Introduction

The purpose of this book is to provide relevant material for each subject in O-level education here in Tanzania. The first edition contains civics, history, geography, biology, chemistry and physics. The content is ordered by syllabus topic and contains relevant definitions and solved problems as they have appeared on NECTA examinations. Though it is impossible to predict NECTA topics and questions, I feel that a student who knows all of the information provided here can get a B in the subject if they are also able to understand English and have competency in the subject material. This is not meant to be a primary resource, but rather it is intended to help guide students and teachers towards relevant topics and questions for study and discussion. This book is for students taking form 4 examinations. Some form 1 and 2 topics are not covered, since they have not appeared on the examinations.

The expectation of this book is that it will provide a base of knowledge that each student will have by the time they come to take their national examinations. In class and in further study, topics and questions can be expanded upon to provide the student with the competency he requires to be successful on his national examinations. Students are encouraged to look at future topics before they are taught in class, so that the teacher can spend class time explaining difficult material, rather than writing definitions or notes on the board.

This work could not have been done without the help of my fellow teachers and staff here at Abbey Secondary School. I am grateful for their contributions to this project. I hope that each year we can update and improve these study guides so that our school can continue to grow academically.

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Legal Statement

No person is permitted to make copies of any part of this book without consent from Jeff Rodwell. The purpose of this book is purely educational and cannot be used for profit.

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2.3.4 Problems associated with forestry resources harvesting

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2.8.0 Transport

2.8.1 Main types of transport

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2.9.0 Form 1 and 2 questions
Form 1

1.1.0 Concept of geography

1.1.1 Meaning of geography phenomena
(Not present in exams)

1.1.2 Importance of geography
(Not present in exams)

1.2.0 The solar system

1.2.1 The concept of a solar system
(Note that Pluto is no longer considered a planet)

The four inner planets from the sun namely Mercury, Venus, Earth and Mars are referred to as “terrestrial planets” because - They are all relatively small, rocky in composition and clustered together close to the sun and they are visible to the naked eyes, which means they resemble Earth

Examples of celestial bodies - Asteroids, moons, planets and stars
Aphelion - The position of the Earth when it is furthest from the Sun
Asteroids - Rocky planetary bodies which orbit the sun
Eclipse - Occurs when three heavenly bodies (e.g. planets/stars) are in one line and one of them is a source of light such as when the moon comes between the Sun and Earth
Equinox - Occurs twice a year, when the tilt of the Earth's axis is inclined neither away from nor towards the Sun, the centre of the Sun being in the same plane as the Earth's equator
Meteorites - Pieces of hard matter such as rocks falling from outer space
The Milky Way - The galaxy which contains our solar system and the planet Earth, it is our galaxy
Tides are highest during an eclipse
The sun is the main source of light, heat and energy for Earth
The lunar eclipse is evidence which proves that the Earth is spherical

1.2.6 The Earth
The rotation of the Earth causes - Day and night, difference of one hour between two meridians of 15°, the
deflation of winds and ocean currents, the daily rising and falling of ocean tides

Earths movements are caused by isostatic adjustment
Day and night are caused by the rotation of the Earth
The Earth shape is a flattened sphere called a geoid or oblate spheroid
The rotation of the Earth causes the deflection of winds and ocean currents
Pangea was divided into two parts called Laurasia and Gondwana
The four seasons which occur on the earth’s surface are result of the revolution of the earth
Deflection - Due to spinning effect of the earth, water and air currents do not travel in straight lines
Coriolis Effect (Ferrel’s Law) - Is an apparent deflection of moving objects when they are viewed from a
rotating reference frame
The Earth has an angle of inclination of 66½ degrees which causes the variation in the length of day and
night

1.2.7 The importance of parallels and meridians
Chronometer - Is a clock which is precise enough to be used as a portable time standard; it can therefore
be used to determine longitude by means of celestial navigation
Latitude - Angular distance east or west of the prime meridian, used for north-south measurement
Longitude - Is the geographic coordinate used for east-west measurement
Meridian (Line of Longitude) - Is an imaginary arc on the Earth’s surface from the North Pole to the South
Pole that connects all locations running along it with a given longitude
Prime Meridian - Is the meridian (line of longitude) at which the longitude is defined to be 0° which runs
through Greenwich UK
Summer Solstice - Occurs exactly when the Earth’s axial tilt is most inclined towards the sun at its
maximum of 23° 26’. In the Southern Hemisphere it occurs on December 22, in the Northern
Hemisphere it occurs June 22
Great Circle - A circle in the surface whose plane passes through the centre of the globe, used to plot
routes for ships and planes across great distances
Horse Latitudes - Sub-tropic latitudes between 30º and 35º in both the North and South Hemispheres
Circle of Latitude - An imaginary east-west circle connecting all locations that share the same latitude
Tropic of Capricorn (Southern Tropic) - Marks the southerly latitude at which the sun can appear directly
overhead at noon, occurs during the December solstice
Tropic of Cancer (Northern Tropic) - Marks the northerly latitude at which the sun can appear directly
overhead at noon, occurs during the June solstice
Winter Solstice - Occurs exactly when the Earth’s axial tilt is farthest away from the sun at its maximum of
23° 26’. In the Northern Hemisphere, the Winter Solstice occurs on December 21, in the Southern
Hemisphere it occurs June 22

1.3.0 Major features of the earth’s surface

1.3.1 Continents
(Not present in exams)

1.3.2 Water bodies
(Not present in exams)

1.4.0 Weather

1.4.1 The concept of weather
Atmosphere - A blanket of air or other gasses which surrounds planets including Earth
Mesosphere - The middle layer of the Earth’s atmosphere
Tropopause - Is the atmospheric boundary between the troposphere and the stratosphere
Troposphere - The lowest portion of the Earth’s atmosphere
Order of layers of the Atmosphere from lowest to highest - Troposphere - Ends at the tropopause - Lowest
1.4.2 Elements of weather

How to calculate Fahrenheit and Celsius -

\[ ^\circ \text{C} = (\text{^\circ} \text{F} - 32) \times \frac{\text{5}}{\text{9}} \]

\[ ^\circ \text{F} = (\text{^\circ} \text{C} \times \frac{\text{9}}{\text{5}}) + 32 \]

Types of rainfall - Convectional rainfall, cyclonic rainfall, orographic rainfall

**Convectional Rainfall** - Occurs when the atmosphere becomes heated more than its surroundings leading to upward motion, rain falls from convective clouds like cumulonimbus clouds

**Cyclonic Rainfall** - Occurs who masses of air with different density (moisture and temperature) meet, warmer air rises over cold air which produces precipitation (rain)

**Orographic Rainfall** - Is caused when masses of air pushed by wind are forced up the side of elevated land formations like mountains

1.4.3 Weather stations

The suitable area to set up a weather station is on fairly level ground in an open space

1.5.0 Climate

1.5.1 Concept of climate

**Climate** - Is the temperature, humidity, atmospheric pressure, wind, rainfall, and other meteorological elements in a given region over long periods of time

**Clouds** - Small particles of condensed water at the lower part of the atmosphere

**Constant Volume Gas Thermometer** - Measures temperature by the variation in volume/pressure of a gas

**Desertification** - Is the process of forming desert by increased heat on the Earths surface causing evaporation or by the destruction of forests

