing, estimations, counting, using instruments.

Advantages of Measurements

i. It is easy to measure and read information shown in the instruments.
ii. Data obtained is accurate.
iii. It is a quick way of collecting data.

Disadvantages of Measurements

i. Sometimes the data obtained may be inaccurate
ii. Errors may occur.

e.) Secondary sources (Content Analysis)

- ✓ This involves a researcher gathering secondary data by extracting/examining previous research work.
- ✓ Secondary sources include:

  - Journals
  - Periodicals
  - Census reports
  - Textbooks
  - Maps

Advantages of using content analysis

- ✓ It is easy to collect data.
- ✓ Inexpensive.
- ✓ Gives access to old information.

Disadvantages of using content analysis

- ✓ The available information could have been biased and thus emphasized prejudiced.
- ✓ The data could be outdated and in some cases irrelevant.
- ✓ In some cases the secondary data may have been inaccurately collected.
- ✓ The available data may appear in a format that is not appropriate.

f.) Experimentation

This is an act of conducting a test or investigation to provide evidence for or against a theory.

Advantages of Experimentation

i. First hand data is obtained.
ii. It can lead to further discoveries.
iii. When properly conducted it give accurate results.

Disadvantages of Experimentation

i. Time consuming.
ii. It may be expensive.
iii. Use of defective instruments may lead to inaccurate data.
iv. Improper handling of equipment and chemicals may lead to accidents.

g.) Sampling

- ✓ A sample is small part of anything intended as a representative of the whole.
- ✓ Sampling is the process by which a representative portion of the phenomena under research is selected for analysis.
- ✓ Population is the phenomena under study.

Types of sampling methods

a.) Random

This sampling technique is useful where the phenomena under research is not distributed in any particular order.

b.) Systematic

This method is useful where the phenomena is large and evenly distributed. The objects for study are selected at regular intervals.

c.) Stratified

This involves the selection of study samples on the basis of the groups or categories of the similar elements of the phenomena.

Advantages of sampling

- ✓ It is less expensive.
- ✓ It saves time.
- ✓ It avoids bias.

Disadvantages of sampling

- ✓ A poorly selected sample can lead to misleading information.
- ✓ It is not suitable to an unevenly distributed population particularly the systematic sampling.

Methods of Recording Statistical

This involves the recording of figures and facts collected in the field to ensure that all details are available for analysis.

a.) Tabulation

This is recording of data by arranging facts of figures in form of table or list.

b.) Photographing

This capturing what observed in the field and storing it inform of photographs. This is done by use of a camera to record geographical information.

c.) Note Taking

This involves the making of short notes during an interview so that no information given is lost.

d.) Labelling of Samples

Once the samples are collected in the field they should be put in polythene bags and clearly labelled by naming them.

e.) Filling in the questionnaires

The data is recorded by filling – in the information as instructed in the questionnaire.

f.) Mapping

This involves the drawing of a sketch map to show the distribution of various items in an area.

g.) Field Sketching

This involves the preparation of a simple sketch of what is observed in the field.

h.) Tape recording

This can be done when one is collecting data through an oral interview where one uses tape recording device to record conversation.

i.) Tallying

Used when the data is collected through counting. One counts and puts a vertical strike for every item counted, on the fifth count one puts a diagonal crossing the four strokes

Analysis of Data

Statistical analysis means examining the recorded figures and facts in detail so as to explain the meaning and features of the data.

Methods of Analysis of Data.

1.) Calculation of percentages

The data collected may be converted into percentages to make it more meaningful.

Example

In the study of a farm, 20 hectares where devoted to tea and the total acreage is 100 hectares. Find the percentage under tea.

Solution

$$\frac{20}{100}\ x\ 100 = 20\ \%$$

2.) Measures of central tendencies

Central tendency is the outstanding general characteristics of the data. The main measure of central tendency are:

- The mean
- The median
- The mode

The mean

The mean also known as arithmetic mean is obtained by dividing the sum of the number of all the values with the number of observations made.

Example

The population densities for five sub- locations are found to be 10,11,14,20 and 20 persons per km^2 then the arithmetic mean (average) is:

$$\frac{(10 + 11 + 14 + 20 + 20)}{5} = 15\ persons$$

Mathematically, the following formulae is used.

$$\bar{X} = \frac{\sum x}{N}$$

Where $\bar{x}$ is the mean.

$\sum x$ is the sum of individual values observed.

N is the number of observations.

The median

This is the middle value in given set of data arranged in a rank. To obtain the median, all the values are arranged in an ascending or descending order and then the middle value is determined.

Example

Find the median 5, 9, 10, 30, 12, 20, and 17

Solution

5, 9, 10, 12,17,20,30

12 is the median

Note:

When the set is an even number we simply add the two middle numbers and divide by two to get the median.

The Mode

This is the most frequent recurring value in a set of data.

Example

Find the mode 4 5 7 9 5 2 8 4 9 5 1 5

Solution

The mode is 5 because it appears the most i.e. 4 times

3.) Measure of dispersion

Measure of dispersion show how the data provided is spread out. The main measure of dispersion is the range. The higher the range, the more dispersed the data is and the lower the range, the less dispersed it is.
The range is obtained from subtracting the higher value from the lower value.

Formulae for calculating the range

$$R = XL - XS$$

Where R is the range

XL is the highest value

XS is the lowest Value

Statistical Presentation of Data

- ✓ This is the method of putting collected, recorded and analyzed data in a form that brings out meaning to other people.
- ✓ The type of method of data presentation depend on:
  - The type of data being presented.
  - The information being put across.

Method of Data presentations

- ✓ These are one or two dimensional drawings that show the relationship between two types of data.

- ✓ When one variable changes, it causes a change in another variable.
- ✓ The first one is called an independent variable while the second one is called dependent variables.
- ✓ In drawing a graph the independent variable is put on the x – axis while the dependent variable is put on y – axis.

Types of graphs.

There are two main types:

- ✓ Simple line graph
- ✓ Simple bar graph

Simple line graph

- ✓ This is one dimensional diagram that shows the relationship between two variables.
- ✓ It is a useful method for presentation of continuous data, such as temperatures.
- ✓ A simple line graph may be either curved or straight with sharp angular turns.
- ✓ Curved simple graphs are used to present continuous data like the mean monthly temperature, population growth rate and changes in air pressure.
- ✓ Straight simple line graphs with sharp angular turns are used to represent data which may have some discontinuity.

Construction of a simple line graph.

i. Draw the x and the y axes on the graph paper.

ii. Choose a suitable scale for the variables noting that the x-axis is for independent variable and y- axis for the dependent one.

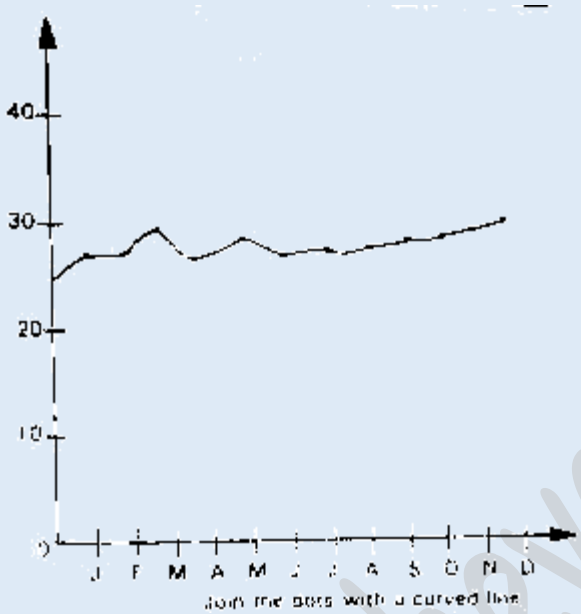
iii. Plot the values accurately using small faint but visible dots.

iv. Join the faint dots by a smooth curve as shown below.

Example

Construction of a simple line graph using curved line

Month	J	F	M	A	M	J	J	A	S	O	N	D
Temp	29	29	30	28	27	26	26	26	26	27	28	29

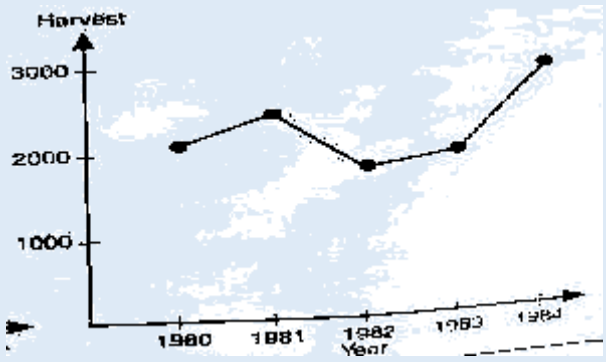


Example

Construction of a simple line graph using a straight line.

Year	1980	1981	1982	1983	1984
Harvest in '000 bags	2050	2600	1800	1950	3000

Solution



Advantages of simple Line Graphs

i. It is easy to construct and interpret.
ii. It is easy to read since it shows the trend.
iii. It enables easy comparisons of variations in the associations between two variables.
iv. It does not involves lengthy and tedious calculations.
v. The trend of the relationship can easily be seen.
vi. Exact values can easily be estimated.

Disadvantages of line Graphs

i. The causes of the illustrated relationship cannot be established from the graph.
ii. It shows no comparisons between two or more sets of data.
iii. Does not give a clear visual impression on the quantity of the data.
iv. It ignores some details of change and may give a false impression on the continuity of some data.

Simple Bar Graph

- ✓ This is a two dimensional diagram which shows the relationship between two variables.
- ✓ This graph is composed of single separate vertical or horizontal bars with each bar presenting a given value.
- ✓ The length of the bars should be the same and conveniently chosen. (Usually 1 cm wide).
- ✓ The length of the bar is equal to the value being presented.
- ✓ The space between two adjacent bars should be constants.

Construction of simple bar graphs

i. Draw the x and y axes. The x-axis is for independent variables.

ii. Decide on the width of the bars and the width of the space to separate the bars. (The same space should separate the x-axis from the first bar).

iii. Find a suitable vertical scale so that the bars do not become too long or too short.

iv. Then plot in the values with small faint but visible dots placed in the middle of the top line will form end of each bar.

v. Neatly draw the outlines of all the bars and label them if necessary.