**Dew** - Is water in the form of droplets that appears on thin, exposed objects in the morning or evening

**Doldrums** - It is an area with low pressure in the tropics

**Drought** - A prolonged lack of moisture in an area as a result of a long period without rainfall

**Fog** - Is a cloud that is in contact with the ground

**Front** - The zone separating two air masses

**Hail** - Is a form of solid precipitation which consists of balls or irregular lumps of ice

**Humidity** - Is the amount of water vapor in the air

**Hygrometers** - Are instruments used for measuring relative humidity

**Inter-Tropical Convergence Zone (ITCZ)** - The zone between the maritime and continental air masses

**Land Breezes** - Occur at night due to the fact that land temperatures drop faster than water (because of different specific heat values), so it is cooler on the land than water

**Macroclimate** - Refers to the regional climate of a broad area

**Maximum Temperature Thermometer** - Used to measure the highest temperature reached in a day

**Microclimate** - A detailed small scale study of weather elements within a natural environment

**Mist** - Is a phenomenon of small droplets suspended in air

**Polar Front** - Where cold air from the Polar Regions meets warmer air from lower latitudes

**Relative Humidity** - Is the amount of water vapor that exists in a gaseous mixture of air and water vapor

**Sea Breezes** - During the day the breeze comes from the sea because the land is warmer and air travels from areas of high pressure to areas of low pressure

**Sleet** - A mixture of snow and rain

**Trade Winds** - Winds blowing from horse latitudes to the equatorial belts. Found in the tropics in the lower troposphere. Used in the past for trade and conquest by Europeans

**Tropical Cyclone** - A low pressure center with develops in low altitudes

**Tsunami** - A strong wave in the ocean caused by an earthquake or by a volcanic eruption

**Weather** - The state of the atmosphere measured by hot or cold, wet or dry, calm or storm, clear or cloudy

Hurricanes and typhoons are tropical cyclones

Salinity of ocean water increases with an increased rate of evaporation of ocean water

Wind blows from areas of high pressure to areas of low pressure

1.5.2 Weather and climate

(Not present in exams)

1.5.3 Impact of climate
1.6.0 Map work

1.6.1 Concept of a map

Choropleth Map - Is a thematic map in which areas are shaded or patterned in proportion to the measurement of the statistical variable being displayed on the map, such as population density or per-capita income

Atlas - Is a collection of maps; it is typically a map of the Earth or a region of the Earth

1.6.2 Components of a map

Contours - Lines that are drawn on the map joining different places with the same height above sea level
Isobar - Is a line connecting points of equal atmospheric pressure
Isobath - Is a line joining all place with equal depth in the ocean
Isohel - Is a line of equal or constant solar radiation
Isohyet - Is a line joining points of equal precipitation on a map
Isoneph - Is a line indicating equal cloud cover
Time Zone - Is a region on Earth, more or less bounded by lines of longitude, that has a uniform, legally mandated standard time, usually referred to as the local time

1.6.3 Quantitative information about maps

Essentials of a map - Key (legend or reference), scale, margin (frame), title, indication of north direction
Ways of showing topographical features on a map - Using contours, hill shading, layer colouring, form lines, hachure, benchmarks, spot height, trigonometrical stations (points)
Techniques of expressing scale of a map - Linear scale, statement (verbal) scale, representative fractional scale (RF scale)

1.6.4 Uses of maps

(Not present in study guide)

Form 2

2.1.0 Human activities

2.1.1 Concept of human activities

(Not present in exams)

2.1.2 Agriculture

2.1.2.1 Small scale agriculture

Small Scale Agriculture - Growing enough food for a family or small population, with little or no extra food for sale (ex subsistence farming)

Outline the main characteristics of small-scale agriculture - Simple tools are used, areas are small, low production, crops are starch based, poor transport, less use of chemicals to control diseases, family labour is used, local superstitious beliefs dominate among farmers

Effects of farming of on the environment - Erosion, destroys bacteria in the soil, overgrazing, deforestation, chemicals, artificial fertilizers tend to increase soil acidity, monoculture destroys fertility

Types of irrigation - Basin Irrigation, overhead irrigation, trickle irrigation, canal irrigation, tank irrigation, irrigation using lifting devices

Explain the tools or ways of empowering women in social and commercial activities - Giving education, loans, incorporating them into decision making, entrepreneurship training

Farming - Is the process of producing crops and keeping animals

Irrigation - Is the practice of ensuring that plants get enough water through artificial methods like the construction of dams, canals or tubes

Mixed Farming - The process of planting trees and growing crops in the same farm unit

2.1.2.2 Large scale agriculture

Large Scale Agriculture - Growing of large amounts of crops to feed the population as well as for sale (ex. cash crops)
Disadvantages of large scale farming in Tanzania - Needs large capital investment to establish and maintain, dependent on crop prices, requires a lot of land, can lead to environmental degradation, contributes to migration to farming areas for employment

Causes of the failure to satisfy food demands in Africa - Poor technology, insufficient capital, climate failures, poor policy and implementation, pests/diseases, low level of education, rural-urban migration

2.1.2.3 Livestock keeping
Livestock Keeping - The practice of having animals such as goats or cows to provide milk, meat or economic value to an individual or family

The problems of beef cattle production in Tanzania - Insufficient capital, lack of adequate cold storage, transportation system, lack of markets, low quality of beef, diseases and pests, shortage of water and food for cattle, tradition of livestock keeping, ignorance of livestock keepers about proper methods of animal husbandry, no emphasis from government on beef cattle production

Beef cattle production can be improved through the following ways - Improvement of transportation and infrastructure, better education of farmers about animal husbandry, explore viability of new markets for beef cattle products, building of adequate storage facilities

Beef Cattle Production - is the rearing of cattle for the purpose of producing products like meat or hides

Destocking - Reducing the number of animals grazing an area of land compared to the lands capacity

Overstocking - Is the act of grazing more animals on a piece of land than the land can handle

Pastoralism - Is an economic activity whereby people live by grazing livestock on natural pastures

Ranching - A system of keeping animals on a large piece of land

2.2.0 Water management for economic development

2.2.1 Importance of water
Economic importance of water - Encourage industrial development, improved family life, generation of HEP, agricultural development, development of transport, fishing industries, soil formation

Explain the need for and problems with irrigation in North Africa - Needs: Areas are semi-arid with low rainfall preventing crops from growing, nomadic groups there are not able to produce enough food for consumption and sale, population is increasing putting pressure on food supplies Problems: Lack of funds in Kenya, lack of modern technology, few irrigation engineers, nomads do not want to settle

Reasons East Africa has not developed an advanced fishing industry - Lack of capital or financial support, poor technology, ocean topography does not encourage fishing grounds, poor market for fish from East Africa, water pollution, poor means of transport, lack of storage facilities

Fishing Industry - Is an economic activity that deals with the production or harvesting of fish

2.2.2 River basin development
The advantages of exploiting the Rufiji and Kagera river basins - Facilitates irrigation farming to produce food and cash crops, enables finish activities by construction of dams, harness water for hydroelectric power generation, source of clean water, provides employment

The disadvantages of exploiting the Rufiji and Kagera river basins - Environmental degradation or pollution, contribute to the loss of biodiversity, expensive infrastructure like dams and channels

Elaborate on the economic importance of forest resources in the Congo basin - Provides raw materials, provides foreign exchange, source of employment, brings economic diversification, develops transportation and communications in the region, can lead to industrial development

2.2.3 Land reclamation
Land Reclamation - The process of turning unproductive land to a useful state such as reclaiming desert land or creating land by filling the seabed

Steps that were taken in Netherlands to reclaim the land - Building of dams and dykes to retain water from the sea, draining of water using canals and pumps, planting reeds to allow water absorption by plants, burning of reeds to clear the area for cultivation, cultivation of reclaimed land

Aims of land reclamation - To control foods, to get more arable land, obtain land for settlement, improve navigation, get clean water

2.2.4 Sustainable use of water resources
Benefits of establishing Tennessee Valley Authority in the USA - Increase in water supply for various uses, improvement in navigation, hydroelectric power, controlling flooding, creating employment, development of tourism, increase size of arable land, development of fishing industry

2.2.5 Water pollution
Eutrophication - Excessive growth of algae in rivers and lakes owing to accumulation in the water of minerals such as nitrates which promote plant growth

Ways of reducing pollutants - Locate industry away from residential areas, recycle waste, efficient engines, efforts by government and other organizations to avoid environmental pollution, stronger policies, use of alternative energy resources, develop other safer activities

### 2.3.0 Sustainable use of forest resources

#### 2.3.1 Types of forestry resources
(Not present in exams)

#### 2.3.2 Importance of forestry resources

**Importance of forests** - Protect soil from degradation or erosion, habitat for animals, production of oxygen, providing building material, paper making, maintaining water sources, attract tourism, research studies

**Afforestation** - Is the planting of seeds or trees to make a forest on land which has not been a forest recently, or which has never been a forest

**Agroforestry** - Approach of using the interactive benefits from trees and shrubs with crops and livestock

**Reforestation** - Is the reestablishment of a forest after removal, for example from a timber harvest

**Rejuvenation** - The renewed activity of an ecological area such as a river or forest

#### 2.3.3 Important areas of forest products, transport and use
(Not present in exams)

#### 2.3.4 Problems associated with forestry resources harvesting

**Problems associated with the exploitation of forests** - Poor capital, lack of valuable species of trees in tropical areas, dense tropical forests, poor transport, low technology, rapid population growth, challenges from environmentalists, coniferous trees face challenges from acidic rain in temperate areas

**Problems facing the forestry industry in developing countries** - Uncontrolled and unplanned cutting of trees, bad cultivation methods and burning of vegetation, wild animals destroy trees as they feed on them, depletion which is caused by higher demand for charcoal and firewood, spread of permanent agriculture, poachers and honey collectors, lack of transport infrastructure, developing countries do not set prices for wood products, many trees in tropical areas have no commercial value

**Discuss the problems associated with exploitation of forest resources in developing countries like Malawi** - Deforestation, drought, landslides, shortage of rainfall, soil erosion, loss of biodiversity

### 2.4.0 Sustainable mining

#### 2.4.1 Types of mining

**Mineral Ore** - Is a type of rock that contains minerals with important elements including metals
(Not present in exams)

#### 2.4.2 Types and distribution of mining regions in the world
(Not present in exams)

#### 2.4.3 Methods of mining

**Shaft Mining Method** - Is the method of excavating a vertical tunnel from the top down, where there is initially no access to the bottom

**Open Cast Mining (Open Pit Mining)** - Is a method of extracting rock or minerals from the earth by their removal from an open pit

#### 2.4.4 Contribution of mining to the economy of Tanzania
(Not present in exams)

#### 2.4.5 Effects of the mining industry in the environment

**Describe the effects of mining activities to the environment** - Pollution, soil degradation, land exhaustion, accelerates deforestation, disappearance of valuable plant species, greenhouse effects, spread of malaria due to standing water in mining pits

**Factors affecting the exploitation of mineral resources** - Availability and size of mineral deposits, quality of deposits, availability of capital to extract minerals, transportation system, availability of labour forces, methods used to exploit resources, market prices for minerals, availability of water supply to cool machinery and for washing minerals, government policy towards mining
2.4.6 Focal studies on oil and natural gas
(Not present in exams)

2.5.0 Tourism

2.5.1 Concept of tourism
Ecotourism - Integrated approach that involves the carrying out of tourist activities with a minimum of negative impacts on the natural environment
Tourism - Is an economic activity which involves movements of people from their normal working places or homes to other places near or far away, for pleasure or recreation

2.5.2 Factors for the development and growth of tourism
Why East Africa is attractive to tourists - Presence of mountains and volcanoes, beaches and coral reefs, culture, art, historical sites, animals, national parks

2.5.3 Importance of tourism
Negative effects of tourism in East Africa - Environmental degradation, environmental pollution, spread of disease, cultural moral decay, spread of illegal drugs, increased government expenditure
Importance of ecotourism to the local community - Leads to empowerment of local economy, living standard is raised, locals gain respect of environment and its resources, preserve culture, builds relationship between visitors and local community, helps control diseases due to gaining of education, reduces water pollution, provide a market for local products (goods), stimulates development of transport, promotes environmental conservation awareness

2.5.4 Focal studies on the tourism industry
Explain the necessary conditional factors that contributed to the development of tourism industry in Switzerland - Availability of capital, good infrastructure and transport, scenery, good climatic conditions, availability of recreational activities, peace, located near other European nations

2.6.0 Manufacturing industry

2.6.1 Concept and importance of manufacturing industries
Manufacturing - Involves processing and changing the raw materials so as to make new products

2.6.2 Types of manufacturing industries
(Not present in exams)

2.6.3 Factors for location of industries
Outline the factors for the location of manufacturing industries - Availability of raw materials, markets, labour supply, power and energy resources, capital, transport and communication, good government support/policy, water supply
Factors limiting the development of dairy farming in East Africa - Poor capital, poor market, lack of storage facilities, poor breeds, lack of electricity and transport, poor technology, lack of skilled labour

2.6.4 Pollutants from manufacturing industry
(Not present in exams)

2.6.5 Focal studies on manufacturing
Importance of manufacturing industries to the world economy - Provides employment, foreign currency, promote development of technology, diversification of economy, leads to self sufficiency, improvement of economic activities like trade/tourism/agriculture, reduces expenses on imports, encourages improvement of social services, development of transportation and communication
Reasons Japan produces ships - Employs modern and advanced technology, possesses highly skilled employees/technicians, iron/steel industries exist in port towns, large and reliable market for ships, geographical nature of Japan, has little land for cultivation, economically developed
Factors for poor development of manufacturing industries in Tanzania - Poor capital, poor market, lack of skilled labour, lack of transportation, lack of technology and communication, lack of electricity
Reasons for the rapid expansion of industries in South Africa - Availability of capital, advanced technology, good transport and communication, ready market, availability of raw materials, presence of skilled and non-skilled labour
Explain the factors favouring dairy farming in Denmark - Development of science and technology, availability of capital, conducive climate, availability of pastures, skilled labour

Reasons for auto industry in Germany - Skilled technicians, advanced technology, availability of capital, ready market, availability of raw materials, power and energy resources, transport and communications

2.7.0 Sustainable use of power and energy resources

2.7.1 Define power and energy
(Not present in exams)

2.7.2 Major sources of power & resources
Natural Resources - Naturally occurring substances that are considered valuable to human activities
Renewable Resource - Any natural resource that can be used without depleting its reserves
Hydroelectric Power - Use of water to create power through the use of turbines
Wind - Use of the wind to power turbines and create energy
Solar - Use of solar panels to get electricity from the Sun’s energy
Non-Renewable Resources - Resources whose reserves can be depleted
Petroleum - Oil used in cars, heavy machines or lubricants. Burned for energy and pollutes
Precious Stones - Gold, diamonds and other minerals mines for market or industrial uses

Ways to conserve natural resources - Avoid deforestation, make good laws, enforce environmental laws, modernize technology to avoid effects of mining or industry, protect water sources, education

Activities of man that affect natural resources - Agriculture, overgrazing, mining, cutting of trees for timber