Example

The table below shows the quantity of minerals produced in tonnes. In the year 2004 - 2005 use it to answer question (a) and (b)

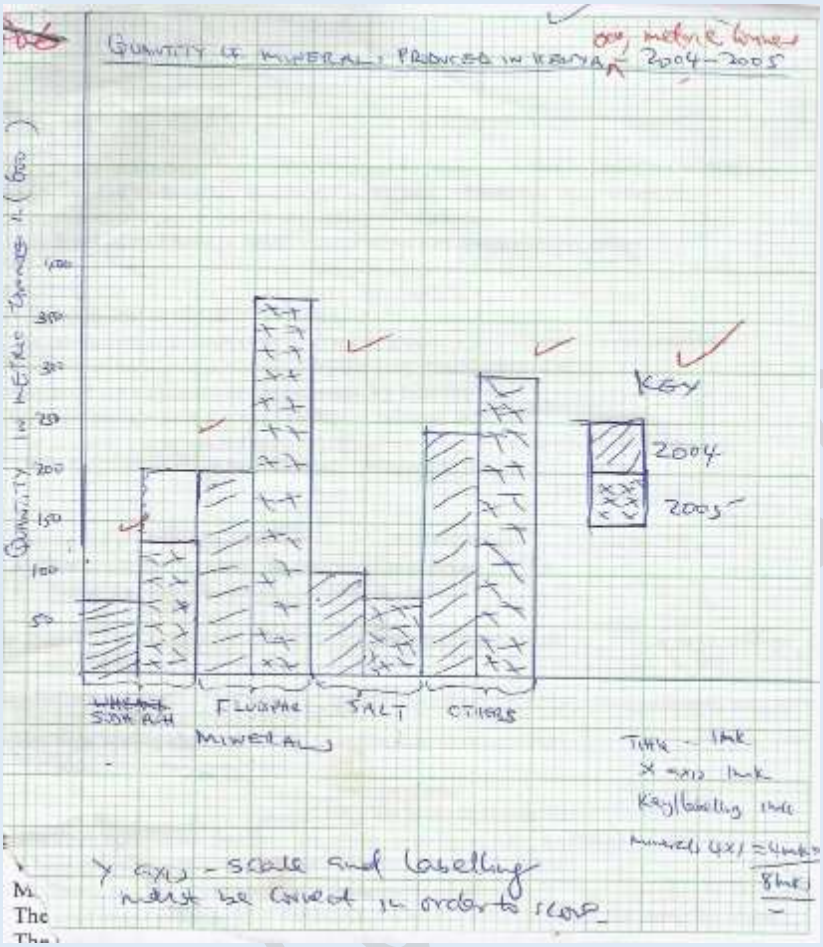
Minerals	**Amount in metric tonnes**	
Year	**2004**	**2005**
Soda-ash	70,000	130,000
Fluorspar	200,000	370,000
Salt	98,000	55,000
Others	240,000	295,000

(a) (i)Using a scale of 1cm to represent 50,000 metric tonnes draw a simple bar graph based on the data above .
(8mks)

(ii) State **two** advantages of using bar graph
(2mks)

(iii) Calculate percentage increase in soda ash production between the year 2004 - 2005

Solution



Advantages of Bar graphs

i. They allow ease in comparison/interpretation.
ii. They give clear visual impression.
iii. They are easy to read.
iv. They are easy to construct..
v. Bars and individual units are suitable to present population of countries.

Disadvantages of Bar graph

i. Difficult to choose a suitable scale when the value for each variable differ by a great magnitude.
ii. It does not show relationship between the same types of data such as temperature or rainfall amounts of more than one place.
iii. The causes of variation in the variables cannot be established from the graph.

Example

The table below gives the figures for the 2009 population census per county for the c

COUNTY	POPULATION
Kiambu	1623282
Murang'a	942581
Nyeri	693558
Nyandarua	596268
Kirinyaga	528054

(a) Besides bar graphs, name three other methods that can be used to represent the above data. (3 marks)

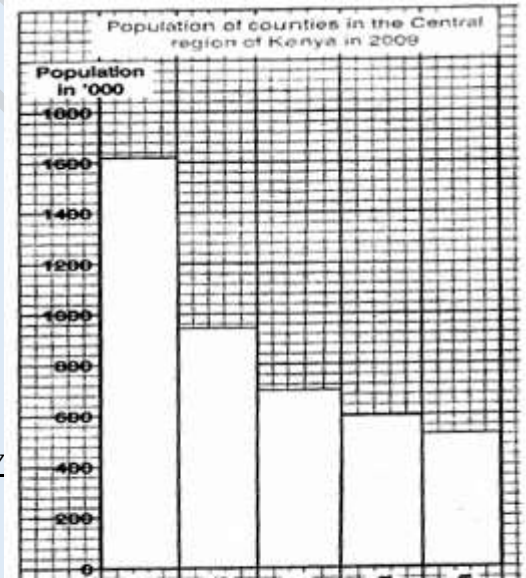
(b) Draw a simple bar graph to represent the data in the table above. Use a scale of 1cm to represent 200,000 persons. (6 marks)

Solution

(a) Other methods of data representation.

- Divided rectangles
- Proportional circles
- Pie chart

(b.) Simple bar graph



Correct bars = 5mks

Y-axis =

Combined line and Bar graphs

- ✓ This graph is a combination of the line and bar graphs.
- ✓ It is mainly used to show the relationship between two types of data especially temperature and rainfall as shown below.

Construction of combined line and bar graph

- ✓ The only difference in construction is that temperature figures are plotted on the right hand side of the y-axis while rainfall amounts are plotted on the left side.

Advantages of combined Line and Bar Graph

i. It is easy to construct and read.

ii. It shows the relationship between two different types of data such as the relationship between temperature and rainfall.

Disadvantages of combined line and Bar Graph

i. It does not show relationships between the same types of Data.

ii. It is difficult to choose a suitable scale when the value for each variable differ by a great magnitude.

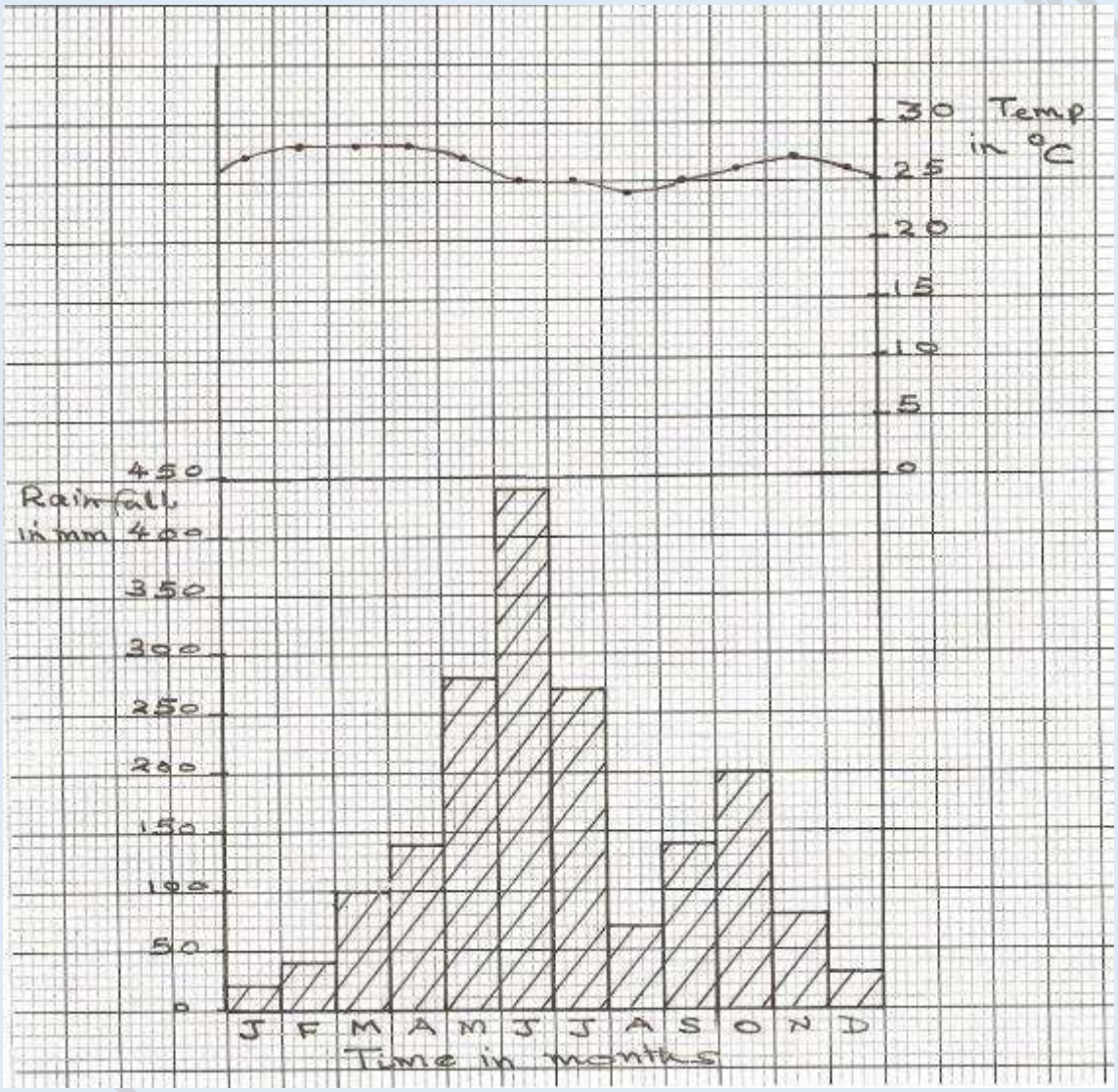
iii. The causeof variation in the variables cannot be established from the graph.

Example

The table below shows the data for temperature and rainfall of station X.Draw a combined line and bar graph to represent the data.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall in mm	20	40	100	140	280	440	270	70	140	200	80	30
Temperature	27	28	28	28	27	25	25	24	25	26	28	26

Solution



Wind rose

- ✓ This is a statistical chart that is used to show diagrammatically the average frequency and direction of the wind at a given place.
- ✓ The wind rose may be drawn in its correct place on a map.
- ✓ The length of the column shows/represents the frequency of wind in the given direction.

Construction of a Wind Rose

i. The centre of the wind rose is a circle of any given size. An octagon may be used instead of a circle.

ii. The number of calm days is written inside the circle or sometimes they, may be indicated immediately under the wind rose.

iii. Eight points of the compass are sufficient.

iv. The length of the columns or arms is drawn proportional to the actual number of days.

Direction of the winds	N	NE	E	SE	S	S W	W	NW	Calm	Total number of days
Number of days	3	3	1	1	2	7	6	4	4	31

Advantages of a simple Wind Rose

i. It is easy to construct.

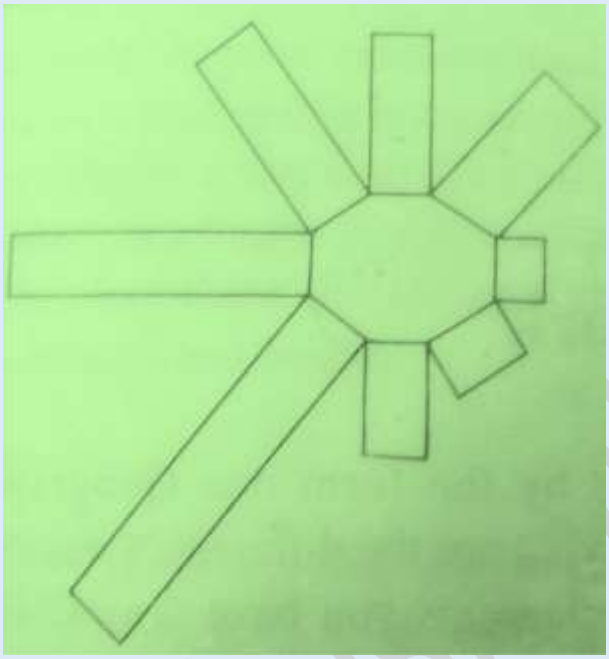
ii. It gives a good visual impression.

iii. It is easy to read and interpret

Disadvantages of wind Rose

i. It does not show the speed of wind.

ii. It does not show the comparison of wind direction.