2.7.3 Methods of acquiring or extracting power and energy
(Not present in exams)

2.7.4 Importance and uses of power and energy resources
Preconditions for establishing hydroelectric power - Presence of a sufficient and constant supply of a large volume of water (i.e. lake or river), steep gradient or slope along the long profile of the river, presence of lakes along the river, availability of space to build dams and reservoirs, enough capital to invest and maintain the plant, presence of skilled technicians, modern technology, market for electricity
Advantages of hydroelectric power - Clean power, does not cause severe destruct of environment, dams help prevent flooding, provides employment, easy to maintain after initial installation, stimulates industrial development, developing nations can use hydroelectric power cheaply

2.7.5 Problems facing power and energy production
Problems associated with exploitation of energy resources - Pollution, low capital, low technology, lack of ready market, lack of skilled labour
Advantages and disadvantages of natural gas - Advantages: Efficient, cleaner than oil, easy to transport
Disadvantages: Explodes easily, causes air pollution, exhaustible (non-renewable)

2.7.6 Focal studies on wind and solar power in the USA and HEP and biogas in Tanzania
Importance of natural gas to Tanzania - Improving standard of living, reducing cost of power, promotes environmental conservation, provide employment, brings in foreign currency, source of government revenue, stimulate exploitation of other energy resources like petroleum

2.8.0 Transport

2.8.1 Main types of transport
(Not present in exams)

2.8.2 Importance of transport
(Not present in exams)

2.8.3 Problems facing the transport industry
(Not present in exams)

2.9.0 Form 1 and 2 questions
Environmental lapse rate experiences temperature decreases by 0.6°C per 100m

1. A football match started in Town X, 76ºE at 4:30 pm. What would be the time for a town at Greenwich Mean Time (GMT)?

<table>
<thead>
<tr>
<th>Step 1: Find the difference in degrees of latitude</th>
<th>Step 3: Change the fraction into minutes. Multiply the fraction by 60 since 1 hour is 60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>76º - 0º = 76º</td>
<td>1/15 * 60</td>
</tr>
<tr>
<td>Step 2: Find the difference in time. Divide the difference of degrees of latitude by 15</td>
<td>x = 4 min</td>
</tr>
<tr>
<td>15º = 1 hour</td>
<td></td>
</tr>
<tr>
<td>x = 76º</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>x = 51/15 hours</td>
<td></td>
</tr>
</tbody>
</table>

Step 4: Find the difference. Moving west is subtraction, moving east is addition
The difference in time is 5 hours and 4 minutes. Since we must move west to reach the Prime Meridian, you need to subtract time

4:30pm - 5:04 = 11:26 am

2. If the time at Place X, 45º E is 10:00 am, what will be the time at Place Y, 45º W?

<table>
<thead>
<tr>
<th>Step 1: Find the difference in degrees of latitude</th>
<th>Step 3: Change the fraction into minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Since one place is east and one is west, the numbers are added, this is because they lie on opposite sides of the GMT</td>
<td>90/15</td>
</tr>
<tr>
<td>E + W</td>
<td>x = 6 hours</td>
</tr>
<tr>
<td>45º + 45º = 90º</td>
<td></td>
</tr>
</tbody>
</table>

Step 2: Find the difference in time. Divide the difference of degrees of latitude by 15
15º = 1 hour
x = 90º

Step 4: Find the difference, moving west is subtraction, moving east is addition
10:00pm - 6 hours = 4pm

3. Micheweni is at sea level and has a temperature of 32º C. What is the temperature of Karatu at 1500m above sea level?

<table>
<thead>
<tr>
<th>Step 1: Find the difference in altitude</th>
<th>Final Equation: 100x = 0.6º C * 1500m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500m - 0m = 1500m</td>
<td>Step 4: Isolate x on the left side of the equation by dividing by 100</td>
</tr>
<tr>
<td>Step 2: Use temperature lapse rate to calculate temperature</td>
<td>100x = 0.6º C * 1500m</td>
</tr>
<tr>
<td>Temperature Lapse Rate: 100m = 0.6º C</td>
<td>x = 0.6º C * 1500m</td>
</tr>
<tr>
<td>x is the difference in altitude from step 1</td>
<td>x = 9ºC</td>
</tr>
<tr>
<td>x = 1500m</td>
<td>Step 5: Take x and subtract from the temperature of Micheweni, you subtract because Karatu has a higher altitude</td>
</tr>
</tbody>
</table>

32ºC - 9ºC = 23ºC

4. What is the longitude of Morogoro if its local time is 10:00 pm, whereas the longitude of Accra in Ghana is 0º and the local time is 7:00pm?

<table>
<thead>
<tr>
<th>Step 1: Calculate the difference in time</th>
<th>Step 2: Find the difference in degree. Multiply the</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00pm - 7:00pm = 3 hours</td>
<td>x = 15º * 3 hours</td>
</tr>
<tr>
<td></td>
<td>x = 45º</td>
</tr>
</tbody>
</table>
number of hours by 15
15º = 1 hour
x = 3 hours

Since Morogoro is East of Ghana, the longitude of Morogoro is 45º E

Form 3

3.1.0 Structure of the earth

3.1.1 The earth’s crust, mantle and core

Order of Layers -

1. Lithosphere - Contains the crust
   - Mohorovic Discontinuity - Boundary between crust and mantle
2. Mantle - Contains the Asthenosphere
   - Gutenberg Discontinuity - Layer of rocks between mantle and core
3. Core (Barysphere) - Contains inner and outer core

Sial and sima are the rocks that make up the outer crust of the Earth

Water Table - Is the level at which the groundwater pressure is equal to atmospheric pressure and is the upper limit of the saturation of water in a saturated rock

Asthensphere - Is the region of the upper mantle of the Earth and balances the movements of Earth's materials

Barysphere (Core) - Scientific name for the core, made up of iron and nickel

Conrad Discontinuity - Is the border between the upper continental crust and the lower one (sial and sima)

Core - Interior layer of the earth which is subjected to great heat and pressure

Gutenberg Discontinuity - The layer of rocks which separates the mantle from the core

Hydrosphere - Is the combined mass of water found on, under, and over the surface of planet

Lithosphere - The hardest part of the Earth's crust (Litho means rock), geographical name of the crust

Mohorovic Discontinuity - Is the boundary between the Earth's crust and the mantle

Sial - Part of the Earth forming the upper part of the crust or continental blocks

Sima - The lower part of the Earth’s crust

3.1.2 Types of rocks of the earth’s crust

Conglomerate - Is a rock consisting of finer-grained materials that have become cemented together

Igneous Rock - Is formed through the cooling and solidification of magma or lava

Metamorphic Rocks - Are formed by the transformation of a rock by pressure and heat inside the Earth

Sedimentary Rocks - They are usually found in layers, important minerals can be found there, some are deposited by wind; they can be formed organically, chemically, or mechanically

Shale - A sedimentary rock composed of rounded gravel-sized particles

Examples of metamorphic rocks - Granite, slate, marble and gneiss

How sedimentary rock is formed - Formed by cementation and compaction of sediments arranged in layers by deposition

Features of sedimentary rocks - Usually found in layers, contain important minerals, can be deposited by water or wind, are formed organically/mechanically/chemically

Economic importance of rocks - Provide building material, used for industry, formation of soil, storage of underground water, provides fuel (coal), manufacturing of cement, salt extraction, decoration in houses

Economic significance of sedimentary rocks - Contain building material, used as decorative material, provide energy (coal), production of cement, formation of features in karst regions

Quartz is a compound element of silicon and oxygen

Granite and basalt are examples of igneous rocks

Marble is metamorphized limestone

The three main groups of rocks on the surface of the earth are igneous sedimentary and metamorphic and are classified according to how they were formed

Igneous rocks are formed when molten rocks from the mantle cool and solidify

Clay is classified as an impermeable rock

3.1.3 Simplified geological time scale

Order of time periods of the geological time scale:

Oldest
1. Paleozoic - Primary period
2. Mesozoic - Middle period
3. Cenozoic - Modern period

Youngest
Cenozoic Era - The most recent of the three classic geological eras and covers the period from 65.5 million years ago to the present following the Mesozoic Era.

Geological Time Scale - Is a chart which is used to date rocks to understand how landforms were created.

3.2.0 Forces that affect the earth

3.2.1 Forces causing earth movements

3.2.2 Internal forces

3.2.2.1 Radial/vertical and lateral/horizontal movement

Features caused by faulting - Formation of rift valleys (graben), horsts, plateaus, basins, block mountains, fault scarps, tilt block landscape, changes drainage and causing of earthquakes, occurrence of springs.

River Valley (Graben) - Is a depressed block of land bordered by parallel faults. A graben is the result of a block of land being downthrown producing a valley with a distinct scarp on each side. Graben often occur side-by-side with horsts.

Horsts - Is the raised fault block bounded by normal faults or graben. A horst is formed from extension of the Earth's crust. The raised block is a portion of the crust that generally remains stationary or is uplifted while the land has dropped on either side.

Plateau - An extensive elevated region with a gentle undulating surface with a uniform summit level.

Spring - Is a natural occurrence where water flows to the surface of the earth from below the surface. Thus it is where the aquifer surface meets the ground surface. Forms from a dyke cutting across a layer of permeable rock.

Aquifer - A natural outflow of water from the surface rock.

Artesian Aquifer - Is a confined aquifer containing groundwater that will flow upward through a well, called an artesian well, without the need for pumping.

Types of earth movements (caused by either compressional or tensional forces) - Vertical movements, lateral movements (orogeneses).

Types of folds - Symmetrical, asymmetrical, over fold.

Symmetrical Fold - A fold produced with limbs of similar nature.

Asymmetrical Fold - A fold where one limb is steeper than the other, they are not similar.

Overfold - Fold formed when compressional forces push one limb of an asymmetrical fold over another.

Types of faults - Normal faults, reverse faults, tear (transformation, shear) fault.

Normal Faults - Produced by tensional forces.

Reverse Faults - Caused by compressional forces.

Tear Fault - A vertical fracture produced when two blocks slide against one another.

Examples of fold mountains - Rocky mountains, Appalachian mountains, Alps, Andes, Atlas, Himalayas.

How a graben (rift valley) forms - Is formed when faults between two rocks sink down due to either compressional or tensional forces.

Anticline - Is a fold that is convex up and has its oldest beds at its core.

Block Mountains - Are formed when large areas of bedrock are widely broken up by faults creating large vertical displacements of continental crust.

Compression Forces - Causes a wrinkling of the Earth's surface due to forces pushing towards each other.

Exfoliation Joints - Are surface-parallel fracture systems in rock often leading to erosion of concentric slabs.

Fault - Is a fracture in the crust due to stress or strain associated with rock displacement.

Faulting - Is the fracturing of the crust to form faults.

Folding - Is when one or a stack of originally flat and planar surfaces are bent or curved.

Lateral Forces - When two forces act away from each other laterally.

Joint - Is a crack in the rock due to stress but is not associated with rock displacement.

Orogeny - Refers to forces and events leading to a severe structural deformation of the earth's crust due to the engagement of tectonic plates.

Range - Chain of mountains bordered by highlands or separated from other mountains by passes or valleys.

Set of fault types - Normal fault, reverse fault, tear (symmetrical) fault.

Syncline - Is a downward-curving fold, with layers that dip toward the centre of the structure.

Tectonic Plates - Is a scientific theory which describes the large scale motions of Earth's lithosphere.

The difference between faults and joints is that joints have no associated displacement. Fold mountains are caused by compressional forces.

3.2.2.2 Vulcanicity
Features with volcanicity - Caldera, craters, dyke, laccoliths, plug dome, solfataras, phacolith, lopolith
  Caldera - A feature formed as a result of a violent volcanic eruption and is shaped like a large basin or depression on the top of a volcano
  Dyke - A vertical feature formed out of the solidification of magma within the Earth's crust, forms across a bedding plane of bedrock
  Laccolith - Is a sheet igneous intrusion that has been injected between two layers of sedimentary rock
  Lopolith - Is a large igneous intrusion which is shaped like a lens with a depressed central region
  Phacolith - Lens-shaped strip of igneous rock formed if magma solidifies along anticlines or synclines
  Solfatara (Fumarole) - Is an opening in the Earth's crust near volcanoes which emit steam and gasses

Features of intrusive vulcanicity - Dyke, sill, laccolith, Lopolith, Phacolith, batholith
  Sill - Is a flat sheet intrusion that has intruded between older layers of sedimentary rock, beds of volcanic lava, forms along the bedding planes of bedrock
  Batholith - A large mass of solidified rock formed when magma cools in the heart of mountain ranges

Major extrusive volcanic features - Caldera, crater, shield volcano, crater, ash and cinder cone (scoria cone), composite cone (strato-volcano), volcanic plug (plug dome volcano), acid lava cone
  Crater - A depression formed on the summit of the cone after the plug has been blown off
  Shield Volcano - A broad domed lava cone with gently sloping sides
  Volcanic Plug - The solidified volcanic feature within the vent that prevents an eruption
  Ash and Cinder Cone - A cone shaped accumulation of rock fragments around a vent
  Composite Cone - A large cone with alternate layers of fragments from ash or lava
  Acid Lava Cone - A dome shaped volcano with convex slopes formed when acidic lava solidifies around a vent

Minor extrusive volcanic features - Solfatara, fumerole, hot springs, geysers
  Hot Springs - Spring caused by the emergence of heated groundwater from the Earth's crust
  Geyser - Is a spring with an intermittent discharge of water ejected violently and accompanied by a vapour phase (steam)

Types of volcanoes - Dormant, extinct, active
  Dormant - A volcano which has stopped erupting but can still erupt at any time
  Extinct - A volcano which has stopped erupting and will not erupt again
  Active - A volcano with frequent eruptions

Lava - Is molten rock expelled by a volcano during an eruption, is the name of magma on the surface
Magma - Is a mixture of molten rock and solids that is found beneath the surface of the Earth
Volcanic Eruption - The forceful emission of magma from the core of the Earth through a vent
Volcano - Is an opening, or rupture, in a planet's surface or crust, which allows hot magma, ash and gases to escape from below the surface
Volcanism - Refers to the range of processes by which molten material and gasses are either intruded into the Earth's surface or extruded from the Earth's surface
Characteristics of a shield volcano - Forms from fluid lava which flows to cover a large surface area, formed by basaltic lava, lava flow is slow, not very tall but occupies a large surface area, crater is small due to slow rate of eruption
A volcanic eruption is most likely to be violent if the lava reaches the surface through a fissure due to high pressure inside the volcano

3.2.2.3 Earthquakes
Causes and effects of earthquakes - Causes: Tectonic forces (diastrophic forces), faulting of lithosphere, volcanism, mass movements, falling of meteorites, man's activities (e.g. quarrying, explosives), movements of large amounts of animals Effects: Death, destruction of property, formation of joints in the rocks, landslides, collapse of buildings, tsunamis, fires