CHAPTER FIVE

FIELD WORK

Specific Objectives

By the end of the topic the learner should be able to:

(a) Define the term field work;

(b) State different types of field work;

(c) Explain the importance of field work;

(d) Explain the procedure to be followed during field work; •

(e) Identify possible problems during field work;
(f) Carry out field work within the local environment.

Content

a.) Definition of field work.

b.) Types of field work.

c.) Importance of field work.

d.) Field work procedure.

e.) Problems likely to be encountered during fieldwork.

f.) Field work within the local environment

Definition

Fieldwork may be defined as an activity that involves the seeing and using of the environment around us as a laboratory for the teaching and Learning of Geography.

It is a scientific method of study that enables geographers and other researchers to use the available natural and human- made phenomena to understand the environment better.

Fieldwork allows the learners to interpret for themselves what they see and to Confirm the facts and ideas that they acquire in the classroom.

It is one of the activities that make geography a practical subject. The activities may be conducted within the school environment, around the school and sometimes far from the school.

Types of fieldwork

i. Field study or field teaching.

ii. Excursions. iii. Fieldwork research.

Field study

- ✓ A field study is aimed at collecting data in order to achieve specific objectives.
- ✓ These objectives are formulated and clearly outlined by the researcher before the study.
- ✓ They are expressions of what the researcher intends to find out during the field study.
- ✓ The study is conducted by an individual or a group of people.
- ✓ It is based on a specific theme, such as: A visit to a farm. The data collected in such a study is recorded, analyzed, interpreted and conclusions drawn from it.

An excursion

- ✓ An excursion is a sight-seeing outing, mainly aimed at relaxing the people involved.

- ✓ It does not require the formulation of objectives or the collection of data.
- ✓ It is however, possible to conduct a field study within an excursion.

Fieldwork research

- ✓ The fieldwork research is a problem solving activity.
- ✓ It is a study conducted by experts in their respective fields of specialization.
- ✓ For example, when there is a disease outbreak affecting livestock in a certain area, the veterinary officers, who are the experts in that field go to the area affected by the disease.
- ✓ Their main aim is to identify the cause of the disease and come up with possible solutions to the problems.

Note:

These three types of fieldwork may be carried out together or separately.

Importance of fieldwork

It helps the geographer to be able to:

i. Apply the skills learned in the classroom to the real life situation.

ii. Identify specific problems that may require geographical investigation.

iii. Study geographical phenomena and processes such as faulting, mass wasting, so as to understand them better.

iv. Identify and categorize factors and features of given geographical phenomena so as to be able to record them for use now and in the future.

v. Think and use observation skills to reason logically and make objective judgment.

vi. Use the geographical techniques of gathering, analyzing and presenting data so as to perfect the following skills: An accurate oral description of what they observe, Coherent expression of ideas, High level reasoning and making of independent and objective judgment and Good maintenance of human relations.

vii. Be familiar with the environment in which they live by training them to acquire the appropriate attitudes, skills and knowledge with which to interpret and improve the environment.

viii. Draw local examples from their own interpretation and observations.

ix. Break the monotony of classroom teaching and learning so that both become more vivid and realistic.

Fieldwork procedure

- ✓ A procedure is an established way of doing things.
- ✓ The fieldwork procedure is straight forward and involves a series of activities to be completed in order to achieve certain objectives.
- ✓ The normal pattern that the fieldwork procedure takes is summarized in the below.

Identify the topic of study

↓

Statement of objectives

↓

Formulation of the hypotheses

↓

Prepare for the fieldwork

↓

Conduct the actual study

Identifying the Topic of Study

- ✓ The topic of study refers to the title of the field study that is to be carried out.
- ✓ The title can be drawn from a topic that has already been studied in the classroom.
- ✓ It should be started in a short, clear and precise statement.

For example:

- A study of weather station.
- A study of Ol'Kalou market.
- A study of Nyadorerea fish fillet factory.

Statement of Objectives

- ✓ An objective describes the actual detail that the researcher intends to look for during the study.
- ✓ Every topic of study may have several objectives.
- ✓ The objectives must be relevant to the topic of study.
- ✓ They should be stated in short clear sentences.

Example

For a topic 'A study of Kisumu fish fillet factory, the following are possible objectives:

- To find out when the factory was established.
- To find out who owns the factory.
- To find out the number of workers employed in the factory.
- To identify the market outlet for the fillet processed in the factory.

For the topic 'A study of landforms near the school, ' the following are possible objectives:

- To find out the types of landforms near the school.
- To find out the highest and the lowest points of the study area.
- To identify the possible processes involved in the formation of the main landforms.
- To investigate the relationship between landforms and soil depth in the area.
- To identify the economic importance of the landforms around the school.

Every objective must have a stem. Other than' to find out' other suitable stems could be: To investigate.....' To identify.....'

A good objective therefore should be specific, measurable, achievable, and realistic and time bound (SMART).

Formulation of the Hypotheses

- ✓ A hypothesis is the researcher's own speculation about the problem in question.
- ✓ It is a tentative answer to the problem in question.

- ✓ It is therefore a theory that has not yet been proved.
- ✓ The researchers make guesses on the basis of any knowledge they have in the area of study.
- ✓ The fieldwork exercise revolves around the testing of the hypotheses to establish whether or not they can be accepted as statement of fact.

Two main types of hypotheses:

Null hypothesis

- ✓ This is stated negatively, for example, there is no relationship between landforms and soil depth in the area.

Alternative or substantive hypothesis

- ✓ This is stated positively, for example, there is a relationship between landforms and soil depth in the area.
- ✓ Students may use either of the two whenever they formulate hypotheses for a study.

Characteristics of a good hypothesis

- ✓ It has an element of comparison, whereby two or three items are compared.
- ✓ The quantitative words used are easily measurable, for example, more, most majority, all. Avoid the use of words like a lot, many or few.

- ✓ The hypothesis leaves room for 'yes' or 'no'.
- ✓ It must be related to one or more of the objectives in question. This means that a hypothesis at times is in question form or negative form.
- ✓ A hypothesis should not be obvious. Below are examples of hypotheses used on the study of landforms used above.

i. Most of the landforms in the area has resulted from internal earth movements.

ii. The highest point in the area is at the top of Mt Longonot.

iii. Is lowest point in the area occupied by a lake?

Preparation for the fieldwork

- ✓ Students and researchers should prepare adequately before going out for a field Study.
- ✓ The more thorough the preparation, the more successful the field study.

The sequence of activities involved in preparation is outlined in the below

Seek permission

↓

Conduct a reconnaissance

↓

Adjust objectives and hypotheses

↓

Choose methods of data collection

↓

Assemble necessary tools

↓

Prepare a working schedule

↓

Divide the students into groups

Seek Permission

- ✓ Preparation for fieldwork begins with the seeking of permission from the relevant authorities, and/or the acquisition of a research permit.
- ✓ Where the fieldwork is conducted by the students and their teacher, the first authority to approach is the principal of the School.
- ✓ Within his/her permission, other details concerning transport, packed lunch, entry fees to national parks, etc., can be taken care of easily.
- ✓ Once the principal's permission is acquired, the teacher and /or the students decide on the suitable data of study.
- ✓ If the study is to be conducted in an industry, the letter is addressed to the manager of the industry.
- ✓ It should be written well in advance to give the manager ample time to reply. The letter should also contain a list of areas that students are interested in.

Reconnaissance

- ✓ Once permission is acquired, the teacher will select a small group of students.

- ✓ Together, they will conduct a reconnaissance or a pre-visit to the intended place of study.
- ✓ A reconnaissance is a short visit to the place of study prior to the actual day of study.

Importance of reconnaissance

i. It familiarizes the researcher with an area of study.

ii. It introduces the researcher to the authorities and respondents in the area of study. This makes it easier to extract information from people already known.

iii. It helps the researcher to identify and decide on the methods and tools to use in collecting information during the study.

iv. It helps to determine the suitability of the area for the study. If it is found unsuitable, then an alternative area of study is sought.

v. It helps to identify any problems the researcher is likely to encounter during the study. This gives him an opportunity to prepare on how to cope with the situation.

vi. It enables the researcher to estimate the cost of study and plan accordingly. vii. It is useful in designing a working schedule.

Revision of objectives

- ✓ After the reconnaissance, the researcher will revisit the objectives and hypotheses and make any necessary adjustments in accordance with the findings of the reconnaissance.

Methods of Data collection

- ✓ Suitable methods of data collection are then chosen some of which may require prior arrangements.
- ✓ For example, the production of enough questionnaire and acquisitions of relevant materials for the study should be done before visiting the field.

Assembling of Research Equipment

- ✓ The researcher then decides on the methods of data collection suited to the area of study.
- ✓ The tools needed for the study should be assembled early to eliminate the last minute rush and forgetfulness.
- ✓ Such tools may include maps, writing materials, a loaded camera, tape recorder, compass, tape measure, plastic bags, geological hammer, binoculars, masking tape etc.
- ✓ The choice of tools is determined by the topic of study and the methods the researcher intends to use to collect data.

Working Schedule

- ✓ It includes a plan of activities for each day of study.
- ✓ It shows specific times during which particular activities should be conducted.

Importance of a working schedule.

i. It gives ample time to each activity so that no activity is forgotten.

ii. It reduces the tendency to waste time and forces the researcher team to work within the allocated time in order to complete the project within the stipulated time.

iii. It provides a basis for evaluating the fieldwork while it is still in progress.

iv. It provides a framework that guides the researcher to remain within the scope of the topic.

v. It provides an estimate of the time required for the study.

The Actual Field Study

- ✓ The actual field study takes place on the day chosen for the study.
- ✓ On this day, the students should rise up early.
- ✓ The schedule should be observed from step one.
- ✓ The main activity taking place is the collection of data.
- ✓ The data to be collected is aimed at satisfying the objectives and testing the hypotheses outlined earlier.

Main methods of data collection

a.) primary or direct methods

- questionnaire
- Interview
- Taking photographs
- Experimenting
- Counting
- Measuring

b.) Secondary or indirect methods mainly content analysis

- Methods of data recording
- Field sketching

- Taking photographs
- Tallying
- Tape recording
- Note taking
- Labeling samples
- Filling - in questionnaires

Data presentation may be done in the following ways:

- Drawing graphs and charts
- Drawing sketch maps and diagrams
- Displaying the completed questionnaires
- Playing the tapes
- Writing a report
- Giving a lecture
- Displaying the labeled samples

Problems likely to be encountered during Fieldwork

The main problems include:

- The researcher may fall sick during study.
- The respondents may become uncooperative or may fail to keep time.
- A language barrier between the researcher and the respondents may call for an interpreter thereby slowing down the progress of the study.
- Transport problem e.g. the vehicle in which the researcher is travelling may break down.
- Environmental constraints e.g. rainfall may cut short the field work.
- The researcher may face the danger of wild animals.

- Steep slopes may be difficult to climb.
- Thick vegetation may be difficult to penetrate.
- Dishonest respondents may lead to collection of inaccurate data.
- Financial constraints may bring the fieldwork to a standstill.