Crest - The upper part of a wave
Earthquake - The sudden movement of the Earth's crust along faulted and volcanic areas when tectonic plates collide with each other
Epicenter - Is the point on the Earth's surface that is directly above the focus
Focus - Is the point where an earthquake originates
Magnitude - Refers to the total amount of energy released by an earthquake
Mercalli Intensity Scale - Is a scale used for measuring the intensity of an earthquake
Richter Scale - Measures the amount of energy released by an earthquake
Seismography - Measures the intensity of an earthquake
Seismology - The study of the Earth's movements such as earthquakes or tremors
Trough - The bottom part of a wave

3.2.3 External forces
External forces operating on the Earth's surface - Exogenic forces, denudational forces

3.2.3.1 Mass wasting
Mass Wasting - Is the geomorphic process by which soil, regolith and rock move downslope under the force of gravity. Is caused by the process of granular disintegration, tips electric polls and fences

Eluviation - The process of the removal of materials from geological or soil horizons

Denudation - The process of rock disintegration by means of erosion, weathering, or mass wasting

Forms of slow mass wasting - Soil creep, talus (scree) creep, solifluction (sludging)
- Soil Creep - Slow movement of soil particles which can be recognized by bending of trees and fences
- Talus Creep - Very slow movement of waste rock of all sizes down a slope
- Sludging - The gravitational flow of soil mixed with gravel saturated with water down a slope

Forms of rapid mass wasting - Earth flow, mudflow, avalanches, landslides, slumping, rockslide, debris slide, rock fall
- Earth Flow - A downslope viscous flow of fine grained materials that have been saturated with water, and moves under the pull of gravity
- Mudflow - The movement of large volumes of materials which are supersaturated with water as mud
- Avalanches - The sudden and catastrophic movement of materials down a slope with snow
- Landslides - Movements of materials which slip rapidly down a slope

Factors affecting mass wasting - Gradient(slope), climate, vegetation, nature of material and extent of saturation, endogenic forces (tectonic forces), human beings

Effects of mass wasting in our daily life - Death, loss of property, soil erosion, formation of fertile soil, creation of lakes, creation of tourist attractions, land degradation

3.2.3.2 Weathering
Weathering - The destruction of rocks by climatic conditions such as rain or temperature change

Types of weathering - Mechanical, chemical, biological (biotic)

Forms of mechanical weathering - Exfoliation, granular disintegration, block disintegration, shattering
- Exfoliation - The peeling off of the outer layer of the rock due to high temperatures
- Granular Disintegration - The breaking up of rocks which consist of different minerals
- Block Disintegration - Takes place when a homogeneous rock breaks into blocks due to temperature, common in rocks that are well jointed
- Frost Shattering - Freezing and thawing causes the rocks to expand and contract until they break

Types of chemical weathering - Oxidation, carbonation, hydration, hydrolysis, solution
- Oxidation - The process where minerals are oxidized when they combine with oxygen and water
- Carbonation - Takes place when a weak acid in rainwater reacts with rocks composed of calcium carbonate such as limestone
- Hydration - When certain minerals absorb water and swell causing fracturing of the rock
- Solution - The process where some soluble minerals dissolve e.g. rock salt

Factors affecting the rate weathering - Nature of the rocks, climate, organisms, relief(slope)
- Nature of the rocks - Mineral composition, rock structure, colour
- Climate - Climatic variations increase or decrease the rate that rocks weather
- Organisms - Plants and animals can break apart rocks chemically or mechanically
- Relief - Steeeper slopes can cause rocks to break apart

Chemical weathering is the result of organic acid and weak carbonic acid

Chemical weathering is most effective when it is hot and wet

Tors - Rock outcrops formed by weathering which is usually found on near the summit of a hill, formed when joints develop in rocks

Wind Attrition - The process by which rock particles rub or collide against each other when they are carried along with the wind

Wind Deflation - The process by which the wind blows away loose rock waste and in doing so, lowers the desert surface producing depressions

Wind Abrasion - The process by which small particles of rock are hurled by the wind against rock surfaces to blast away features

3.2.3.3 Erosion and deposition by water, ice, wind and wave action

Water
Types of deserts - Sandy, rocky (erg), badlands, mountainous
Erg - A stony desert
Depositional features due to water action in deserts - Alluvial fans, alluvial cones, bajadas (bahada), peripediment, playas (sebkhas/chotts) and Salinas(salars)

**Alluvial Fans** - Fan-shaped features formed when large quantities of sediments are deposited at the foot of steep slopes

**Alluvial cones** - Look like alluvial fans but consist of coarser material

**Bajadas** - Continuous gently sloping features with an undulating surface formed when alluvial fans/cones coalesce during the deposition of more sediment at the foot of a steep slope

**Playas/Salinas** - Are temporary salt lakes

**Peripediment** - A gentle slope formed when alluvial deposits overlie the edge of the pediment surrounding the playa

Erosional features due to water action in deserts - Rills, gullies, wadis (chebka), pediment, pediplains, inselbergs, mesas, buttes, dry river valleys

**Rills** - Small, shallow grooves formed due to erosion by surface runoff

**Gullies** - Deep, steep troughs produced when erosion in rills becomes larger

**Wadis** - Steep-sided, deep and flat floored valleys formed due to severe erosion by water in the desert

**Pediment** - Gently sloping platform formed when the edges of the desert and semi-desert highlands get pushed back by erosion and weathering

**Pediplains** - Multi-concave features resulting from the coalescing of several adjacent pediments

**Mesas** - Extensive flat-topped residual tablelands with resistant rock on the top

**Buttes** - Small but prominent residual flat-topped hills capped with resistant rock which remain after denudation of a plateau in arid areas

**Dry River Valleys** - River valleys which remain dry after streams of water dry during the dry season

Surface features of a karst region (limestone surface features) - Scarp, hills and mountains, grikes (grykes), clints, swallow holes (sink holes or ponor), doline, uvala, polje, gorge, terra rosa

**Terra Rosa** - A red clay which is found in floor of a polje

**Scarp/Hills/Mountains** - Formed when there are hard rocks which have not been eroded away that remain standing as residual features

**Grikes** - Gullies formed when water erodes the cracks on the surface before going underground

**Clints** - Ridges or blocks in limestone rock separating grikes in a karst region

**Sinkhole (Swallow Hole)** - A vertical hole produced when the joints are enlarged by water percolating into the rock

**Doline** - Is a large depression produced when several swallow holes coalesce (join together)

**Uvala** - Is a large depression formed when Dolines coalesce

**Polje** - A very large depression formed when several uvalas collapse

**Gorge** - Steep sided trough lined by steep rocky cliffs which form when the roof of the cavern collapses

**Karst** - A well developed surface of a limestone region where the rocks are well jointed

**Limestone** - A soluble rock with jointed structures resembling a wall

Underground features of a limestone area (caves) - Caverns, stalactites, stalagmites, underground river, natural pillar, anthodites, resurgent river

**Caverns** - Underground chambers formed due to the solution of limestone rock underground

**Stalactite** - Long needle like calcite rock that hangs downward from the roof of a limestone cave

**Stalagmite** - Is a type of structure found on the floor of a limestone cave due to the dripping of mineralized solutions and the deposition of calcium carbonate

**Underground River** - The river formed when water sinks underground through sinkholes and joints

**Natural Pillar** - A natural column formed when a stalactite and stalagmite join together or when a stalagmite reaches the roof

**Anthodites** - Delicate flower-like formations which are formed when calcite is deposited on the roof of caverns

**Resurgent River** - An underground river that reappears on the surface somewhere

The amount of water that sinks into the ground from the surface depends on the underlying geological structure

Erosional features in the upper section of a river (young stage, river torrent, or river mountain) -

**V-shaped valley**, interlocking spurs, river capture, waterfalls, canyons(gorge), rapids, pot holes, plunge pool, boulders

**V-shaped Valley** - A valley with a strong gradient which is formed due to the river's high velocity

**Interlocking Spur** - Is a natural geographical feature which occurs in a river's upper course, where vertical erosion is the dominant force in determining the river's course

**River Capture** - Process where a stronger river captures a weaker river when the stronger river erodes its valley both vertically and headword at a faster rate and flows at a lower level than the weak river

**Waterfalls** - Sudden downpours of water along a river due to the sudden drop of slope in the riverbed

**Canyon** - A deep ravine cut between cliffs like mesas, buttes, or plateaus by a river in a desert climate
Rapids - The sudden descent of the stream of water without a waterfall, the slope is not steep enough
Pot Holes - Shallow depressions cut by pebbles as they are carried by swirling water on the riverbed
Plunge Pool - A large deep depression that develops at the base of waterfalls due to abrasion by pebbles carried in the river
Boulders - Large rocks broken up by river erosion that are too heavy to be taken downstream

Features resulting from river capture - Elbow, pirate river, wind gap, misfit river
Elbow - The bend produced where the river has been diverted
Misfit River - Stream which lost headwaters due to its volume being captured by another river
Wind Gap - The valley behind the misfit river in between the misfit river and the elbow
Pirate River - The river which takes volume from the misfit river and is rejuvenated in the process

Features in the lower section (old stage, or flood plain of the river) of a river (depositional features) -
Flood plain, natural levees, ox-bow lakes (Cut-offs), deflected tributary, deltas, estuaries
Flood Plain - A gently sloping area produced as a result of deposition of alluvium (silt and sand)
Levee - Embankments produced as the result of deposition of sediments along the bank of the river in the flood plain. Also created by humans to prevent flooding
Ox-bow Lakes - Cut-off meanders formed as the river cuts through the necks of the loops or well-established river bends
Deferred Tributary - A tributary in the lower course of a river that has been forced to flow alongside the main valley before joining the river
Deltas - Low lying swampy plain formed as the result of accumulation of alluvium at the mouth of a river
Estuary - River valley that has been drowned by a rise in sea level or the fall of the land along the coast

Basin lakes of Africa - Victoria and Chad

Types of river rejuvenation - Dynamic rejuvenation, static rejuvenation
Dynamic Rejuvenation - Rejuvenation brought about by either sea level change or land level change
Static Rejuvenation - Is the type of rejuvenation caused by the increase in the river volume due to heavy rainfall, melting of ice or river capture

Features due to river rejuvenation - Knick point (rejuvenation head), paired terraces, incised meanders
Knick Point - Break of the slope in the long profile of the river valley where the riverbed drops sharply
Paired Terraces - Steps or benches on either side of a river valley formed as a result of undercutting of the river due to renewed erosion
Incised meanders - Steep sided curved bends of the river valley produced as a result of the undercutting of the riverbed by the river along the meander

Rejuvenation - The renewed activity of an ecological area such as a river or forest

Types of drainage patterns - Dendritic pattern, trellised pattern (rectilinear pattern, rectangular pattern, radial pattern, annular pattern, centripetal pattern, and parallel drainage pattern
Dendritic Pattern - Looks like a tree trunk with its branches as veins, possessing many tributaries
Trellised pattern - Develops in areas with alternating hard and soft rock, the tributaries join the main river valley at almost right angles
Rectangular Pattern - Its tributaries join the main river at a right angle
Radial Pattern - The drainage pattern where streams flow outwards down flanks or slopes of a dome or cone such as a volcano e.g. Kilimanjaro
Annular Pattern - A series of streams flowing in a spiral way forming concentric circles
Centripetal Pattern - Streams flowing from all directions converge at the center in the basin
Parallel Drainage Pattern - A series of streams running parallel to one another

Types of drainage systems - Accordant drainage system, discordant drainage system
Accordant Drainage System - The normal drainage system of a river, the water flows in accordance to rock structure and slope
Discordant Drainage System - Does not flow in accordance with rock structure or slope

Accordant drainage systems are seen by the following drainage patterns - Radial, trellised, rectangular, centripetal drainage patterns

Discordant drainage systems - Antecedent, superimposed, anteposition
Antecedent - A river maintains its course by eroding vertically up the land due to having enough velocity to go up the slope
Superimposed - The opposite of an antecedent, the river maintains its course into a newly exposed rock layer without following the structure of the rock
Anteposition - Develops as a result of the combination of antecedence and superimposition
Alluvium - Loose soil or sediments, eroded, deposited, and reshaped by water on Earth’s surface
Deposition - The laying down of rock particles on the surface

Importance of rivers - Water supply, transport, hydroelectric power, sources of materials like sand/diamonds, fishing grounds, tourism, irrigation

Causes of river rejuvenation - A fall in the sea level (eustatic change), land uplift and subsidence (isostatic change), increase in the river volume (discharge)

Conditions necessary for the growth of coral polyps:
1. Warm waters with temperatures between 20-30 degrees Celsius
2. Clear salty water, hence they do not occur at river mouths
3. Sunlight that penetrates to a depth of about 50m
4. Plentiful supply of plant food and oxygen

Types of coral reefs - Fringing reef, barrier reef, atoll
  Fringing Reef - A reef attached to the coast with a shallow lagoon separating it from the mainland
  Barrier Reef - Similar to a fringing reef but the barrier reef is farther away from the coast and is separated from the mainland by a larger deeper lagoon
  Atoll - Circular or elliptical shaped coral reef enclosing a lagoon found in mid oceans

Features of an ocean floor - Continental shelf, continental slope, trench, plateau, basin, plain, deeps
  Ocean Ridge - Is an underwater mountain range, typically having a valley known as a rift running along its spine, formed by plate tectonics

The continental shelf is the best place for commercial fishing

Attrition - Collision of loads with each other and broken down in a river
Cross profile of a river - Distance between one side of a river and the next
Dendritic Drainage - A drainage pattern which looks like a tree with its branches
Drainage Pattern - Is the plan or layout of the river with its tributaries
Formation of a river delta - First corrasion, then transport, then deposition
Hydraulic Action - Wearing away of the sides and bottom of a river’s channel by the load carried by a river
Long profile of a river - Stretch of the river from its source to its mouth
Meander - Is the bend in a river as it courses downriver
Potholes - Is a type of disruption in the surface of a roadway where a portion of the road material has broken away, leaving a hole
River Rejuvenation - Is the renewal of the erosive activity of a river in its valley
River Valley - A section of a river where erosion is pronounced and is characterized by a V-shaped valley
The source of a river is the catchment area

River water can flow in the following two ways: Laminar and turbulent

Waves
Features due to wave deposition - Spit, tombolo, sand bar, mudflats, beaches, berms, cusps
  Spit - A low narrow ridge of sand attached to the land at one end with the other side ending in the sea
  Tombolo - Is a deposition landform in which an island is attached to the mainland by a narrow piece of land such as a spit or bar
  Mudflat - Are coastal wetlands that form when mud is deposited by tides or rivers. They are found in sheltered areas such as bays, bayous, lagoons, and estuaries
  Beach - Lies between the high and low water levels (tides), formed by deposition of sand along water
  Berm - A narrow ridge or shelf with a steep front which is found on the upper part of some beaches
  Cusps - A series of small, horn-shapes projections separated by shallow indentations that face seawards giving the beach a curved appearance
  Sand Bar - A ridge of material which lies parallel or almost parallel to the coast or across the estuary or bay between two headlands