Follow up Activities

These are activities that the students will be involved in immediately after the study.

The activities involves

- Discussions.
- Comparing notes.
- Write reports.
- Taking advise on how to present
-

End of topic

Did you understand everything?

If not ask a teacher, friends or anybody and make sure you understand before going to sleep!

Past KCSE Questions on the topic

1. State two ways in which information collected during the field study would be useful to the local community. 2mks

2. Your class is required to carry out a field study of a river. What would be the advantage of dividing the class into groups according to the stages of the long profile 3 of a river?

3. What would be the disadvantages of c using secondary data in this kind of a field study?

4. You intend to carry out field study on population in the local open air market,

(i) State three reasons why it would be necessary for you to visit the market

Before actual field study.

(ii) Give two methods you would use to collect information on pollution. ,

(iii) State three follow up activities necessary for the study. -51

5. You are supposed to carry out a field study on the uses of vegetation in the area around your school.

(a) State three reasons why it would be necessary to visit the area *before* the day of the study.

(b) Give four uses of vegetation you are likely to identify during the study.

(3mks)

(c) Why is it necessary to sample part of the forest for the study?

6. List three types of fieldwork.

(3mks)

7. Explain the importance of field work. (5mks)

8. Outline the procedure for carrying out field study.

(5mks)

9. List some topics in physical geography on which you can carry out a field study.

(4mks)

10. State five ways in which you would prepare for field study to a weather.

(5mks)

11. What is the importance of carrying samples from the field to the school?

(4mks)

12. Formulate five suitable objectives for field study on a visit to a forest.

(5mks)

13. Discuss types of hypothesis.

(2mks)

14. List five methods of data presentation.

(5mks)

15. Explain five problems one would encounter on field study in a forest?

(5mks)

16. Why is reconnaissance important?

CHAPTER SIX

MINERALS AND ROCKS

Specific Objectives

By the end of the topic the learner should be able to:

(a) Define minerals and rocks;

(b) State the characteristics of minerals;

(c) Classify rocks according to mode of formation;

(d) State the characteristics of rocks;

(e) Account for the distribution of major types of rocks in Kenya;

(f) Explain the significance of rocks;

(g) Identify major types of rocks and their use within the local environment.

Content

a.) Definition of (a) minerals and (b) rocks.

b.) Characteristics of minerals.

c.) Classification of rocks according to mode of formation.

d.) Characteristics of rocks.

e.) Distribution of major types of rocks in Kenya.

f.) Significance of rocks.

g.) Field work - Identification of major types of rocks and their uses within the local

Introduction

What is a mineral

Inorganic substances which occur naturally at or beneath the earth surface/A naturally occurring, crystalline, inorganic substances with a definite chemical composition and physical properties.

Characteristics of Minerals

i. Tenacity

This is the ability of a mineral to resist/to withstand tearing, crushing or breaking differs. It is different from one mineral to another and it can be brittle, ductile, elastic, malleable or flexible.

ii. Lustre

Refers to surface appearance of minerals as it reflects light. The two main types of lustre are metallic and non-metallic. Some minerals are shiny while others are dull.

iii. Colour

Minerals have specific colours for example gold is yellow and Copper is brown.

iv. Hardness

The measure of degree of resistance of a mineral to disintegration. Some minerals such as diamond have a high resistance while others such as Talc are soft.

v. Shapes

Some minerals aggregate into distinct crystal shapes, for example, a crystal of quartz is a six- sided prism.

vi. Composition

Some minerals are composed of one element such as gold, copper, diamond and silver while others such as bauxite and feldspar have two or more elements.

vii. Specific gravity

This is the measure of the relative weight of a substance. Different minerals have different specific gravity.

viii. Tastes and solubility

Different minerals have different tastes and solubility.

Definition of Rocks

A rock is an aggregate of mineral particles forming solid part of the earth's crust

Different between a rock and a mineral

- ✓ A rock is a natural occurring aggregate of mineral particles forming the earth's crust while a mineral is a naturally occurring crystalline inorganic substance with a definite chemical composition and physical properties.

- ✓ Rock is a solid substance made up of an aggregate of minerals while a mineral is an inorganic substance found in the crust or on the surface made up of one or more elements.

Ways in which rocks can be classified.

a.) By mode of formation

b.) By physical and chemical characteristics.

c.) By age

Classification of Rocks According to the Mode of Formation or Origin

According to mode of formation we get three types of rocks.

i. Igneous rocks
ii. Sedimentary
iii. Metamorphic rocks

Igneous rocks

- ✓ The word igneous means fire in Latin.
- ✓ Igneous rocks are formed the cooling and solidification of magma which is a combination of silicate minerals.

Formation of extrusive igneous rocks

- ✓ During volcanic eruptions, lava and other volcanic materials are thrown on to the earth's surface.

- ✓ The lava cools and solidify to form extrusive/volcanic igneous rocks.
- ✓ The rate of cooling and solidification is very rapid due to presence of low temperature such that the rocks formed will have minerals with fine textured and small crystals.

General characteristics

- Crystalline in structure
- Glassy in appearance

Igneous rocks can be divided further into:

a.) Intrusive/plutonic rocks

Plutonic rocks are intrusive igneous rocks which are formed deep on the earth's crust.

Types of plutonic rocks

- Granite
- Diorite
- Peridotite
- Gabro
- Syenite

How intrusive igneous rocks are formed

- ✓ Heat and pressure beneath causes rocks to melt.
- ✓ This lead to formation of lines weakness cooling into the earth coast cooling into the earth coast.
- ✓ Magma cools and solidifies inside the coast to form intrusive igneous rocks

b.) Hypabyssal rocks

- ✓ They result from magma being intruded into other rocks, often overlying layers of strata at shallow depths beneath surface level.
- ✓ Since the molten rock undergoes relatively rapid cooling in dykes (vertical fissures) and sills (horizontal sheets),
- ✓ Crystallization is speeded up and the rocks are therefore finer in texture than the coarsely, crystalline plutonic rocks.

Examples

- Porphyry
- Dolerite
- Lamprophyre

Volcanic or Extrusive Igneous Rocks

- ✓ Volcanic rocks are rocks which are formed on the surface of the earth when lava cools and solidifies.
- ✓ The cooling and solidification is very rapid because of lower pressure and temperatures on the surface of the earth.

Characteristics

- Small crystals
- Fine grained/fine texture

Classification of Extrusive rocks

- Those that are formed as a result of larva flow.
- Those that formed as a result of ejection of volcanic materials.

Those formed as a result of Lava Flows

✓ Formed from lava that flows on the surface before cooling and solidifying.

✓ Some of the resultant rocks may have the same composition as intrusive types for examples rhyolite – granite, andesite- diorite while basalt is the extrusive equivalent to gabbro.

Those formed as a result of Ejection of Volcanic materials

✓ Solid or nearly solid materials throughout during volcanic eruption on cooling forms various types of rocks.

✓ An example is pumice which is spongy and can float on water.

Sedimentary rocks

✓ Sedimentary Rocks are formed from pre-existing igneous or metamorphic rocks, through the process of weathering/ erosion.

✓ The sediments are deposited in layers / strata and over a period of time they are consolidated into hard rock.

Characteristics

- Made up of layers known as strata / bedding planes.
- Are either mechanically / organically chemically formed.
- Have joints that meet the bedding planes at right angles.
- Some have fossils.
- Are non-crystalline.
- They are formed in layers/stratified.
- They easily bend/fold when subjected to pressure.

- They consist of different rock particles/sediments.

Classification of sedimentary rocks

- Mechanically derived sedimentary rocks
- Organically derived sedimentary rocks
- Chemically derived sedimentary rocks.

Mechanically formed sedimentary rocks

These are Rocks which are formed when eroded rock materials are transported by agents of erosion and deposited in layers.

Formation of mechanically formed sedimentary rocks

- ✓ Formed from pre-existing rock material
- ✓ Weathered rock particles pre-existing rock are particles transported and deposited by wind, water, ice or waves in layers.
- ✓ The materials are laid down/deposited in thick layers/strata.
- ✓ The sediments are compressed over time and become compacted and hard due to pressure.
- ✓ This forms mechanically formed sedimentary rocks e.g. sandstone

Types of mechanically formed sedimentary rocks

- Arenaceous rocks e.g. sandstone.
- Argillaceous rocks e.g. shell.
- Rudaceous e.g. brecia

Organically Formed Sedimentary Rocks

These rocks are formed when remains of previously existing plant or animal organisms are accumulated over period of time forming layers.

Formation of organically formed sedimentary Rocks

- ✓ Dead plant or animal remains/fossils are deposited in layers in lakes/oceans or on land.
- ✓ Over time they are compressed by other sediments piling on them.
- ✓ They are compacted and harden to form organically formed sedimentary rocks e.g. limestone.

Classification according to composition

Calcareous

- ✓ Rocks are rich in calcium carbonate.
- ✓ Formed from skeleton/ shells of dead organism.
- ✓ They include limestone rich calcite and dolomite.
- ✓ Limestone rich in fossils is called coral or shelly.
- ✓ The ones derived from skeletons of calcareous algae is called chalk.
- ✓ Oolite is rich in ooliths.

Ferruginous

- ✓ Rocks are formed in lakes and marshes by precipitation of hydrated iron oxide from water.
- ✓ This process is assisted by minute bacterial organism released by decomposing vegetative matter.
- ✓ Example is ferruginous rocks.

Siliceous

- ✓ Rocks formed by the accumulation of remains of organisms like radiolarians, diatoms and sponges whose skeleton are rich in silica.
- ✓ They are formed in places which were once under water but are now dry.
- ✓ Diatomite is an example of a siliceous rock.

Carbonaceous

- ✓ Rocks are formed from the accumulation of remains of plants which have been buried.
- ✓ Once buried these remains change gradually, under pressure.
- ✓ At each stage the amount of carbon content increases.
- ✓ Coral is the main rock of carbonaceous type.

Chemically Formed Sedimentary Rocks

These are formed when rocks are precipitated or when solutions of salt are evaporated and particles accumulate in layers.

Formation of Chemically formed sedimentary rocks

- ✓ Minerals of the preexisting rocks are dissolved when it rains and carried away in solution.
- ✓ Mixture of this solution carried by rivers and the lake/sea water react and cause precipitation of the sediments.
- ✓ The sediments are laid down in layers on the bed of oceans/lakes, where they are compacted and harden to form chemically formed sedimentary rocks

Or

- ✓ Dissolved minerals in Lake Basin may evaporate due to high temperatures.
- ✓ This causes the minerals to re-crystallize and settle/deposit on the lake bed.
- ✓ They accumulate over time in layers where they are compressed, compacted and harden to form chemically formed sedimentary rocks e.g Travertine, Trona, etc.

Classification of chemically formed sedimentary Rocks

a.) Carbonates

b.) Sulphates

c.) Chlorides

d.) Silicates

e.) Iron stones

Carbonates

- ✓ Contains mainly carbonate compounds
- ✓ Examples are Travertine, Dolomite, Trona

Sulphate

- ✓ These are mainly made of sulphate compunds
- ✓ They are formed as a result of desiccation/drying or evaporation from waters of shallow desert lakes or constricted shallow bays of seas where evaporation is rapid.
- ✓ Examples are gypsum

Chlorides

- ✓ These are mainly salt made up of the mineral halite sodium chloride

Silicates

- ✓ These are formed from deposition of silica,originally in solution in sea water.
- ✓ This leads to accumulation and compression into rock. ✓ Examples are flint.

Ironstones

- ✓ Examples are limonite and haematite

Metamorphic Rocks and their characteristics

- ✓ The word metamorphic is derived from two Greek words meta meaning change and morphee meaning form hence change of form.
- ✓ These are rocks formed within the earth crust by transformation in the solid state of pre-existing rocks as a result of high temperature, high pressure or both.

Factors determining the degree of change of rocks during metamorphosis

i. The resistance of the rock to crushing.
ii. The grain size of the rock being changed.
iii. The porosity of the rocks.
iv. The solubility of the constituents of the rocks.

iv. The chemical action of the minerals.
v. The stability of the minerals that are produced.

The metamorphosis or change from the original state may result from:

a.) Heat which causes the minerals to re –crystalize; such action is called thermal metamorphism.

b.) Stress which causes alteration in the rock structure; this kind of metamorphism is referred to as cataclastic metamorphism.

c.) The action of heat and stress working together: a process referred to as regional metamorphism.

The above gives three kinds of metamorphism.

Dynamic / Kinetic metamorphism

Occurs when pre-existing rocks are subjected to intense pressure

When the weight of the overlying rock layers creates pressure on the lower layers, it leads to change in structure / gain alignment of the rocks

Contact / Thermal

Occurs when pre-existing rocks are subjected to intense heat.

During volcanic eruptions, hot magma / gas / liquids may intrude into sedimentary rock. The rock grains will recrystallize due to heat to form new minerals.

Thermal – dynamic metamorphism

It occurs when pre- existing rocks are subjected to both heat and pressure.

In the mountain building process, sedimentary rocks are compressed and due to this, pressure, heat is generated. This heat modifies the structure of the original rocks.

Changes that occur in rocks during metamorphism

- New minerals are formed.
- The rocks are hardened / become more resistant.
- The rock may recrystallize.
- The chemical composition of the rocks change
- Physical characteristics / appearance of the rock changes is altered.

Distribution of major Types of Rocks in Kenya.

Distribution of Rocks in the Coastal Region

- ✓ The Coastal region of Kenya is generally an uplifted area. As a result of this uplifting, a platform of sedimentary limestone rocks was exposed.
- ✓ This platform that was once part of the ocean floor is termed as the continental shelf.
- ✓ The coastal region of Kenya consist of three types of geological formations. These are:

a.) Sedimentary Rocks

- ✓ The sedimentary rocks of the coastal areas are and the ocean fringe are largely lime stones of coral origin.
- ✓ Coral limestone deposits are mainly produced by coral polyps.
- ✓ Polyps are minute marine organisms that live in colonies in warm tropical waters.

Why coral rocks are widespread at the coast

- Salty water favors growth of coral polyps
- Warm water with temperatures between 20^0c and 29^0c for the growth of coral polyps
- Clear water which is free from silt or mud favor coral growth by receiving sunlight
- Shallow water of less them 60 meters deep to which sunlight can penetrate for coral growth
- Well oxygenated water for coral growth

Importance of coral rocks

- Used as building materials and blocks.
- Fascinating rock features attract tourists.
- Coral limestone is a raw material for cement manufacture.

✓ Limestones sedimentary rocks extents from the north coast in kilifi through Mombasa is land to the south coast Kwale.

✓ Sandstones are common in kilifi and kwale Districts.

✓ A small section of Malindi with gypsum rocks.

Reasons why sedimentary rocks are dominant along he Kenyan coasts

i. Some parts of the coastal plain emerged from the sea where sedimentation occurred.

ii. The coastal plain is lowland which has facilitated deposition of weathered rock materials.

iii. The shallow continental shelf provides favorable environment for the coral polyps whose skeletons are deposited and accumulate to form rocks.

b.) Basement rocks

- ✓ Basement complex rocks are found to the west of the sedimentary rock areas.
- ✓ They occur in many areas of Taita and Tana River Districts.
- ✓ Quartzite rock is found in some parts of Tana River,Kilifi and kwale Districts.

Distribution of rocks in the Nyika Plateau and the Dry Lowlands

The rocks include:

a.) The metamorphic rocks of the basement complex system.

b.) Sedimentary rocks.

c.) Volcanic rocks.

Distribution of rocks in the Rift Valley and its Associated HighLands

The region contains three distinct types of rocks. They include:

a.) Basement complex rocks – they are sedimentary rocks usually compounds of grits, sandstones, shales and lime stones.

b.) Tertiary Volcanic rocks – these were erupted during the tertiary geological times and they are the most widespread rocks in the rift valley and its associated highlands.

c.) Quaternary volcanic rocks – they are the youngest rocks in the region.

Distribution of rocks in western Kenya

- ✓ These region has some of the oldest rocks and one of the most complicated geological history in kenya.
- ✓ Granite and gneiss are common in most parts of kisii districts,Maragoli and Bunyore areas.
- ✓ Volcanic rocks are common near the shores of kavirondo and winam Gulfs and in the area around Gwasi hills volcanic rocks are found.
- ✓ Winam gulf and Kano Plains the zones are covered by sedimentary rocks.
- ✓ The southern shores of winam gulf are covered by quartenary sedimentary rocks which are also found in Rusinga and Mfangano islands.

Significance of rocks and minerals to the economy

i. Some rocks such as granite, volcanic peaks may form unique sceneries which attract tourists promoting tourism industry.

ii. Rocks provide the parent materials through weathered rocks especially volcanic rocks forming fertile volcanic soils for agricultural production.

iii. Rocks such as sandstone, marble and limestone are strong and resistant to weathering are used in the building and construction industry. iv. Minerals and other valuables substances are extracted/mined. Some rocks are used as raw materials for the manufacturing industry.

v. Impermeable rocks may act as storage of underground water which can be tapped to supply water for domestic and industrial use.

vi. Through weathering rocks provide soils which are useful for agricultural production

vii. Some rocks have valuable mineral ores which are exploited and sold to generate revenue. Some rocks are e.g kisii soapstone is used for making carvings.

viii. Some provide salts used for both domestic and industrial purposes e.g soda ash in lake magadi.

ix. Fuels of great economic value are derived from rocks e.g coal and petroleum.

x. Sedimentary rocks contain nitrates ad potash used in making of fertilizer, medicine and dyes.

Field work on Rocks and Minerals

1.) You carried out a field study on rocks within the school vicinity.

a.) State three objectives of your study.

i. To find out the type of rocks within the school vicinity.
ii. To find out the physical characteristics of the rocks within the school vicinity.
iii. To find out the uses of the rocks within the school vicinity.
iv. To find out the distribution of the rocks within the school vicinity.

b.) State three equipment/tools you used during data collection.

i. Geological map/route map ii.
Geological hammer iii.

Magnifying lens iv. Paper bags

v. Camera

c.) Give three reasons why you used field work in studying rocks.

i. To get first-hand information on different types of rocks.
ii. Application of theoretical knowledge learnt in class to real life situation.
iii. Developed various skills such as observation, sketching and analysis during the collection of data.
iv. To break the classroom monotony.
v. To enhance visual memory/comprehension of the content on rocks.

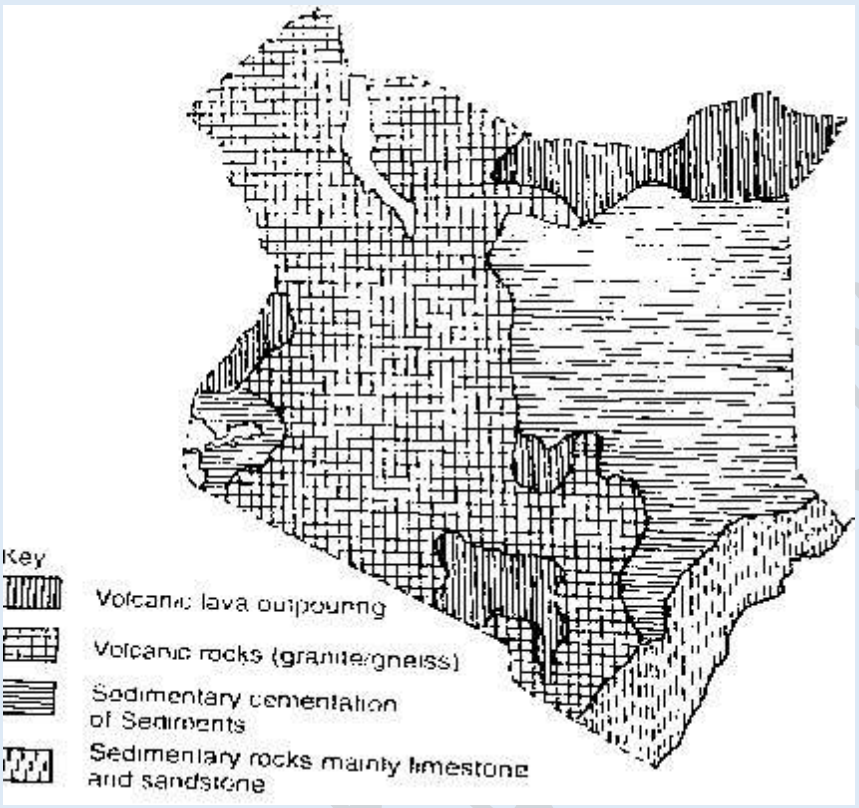
d.) What three recommendations would you give to the local community from your findings?

i. To advertise the various features formed by the different rocks as tourist attractions.
ii. To drill wells since some of the rocks are water reservoirs. iii. To exploit the rock for construction. iv. The rocks disintegrate to form soils which they can use for pottery. v. To quarry the rocks for sale as a source of livelihood.
vi. Ways of protecting the soil due to quarrying/adopt environmental protection measures.

e.) Preparation of field study

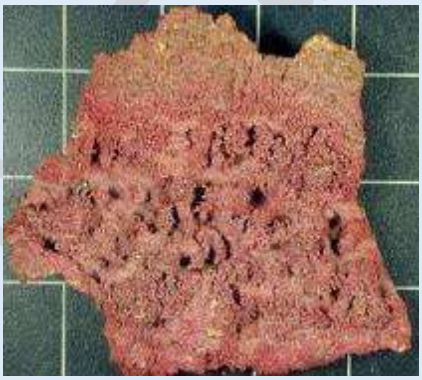
i. Read extensively on different types of rocks.
ii. Prepare a working schedule.
iii. Obtain permit from the relevant authorities.
iv. Select suitable methods of data collection/recording
v. Conducting previsit.
vi. Holding discussion in class.
vii. Obtain necessary materials and equipment.
viii. Obtain the map of the area.

Distribution of rocks in Kenya


Key
Volcanic lava outpouring
Volcanic rocks (granite/gneiss)
Sedimentary cementation of Sediments
Sedimentary rocks mainly limestone and sandstone

Pictures of common rocks and minerals

Silver.



Copper.

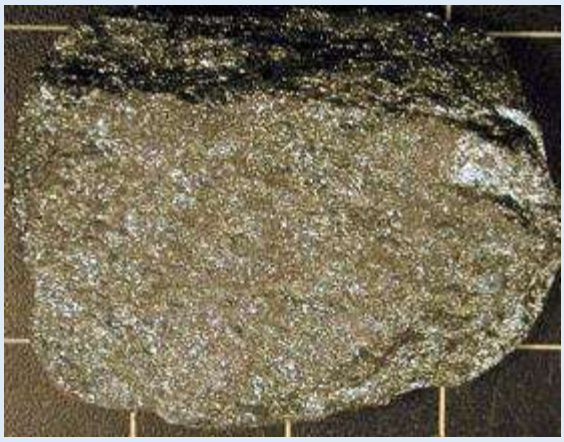
Graphite.

Pyrite.

Galena

Halite or rock salt.

Corundum



Hematite

Calcite.

Dolomite

Gypsum.

Albite.

Biotite.

Hornblende.

Olivine.

Orthoclase.

Quartz

End of topic

Did you understand everything?

If not ask a teacher, friends or anybody and make sure you understand before going to sleep!

Past KCSE Questions on the topic

1. (a) Describe the following characteristics of minerals

(i) Colour

(2mks)

(ii) Cleavage

(2mks)

(iii) Hardness

(2mks)

(b) (i) Give two types of igneous rocks (2mks)

(ii) Explain three conditions necessary fro the growth of coral polyps

(6mks)

(c) State four uses of rocks (4mks)

(d) You are planning to carry out a field study on the rocks within your school environment

(i) Give two secondary sources of information you would use to prepare for the field study

(2mks)

(ii) State why you would need the following items during the field study:

- A fork jembe (1mk)
- A polythene bag (1mk)

(iii) Suppose during the field study you collected marble, sandstone and granite, classify each of these samples according to its mode of formation (3mks)

2. (a) State two characteristics of sedimentary rocks (2mks)

(b) Give two examples of chemically formed sedimentary rocks (2mks)

3. a) Name the type of rocks which results from the metamorphism of:

(i) Granite

(ii) Clay (2mks)

(b) Give two reasons why sedimentary rocks are widespread in the coastal plain of Kenya.

(2mks)

4. (a) (i) What is a rock?
(2mks)

(ii) Describe three ways through which sedimentary rocks are formed

- Mechanically formed
- Organically formed
- Chemically formed (6mks)

(b) Describe two process through which sedimentary rocks changer into metamorphic rocks

(c) Give an example of each of the following types of igneous rocks

(i) Plutonic rocks
(1mks)

(ii) Hypabyssal rocks (1mks)

(iii) Volcanic rocks
(1mks)

(d) Suppose you were to carry out a field study of rocks within the vicinity of your school

(i) Name three secondary sources of information you would use to prepare for the field study

(3mks)

(ii) State four activities you would carry during the filed study

(3mks)

(iii) State three problems you are likely to experience during the field study

(3mks)

5. (a) Differentiate between plutonic rocks and volcanic rocks

(b) Describe how lava plateau is formed

(c) (i) Name three volcanic features found in the rift valley of Kenya

(ii) Explain four negative effects of vulcanicity in Kenya

(d) You intend to carry out a field study of a volcanic landscape

(i) State four reasons why it is necessary to conduct a reconnaissance of the area of study.

6. (a) State two main conditions that influence the characteristics of igneous rocks.

(2mks)

(b) Write down three characteristics of sedimentary rocks.

(3mks)

(c) Name two examples of organic sedimentary rocks and where found in Kenya.

(2mks)

(d) Name four examples of metamorphic rocks and state the original rock from which each was formed.

(4mks)

(e) Describe the importance of rocks to human activities.

(5mks)

7. (a) State with examples three classes of mechanically formed sedimentary rocks. (6mks)

(b) Differentiate between regional metamorphism and contact metamorphism.

(4mks)

8. (a) List two examples of extrusive igneous rocks.

(2mks)

(b) Differentiate between extrusive and intrusive rocks giving an example in each case. (2mks)

9. What is a rock?
(2mks)

10. What is a mineral?
(2mks)

11. Describe changes that occur in sedimentary rocks when they are subjected to high heat and pressure. (4mks)

12. Describe calcareous rocks.

(2mks)

13. Describe carbonaceous rocks.

(2mks)

14. Give examples of chemically formed sedimentary rocks.

(2mks)

15. How are coral rock formed?
(3mks)

16. How do rocks become metamorphic? (3mks)

CHAPTER TWO

Specific Objectives

By the end of the topic the learner should be able to:

(a) Define the term mining;

(b) Explain the factors that influence the occurrence of minerals and mining activities;

(c) Describe methods of mining;

(d) State the location of the major minerals of East Africa and show them on a map;

(e) Explain the significance of locally available minerals in Kenya;

(f) State and account for the problems facing the mining industry in Kenya;

(g) Explain the effects of mining on the environment;

(h) Describe the occurrence of specific minerals and their exploitation in selected countries.

Content

a.) Definition of mining
b.) Factors influencing the occurrence of minerals and their exploitation
c.) Methods of mining.
d.) Distribution of major minerals in East Africa
e.) Significance of minerals in Kenya.
f.) Problems facing the mining industry in Kenya.
g.) Effects of mining on the environment.
h.) Study of Trona on Lake Magadi in Kenya ,Gold and diamonds in South Africa and Petroleum in the Middle East

Definition of the term mining.

Mining is the process of extracting valuable minerals from the earth's crust

Ways in which minerals occur

i.) Minerals may occur in beds and seams
ii.) Minerals may occur as weathered products
iii.) Minerals may occur in alluvial or placer deposit
iv.) Minerals may occur in veins and lodes
v.) Minerals may occur as evaporates

Factors influencing exploitation of Minerals

The value of the minerals

Minerals that are of high value are often mined at a very high cost because of their high demand. Such minerals fetch high prices that lower the cost of extraction.

The size of the mineral Deposit

Where the mineral deposits are relatively small, labour intensive methods that are relatively cheap are employed if the value of such minerals is very high

The quality of Ore

The higher grade ores are more economical to exploit than lower grade ores because they yield a large amount of metal and they are also easier and cheaper to smelt.

Method of mining

Minerals that occur at near the surface can be cheaply mined using open-cast mining method. Minerals that occur at greater depths in the earth's crust are expensive to extract especially by deep shaft method. Such minerals can only be extracted if they area of high value

Technology

Mining requires advance technology from exploration up to the actual mining and processing stages. If there is lack of this technology mining process will be greatly affected.

World market prices

Fluctuation of world market prices affect the expected incomes by the exporting countries. When the prices are low, mining activities is shaken due to inadequate funds.

Transport system

When minerals occur and there are transport systems, then it is cheap to exploit them. Mineral deposits in remote areas with poorly developed transport system are less likely to be exploited.

Capital

Mining involves a large outlay of capital. Most developing countries generally have inadequate capital to exploit their own minerals. This has therefore, given foreign investors an upper hand over the local people in the mining industry.

Methods of mining

The type of mining adopted depends on:

- ✓ The mode of occurrence.
- ✓ Relative ease.
- ✓ The expense to be incurred.

The most common methods are:

a.) open cast mining
b.) underground mining
c.) Alluvial mining

Open cast mining

There are two methods of open cast Stripping and hill slope boring

Stripping

- ✓ Employed if the mineral deposits occur very close to the surface
- ✓ Unwanted materials lying on top of the mineral deposits are removed.
- ✓ If surface materials are soft, they are removed/by one excavators but if they are hard, explosives are used to loosen the materials.
- ✓ Excavators are used to dry up the mineral deposits.
- ✓ The extracted ore is loaded into lorries using excavators and transported to the processing plans.

Hill – Slope Boring

- ✓ If coal outcrops on hill slopes, boring instruments known as Augers may be employed to remove it.
- ✓ These augers are very large with a diameter of 1.5 metres and can reach as far as 105 metres below the ground.
- ✓ They drill out huge pieces of coal and bring them to the surface for transport by waiting trucks.

Underground mining

- ✓ It is applied if the mineral deposits are covered by a great thickness of rocks.

Types of underground mining

a.) Drift or adit method
b.) Shaft method
c.) Solution method
d.) Drilling method

Drift or adit Method

- ✓ Where the mineral occurs in gently sloping veins or seams that are exposed on the side of a hill or valley.
- ✓ It may be possible to exploit it from adits.
- ✓ Adits are horizontal or gently inclined tunnels which are dug into the hillside.
- ✓ Copper mining in Kilembe western Uganda.

Shaft method

- ✓ In cases where the mineral bearing rock does not outcrop or where it occurs in very steeply inclined seams,vertical shafts have to be sunk.
- ✓ From the shaft,horizontal tunnels or galleries are driven outwards until the vein of the mineral bearing rock is reached.
- ✓ The mineral bearing rocks are usually blasted loose by explosives
- ✓ Then transported along the tunnel to the shaft by light railway or conveyor belt.
- ✓ It is then brought to the surface by a type of a lift called a cage that moves up and down the shaft.
- ✓ The cages are also used in transporting the miners and their equipment to and from the working levels.
- ✓ The galleries must be supported by timber pit props or steel concrete beams to hold up the roofs and must be ventilated and kept free of water.

Problems of shaft mining

i. Sometimes mines get flooded with subterranean water.
ii. There are occasional emissions of poisonous gases.
iii. The dust produced causes respiratory diseases.
iv. Sometimes tunnel collapse causing deaths of the miners.

Solution Method

- ✓ Underground mining may be done by people who are on the surface.
- ✓ For minerals such as salt, Potash, or Sulphur, pipes with super-heated water/steam may be sunk down to the deposits.
- ✓ The mineral dissolves into the water, which is then pumped to the surface.
- ✓ At the surface, the water is evaporated and the mineral extracted.

Drilling Method

- ✓ It is commonly used in the exploitation of petroleum and natural gas.
- ✓ The deposit is reached by boring wells.
- ✓ The petroleum or gas is then brought to the surface either under its own pressure or pumping.

Alluvial mining (placer mining)

- ✓ Sometimes a mass of sand or gravel contains particles of gold, tin or platinum which have been eroded from exposed veins, washed down by water and laid down as alluvial deposit e.g. tin in Malaysia, gold in South West U.S.A and Diamonds in South Africa.
- ✓ When minerals occur as alluvial deposits,they are usually recovered by placer mining methods.

Placer mining methods

i. Panning
ii. Dredging
iii. Hydraulic mining

Panning

- ✓ The method involves digging out the sand/gravel which contains mineral particles and mixed with water from the river in a shallow pan.

- ✓ The mixture is then whirled such that the lighter particles of sand/gravel are pushed on the sides of the pass white the heavier mineral particles are at the bottom of the pan which are easily removal by hand as the waited mineral.

Dredging

- ✓ It is advanced form of placer method.
- ✓ Where deposits are large enough, a dredger is employed.
- ✓ It floats on a larger pond and may be used to dig up waterlogged alluvium.
- ✓ For smaller or less accessible deposits, a ground pump is usually used.
- ✓ The material is passed over sloping channels with a series of traps, which catch the heavier particles while the waste material is washed away.
- ✓ This method is used in the extraction of soda ash at Lake Magadi.

Hydraulic mining

- ✓ When alluvial deposits occur on a valley side or form thick terrace deposits.
- ✓ A powerful jet of water under high pressure is directed at the hill or terrace side.
- ✓ Then gravel and mineral grains are recovered and washed out.

Significance of mining in Kenya.

i. Mineral provide raw materials for industries.
ii. Minerals lead to development of transport and communication e.g. road, railways, telephone.
iii. Mining creates employment.
iv. Mining leads to development of settlement / towns e.g. Magadi town.
v. Minerals are exported to earn foreign exchange.
vi. Mining leads to development of social amenities e.g. hospitals, schools.

Distribution of Major Minerals in East Africa

- ✓ The chief mineral exports in the region include:
  i. Diamonds
  ii. Copper
  iii. Soda ash

Uganda

- ✓ In Uganda copper is the most important mineral deposit.
- ✓ The kilembe copper mines are located in a valley on the Eastern side of Ruwenzori Mountains.
- ✓ Copper occurs in the form of copper sulphide ore (chalcopyrite).
- ✓ The copper mineral ore also contains small percentage of cobalt.
- ✓ There are huge cobalt concentration at Kesese.

Other important minerals in Uganda

i. Limestone which is mined near Hima in North- West Uganda and in Tororo.
ii. Phosphate also mined near Tororo is used for fertilizer manufacture.
iii. Tin ,wolfram and Beryl are mined inSouth West Ankole and Kigezi.

Tanzania

- ✓ Large deposits of diamonds are found at Mwandui in Shinyanga District.
- ✓ Good quality coking coal lies in the Ruvuma river basin to the eastern side of Lake Malawi and in Kivira – Songwe.

Other important minerals found in Tanzania

i. Tin found near kyerwa.
ii. Mica found near Morogoro.
iii. Coral limestone found near Dar-es- salaam.
iv. Iron ore found near Chunga.

Kenya

- ✓ Soda ash is the most important mineral found in Lake Magadi.

Other important minerals found in Kenya

i. Fluorspar that is found in rock layers on the slopes of the Kerio Valley.It is mined at Kimwarare.
ii. Limestone which is found in areas with coral rocks.The mines for Limestone are found at Bamburi near Mombasa,Athi – River near Nairobi, Sultan Hamud, Kerio Valley Koru and Homa bay.

iii. Diatomite which is found in Kariandusi ,near Gilgil and at Gicheru in the Nyandarua ranges.
iv. Salt which is found on the surface of Lake Magadi and at the shore of the indian ocean. Salt is mined at Ngongoni near Malindi.
v. Natural carbon dioxide which is found at Kereita near uplands and in Esageri near Eldama Ravine.
vi. Gold is found in small deposits in Kakamega and at Macalder in Migori Districts.
vii. Gemstones are found in small deposits in different parts of the country.The best gemstones are Rubies found near Voi and garnet at Mwatate in Taita Taveta Districts.
viii. Titanium which is found in Kwale District.
ix. Soap stone,which are formed at Tabaka in kisii District and used for sculpture.

Negative effects of mining on the environment

i. Mining causes land destruction / ugly land / badlands.
ii. Mining causes pollution of environment air, water, soil and also noise.
iii. Mining causes loss of bio-diversity - animals migrate, vegetation cleared.
iv. Leads to soil erosion since land remains bare.
v. Mining may lead to landslides.
vi. Mining may lower the water table of a given place.

Problems facing the mining industry in Kenya.

i. Insufficient capital for the exploitation of mineral has led to reliance on loans from the developed countries. Loans may not always be available, so exploitation may be delayed.
ii. Foreign companies manage most of the mining activities. They remit some export revenues to their countries, thus reducing the country's export earnings. This has hampered the development of the mining industry.
iii. Remoteness and poor transport systems hinder exploitation of minerals in that areas with mineral deposits are inaccessible.

iv. Insufficient skilled personnel leading to dependency on expatriates for prospecting minerals and mining.
v. Kenya has small mineral deposits which ae uneconomical to work for.
vi. Air is polluted by dust and smoke emitted from blasting, quarrying and processing of mineral ores. The polluted air is harmful to human health.
vii. Derelict land caused by mining activities is dangerous to both people and animals.
viii. Tip-heaps and mini-holes make the land ugly and unusable for agriculture and settlement

Ways in which mining derelicts can be reclaimed

- ✓ Planting trees
- ✓ Creating parks to attract tourists
- ✓ Landscaping for settlement or farming.
- ✓ Refilling the holes.

Exploitation of Minerals in Selected Countries

Trona on Lake Magadi in Kenya

- ✓ Soda ash occurs in form of cystals called Trona on the floor of the Great Rift valley.
- ✓ The Trona deposits occur naturally in Lake Magadi as a solution of different sodium salts.

Mode of Formation

- ✓ Rain water in the neighboring areas percolates into cracks on the floor of the Rift valley.
- ✓ High underground temperatures heat the water, which dissolves the soda salts abundantly found in the underground rocks strata of the Rift valley.
- ✓ The heated water forms springs that eject the dissolved water to the surface.
- ✓ The dissolved solution flows to lake Magadi where due to high temperatures it's rapidly evaporated leaving behind solid crystal of Tron on the surface of the Lake.

Extraction and Processing

- ✓ A dredger is used to excavate Trona from crystals from lake bed.
- ✓ The crystals are fed into crushers and mixed with a solution from the bed of the lake called liquor.
- ✓ The mixture is then pumped through a pipeline to the factory.
- ✓ At the factory the Trona crystals are cleaned then the liquid is removed and pumped back.
- ✓ Cleaned crystals are heated and converted into soda ash.
- ✓ The soda ash is then reduced into required sizes and packed for exports.

Uses

- ✓ Used in the manufacture of glass,soap,caustic soda and detergents.
- ✓ It is also used in other industries that include paper making,oil refining and textile industries.

Ways in which soda ash contribute to the economy of Kenya/Benefits

i. It is exported to earn foreign exchange which is used in the economic development of the country.
ii. It creates employment opportunities.
iii. It provides raw materials to the manufacturing industries leading to industrialization eg the glass manufacture.
iv. It has led to development of social amenities in the area
v. It has led to the growth to magadi town
vi. Led to the growth of both local and foreign tourism

vii. Provide revenue to the government through taxes.

Problems facing Trona mining in L. Magadi.

i. Competition from other countries with large deposits of soda ash/Limiting of markets.
ii. Low market price of salt/trona.
iii. Very high temperatures making it quite unfavorable for human settlement.
iv. High cost of hiring labour leading to reduction in profile.

Gold in the Republic of South Africa

- ✓ Gold appears in grains in solid rock.
- ✓ It is found in a rock called banket that takes the form of beds of hard conglomerate.
- ✓ The ore is usually found in quarts veins,metamorphic rocks or in redistributed sediments.
- ✓ In south Africa 60 large – scale gold mines are located within an arc of 320 km in length called the 'Golden Arc'.
- ✓ This covers the orange Free state and Transvaal Provinces.
- ✓ The main area is the Witwaterand(the Rand),Ogendaalrus and Lydenburg.
- ✓ The Witwatersrand region is the world's largest gold producer.

Method of Extraction

- ✓ The gold bearing rock is drilled and blasted underground.This gold bearing reef is reached by sinking vertical shafts since the rocks rocks dip down sharply to great depths of upto 6,000 m.
- ✓ From the vertical shafts,horizontal shafts at different levels are run to the banket and when this is reached,other horizontal shafts are cut along the line of the reef.
- ✓ By working upward and downwards from from these shafts,the banket is removed from the reef. It is then hauled the shaft to the surface.
- ✓ Extraction of gold involves crushing the hard banket into small chips that are in turn mixed with water and ground until it is as fine as flour or pulp to get the gold.

- ✓ Alluvial gold is recovered by panning.

Processing and Marketing

- ✓ After the preliminary concentration of the ground pulp ,as much as 94% of the gold is removed by solution in cyanide.
- ✓ The content is called potassium gold cyanide.The solution is not pure gold because it contains amount of uranium.
- ✓ The solution is then mixed with zinc dust causing the solution to precipitate out leaving uranium.
- ✓ This is fed into the sulphuric acid tanks which dissolves the uranium.
- ✓ Gold is melted out and formed into bars at Gemstones town on the rand.

Contribution of Gold to the Economy of South Africa.

i. It earns the country foreign exchange which is used as a means for paying international debts.
ii. It offers employments to many people raising their standrds of living.
iii. It has led to widespread urbanization contributing to the formation of the witwaterstrand conurbation.
iv. It has formed a broad based market for other industrial operations.
v. It has led to the development of Modern infrastructure and amenities.

Problems Facing Gold Mining

i. The costs involved in mining gold have increased greatly.
ii. Due to increasing demand to provide higher wages, married quarters and other social amenities this has led to additional cost in acquiring labour.
iii. A lot of water is needed for processing gold but the ever increasing population in the Rand also needs water, yet this area receives seasonal rainfall.
iv. The Rand mines are becoming deeper.This has led to pressure bursts underground and ground shatters as the ore is removed. This is due to the great pressure from the heavy weight of the rocks above.
v. The gold grade being worked now is of poorer quality than that of some years back.
vi. Exhaustion of the minerals because gold is a non – renewable resources.

Diamonds in the republic of South Africa

- ✓ The formation of diamonds is connected to volcanic activity.
- ✓ These diamonds are found within the igneous rocks ,in pipes that molten rock slowly solidifies after eruption.
- ✓ We have gem diamonds and alluvial diamonds.

Gem diamonds

- ✓ These diamonds form at greater depth and are carried up into the pipe during an eruption.
- ✓ After millions of years, the intrusive rock is gradually eroded eventually exposing to the surface the pipe containing the diamonds.
- ✓ These diamonds are obtained by open cast mining.

Alluvial diamonds

- ✓ These diamonds are formed when the volcanic pipes are eroded along with it.
- ✓ These diamonds and rocks are deposited in the sea or can be in the process of being transported by the rivers to the sea.

Diamonds were discovered in 1866 on the banks of Orange River and they occurred in rocks called kimberlite.

The kimberlite diamond deposits occur in broad belt that extent from the western orange Free State to central Transvaal.It thus includes Koffie, Jagersfantein, Kimberley and Pretoria. The rock at Kimberly is mined with shafts and underground tunnels.

Processing and Marketing

- ✓ The first stage is the blasting of the rock (ore) that is then lifted to the surface.
- ✓ At the surface the rock is then crushed into small pieces.
- ✓ It is then washed and some of the dirt is removed.
- ✓ The remaining rock that includes diamonds is passed over a rotating table.
- ✓ This table is covered with grease that repels water that is made to flow over it.
- ✓ The wet piece of rock will not stick to the grease but will slide off the table as waste.
- ✓ On the other hand the diamonds do not get wet in the water and so they stick to the grease.
- ✓ When the rotating table is stopped, the grease with the diamonds is removed. This is done repeatedly.

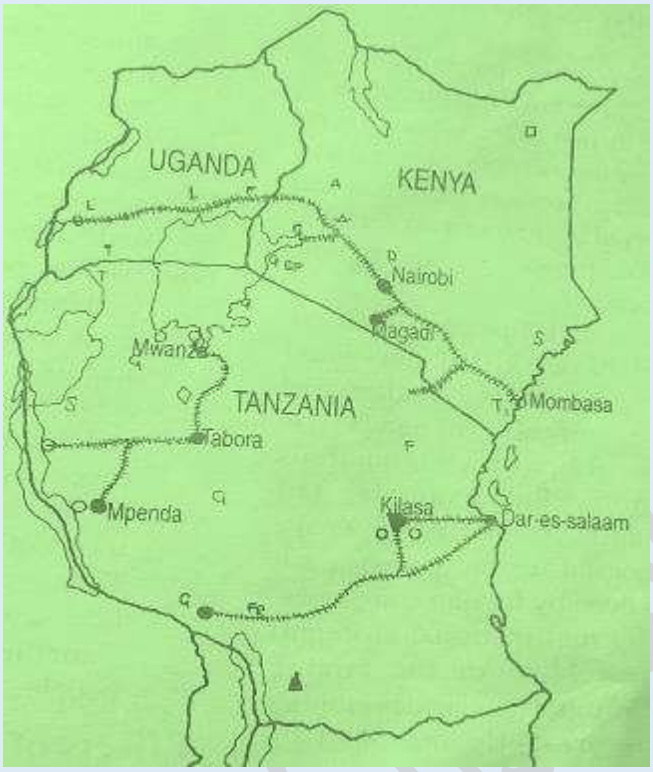
Contribution of Diamond to the Economy of South Africa

i. Provides employment opportunities.
ii. It earns foreign exchange.
iii. It has led to the growth of urban centres.
iv. It has contributed to the development of infrastructure e.g. Roads and Railways.

Problems Facing Diamonds Mining in South Africa.

i. Fluctuations in the world market prices.
ii. Low mineral content in the ore making it processing elaborate and expensive.
iii. High cost of mining and processing of diamonds.
iv. Labour competition with other sectors of the economy such as manufacturing.
v. Continued mining has led to reduced diamond reserves s most mines are becoming depleted.

The distribution of Major minerals in East Africa



Key

G – Gold	D –Diatomite	R – Rubies	S - Salt
L – Limestone	Ti – gypsum	C – Copper	Sp – Soap stone
F – Phosphate	Fe- Iron	T – Tin	A - Asbestos

Petroleum in the Middle East

- ✓ The major oil producers in the middle east are:

- Saudi Arabia
- Iraq
- Iran
- Kuwait
- United Arabs Emirates

✓ All the oil producing countries are members of OPEC

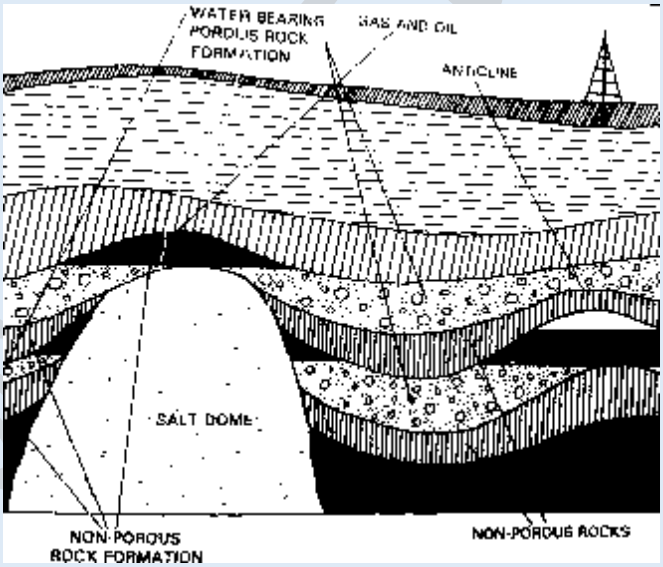
Mode of Formation

✓ Oil forms from the remains of many small creatures that lived in shallow lagoons about 100 to 200 million years ago.

✓ The decaying remains of these creatures mixed with the mud at the bottom as sediments.

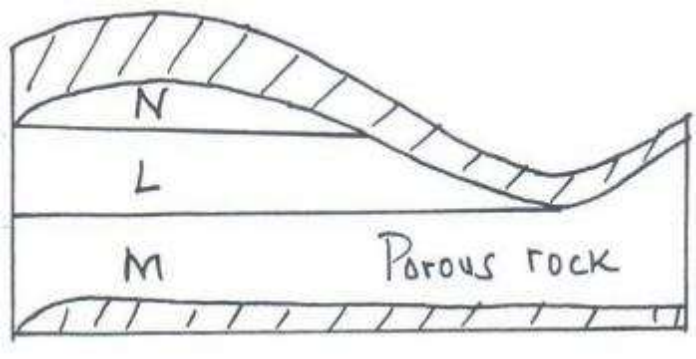
✓ Over the years, these sediments pilled on each other slowly transformed into sedimentary rocks.

✓ Gradually, the animals remains were converted into oil and gases as shown below.



Example

The diagram below shows the occurrence of petroleum in the earth's crust.



(I) Name the substances in the areas labelled **L, M and N**.

L - Petroleum oil

M - Water

N - Gas

(II) Give **two** by-products obtained when refining crude oil.

- Tar
- Wax
- Bitumen / pitch / asphalt
- Grease lubricants.
- Resin / petrol chemicals

End of topic

Did you understand everything?
If not ask a teacher, friends or anybody and make sure you understand before going to sleep!

Past KCSE Questions on the topic

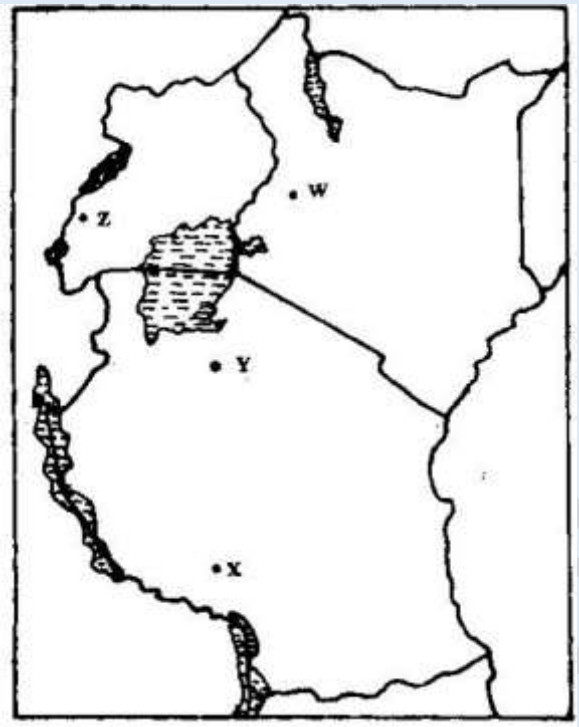
1. The table below shows petroleum production in thousand barrels per day for countries in the Middle East in April 2006. Use it to answer question (a)

Country	Production in '000" barrels
Iran	3800
Kuwait	2550
Qatar	800
Saudi Arabia	9600
United Arab Emirates	2500
Iraq	1900

a) (i) What is the difference in production between the highest and the lowest producer (1mk)

(ii) What is the total amount of petroleum produced in April 2006 in the region? (1mk)

b) State three conditions that are necessary for the formation of petroleum (3mks)



2. Use the map of East Africa below to answer questions (

a) (i) Name the railway terminuses marked P, Q R (3mks)

(ii) In each case give the main commodity transported by the railway lines marked s and T. (2mks)

b) (i) State four reasons why road network is more widespread than railways in East Africa. (4mks)

(ii) One of the problems facing road transport is the high frequency of accidents. Explain four conditions of roads in Kenya that may lead to accidents. (8mks)

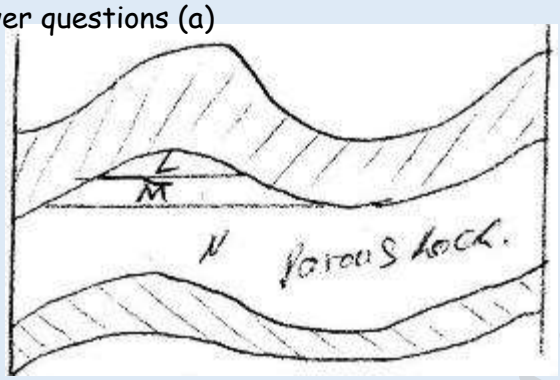
c) i) Name three physical regions through which River Tana passes (3mks)

ii) Explain thee effects of land pollution can be controlled

d) State four ways through which land pollution can be controlled (4mks)

3. The diagram below show the occurrence of petroleum in the earth's crust.

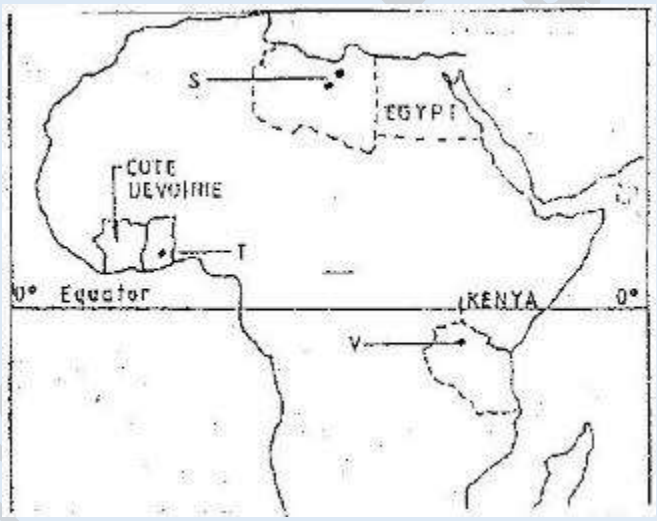
Use it to answer questions (a)



a) Name the substances in the areas labeled L. M and N (3mks)

b) Give two by-products obtained when crude oil is refined (2mks)

4. Use the map of Africa to answer question (a) (i)



i) Name the minerals mined in the areas marked S, T and V.

ii) State two formation in which mineral ores occur.

b) Explain four problems, which Zambia experiences in the exportation

of copper.

c) Explain three ways in which coal contributes to the economy of Zimbabwe.

d) Describe three negative effects of open cast mining on the environment.

5. a) Explain how deep shaft mining is done (2mks)

b) Disadvantages of using the above method (2mks)

6. Explain four effects of land dereliction on the environment. (4mks)

7. Describe how panning mining is carried out. (3mks)

8. Identify four problems facing gold mining in South Africa. (4mks)

9. (a) In what ways has Kenya benefited from the mining of soda ash in Lake Magadi? (2mks)

(b) What are the negative effects of mining on the environment? (4mks)

10. (a) Explain what is meant by placer mining. (2mks)

(b) Name three mining methods.

11. Describe the occurrence and exploitation of Trona in Kenya till it is ready for marketing.

12. Name seven significances of minerals in Kenya. (7mks)

13. Explain diamond and gold in South Africa under following headings:

- Occurrence
- Extraction
- Benefits to the economy
- Problems (10mks)

14. Name five uses of soda ash. (5mk)