Features due to wave erosion - Cliffs, wave-cut platforms, bays, caves, blowhole (gloup), arch, geo, stack, stump, headland
  Cliff - Is a high perpendicular or steep rock face along a sea coast produced by waves below
  Wave-Cut Platform - A plateau like structure produced by continual undercutting of a cliff by waves
  Headland - Is a high promontory with a steep face which projects into the sea or a lake when less resistant rocks are eroded away
  Bays - A curved indentation of the sea into the land which is formed by the erosion of less resistant rock
  Cave - Is a tunnel-like opening at the base of a cliff face that forms where there is a weakness in the rocks (joint or fault) through constant wave erosion by abrasion and hydraulic action
  Arch - Is a roof-like structure formed as a result of a headland being eroded right through from one cave to the other side of the headland
Stack - Is an isolated mass of rock near a coastline detached from the mainland by wave erosion which caused the collapse of an arch

Stump - Is an isolated mass of rock which was formed as a result of a stack being considerably eroded

Blowhole - Is a hollow structure nearly vertical on the land formed when erosion occurs along a vertical joint which passes from the land surface to the cave roof

Geo - A long narrow inlet of the sea, penetrating cliffs that have been formed as the result of the collapse of the roof joining a cave and blowhole

Shore - The land between the high tidal water level and the low tidal water levels

Shoreline - The line where the shore and sea meet

Classification of Coasts - Submerged coasts, emergent coasts, stable coasts, compound coasts

Submerged Coasts - Result from the rise of the sea level or submergence of land

Emergent Coasts - Result from the fall in sea level or uplift of land

Stable Coasts - Coasts formed where there is little change

Compound Coasts - Produced from the mixture of emergences and submergences

Types of submerged upland coasts - Ria coasts, fiord coast, dalmation coasts (longitudinal coasts)

Ria Coast - Formed when the highland area with river valleys is submerged and the lower parts of its river valleys become flooded by water from the sea

Fiord Coast - Formed when glaciated U-shaped valleys are flooded after the submergence of the former coastal highland area

Dalmation Coast - Form where a mountainous area which lies parallel to the coast is submerged, forms valleys called sounds

Lakes

Classification of Lakes - Created by diastrophic movements, volcanic activity, erosion, deposition, man

Lakes caused by diastrophic movements - Rift valley lakes, down-warped lakes

Rift Valley Lakes - Formed when water occupies rift valleys formed as a result of faulting

Down-Warped Lakes - Formed when water occupies basin-like depressions

Lakes due to volcanic activity - Crater and caldera lakes, lava dammed lakes

Crater and Caldera Lakes - Formed when water occupies a crater or caldera

Lava Dammed - Formed when a river is blocked by lava that erupts and runs across the river

Lakes due to erosion - Glacial lakes, trough lakes, rock basin lakes

Glacial Lakes - Tarn lakes formed when water fills land occupied by cirques

Trough Lakes - Lakes formed when water occupies hollows on the floor of U-shaped valleys

Rock Basin Lakes - Formed when water occupies the depressions formed on the rock surface

Lakes due to deposition - Glacial depositional lakes, moraine dammed lakes, kettle lakes, ox-bow lakes, delta lake, flood plain lakes, marine deposition, lucastrine

Lucastrine - A delta which is found in a lake

Lakes which occur as a result of deposition - Playa, Ox-bow, Delta, Lagoon

Playa - Is a desert basin with no outlet which periodically fills with water to form a temporary lake

Ox-bow Lake - Is a waterhole that forms at the lower side of the river, where the river develops meanders while deposition is taking place

Delta - A broad tidal channel where a river enters the sea

Lagoon - Is a body of shallow sea water separated from the sea by some form of barrier

Lake - Is a hollow or depression on the Earth’s surface where water has accumulated

Manmade Lakes - Are formed as a result of the construction of a dam across a river

Ice

Sapping - The breaking of rocks by the alternation between thawing and freezing of water at the bottom of cracks in glaciated land

Erosional features formed in a glaciated highland - Truncated spur, U-shaped valley, pyramidal peak, arête, cirques (corrie/cwm), hanging valley, fjord, ribbon lake

Pyramidal Peak - Mountain top that has been carved by ice during glaciation and frost weathering

Cirque (Corries) - Circular depressions which are formed by glaciations in the highlands

U-Shaped Valley - A steep-sided, flat bottom, wide valley which contains features produced by both glacial erosion and deposition

Arête - A steep ridge separating two cirques which is formed by cutting back of the walls of cirques

Truncated Spur - Spurs whose ends have been cut off due to erosion as ice moves down the valley

Hanging Valley - Is the tributary valley of the U-shaped valley which hangs above the floor of a U-shaped valley separated by an almost vertical slope. If there is a river a waterfall will form

Fjord (Fiord) - Is a submerged glaciated U-shaped valley formed when the glacier has eroded its path by undercutting and been plunged into the sea

Ribbon Lakes - Lake that occupies an elongated trough excavated by ice in a U-shaped valley
**Tarn Lake** - Is a mountain lake or pool, formed in a cirque excavated by a glacier

**Erosional features formed in a glaciated lowland** - Eroded plain, crag and tail, roche montonée
- **Eroded Plain** - Is a rounded topography with a large area of bare rock scratched by boulders embedded in the base of the glacier
- **Crag and Tail** - Is a resistant mass of rock standing in the path of a moving glacier
- **Roche Montonée** - Outcrop of resistant rock smoothed by a glacier into a gentle slope

**Depositional features of a glaciated lowland** - Till plain (boulder clay plain), drumlin, erratics, kames, eskers, kettles, moraines, outwash plains, kame-terrace
- **Till Plain** - A long plain made of clay and boulders deposited by ice sheets and glaciers over a surface which contains features like erratics, drumlins, kames, eskers and kettles
- **Kettles** - Are the depressions formed after the melting of the ice block enclosed within the till
- **Erratics** - Are large boulders deposited by a glacier or ice sheets as they melt
- **Drumlin** - Elongated egg-shaped hills made of boulder-clay which occur in groups
- **Moraines** - Refer to the boulder clay deposits laid down in the lowlands to form ridges
  - **Lateral Moraine** - Lines of glacial deposits along the sides of valleys
  - **Medial Moraine** - Consist of rock fragments deposited in the middle of the valley which marks the point where two glaciers met
  - **Terminal Moraine** - Refers to the ridge like feature found at the end of a glacier
  - **Recessional Moraines** - Series of parallel terminal moraines that mark the retreat of glaciers
- **Esker** - Is a long winding ridge of stratified sand and gravel
- **Kame** - A feature of an irregular undulating mound of bedded sands and gravel
- **Kame-terrace** - Is a discontinuous ridge along the valley side formed by deposition of sands in narrow lakes between a glacier and the adjacent rock wall
- **Outwash Plain** - Is a wide gently sloping plain formed as the result of deposition of material by melt-water from the glacier

**Wind**

**Erosional features due to wind in deserts** - Rock pedestals, zeugen, yardangs, blowouts (deflation hollows/pan), inselbergs, desert pavements, ventifacts (draikanter)
- **Rock Pedestals** - Tower like structures composed of alternate bands of soft and hard rock formed due to wind abrasion in the desert
- **Zeugen** - Ridges consisting of alternate layers of hard and soft rock formed in areas where rock layers lie horizontally and are characterized by joints
- **Yardangs** - Are the ridges consisting of hard and resistant rock bands standing either vertically or at an angle which run parallel to the direction of the prevailing wind
- **Blowouts** - These are hollows or depressions produced by wind deflation
- **Inselbergs** - Residual hills consisting of hard and resistant rocks left behind after the rest of the surface has been eroded away
- **Desert Pavements** - The horizontal areas of bare polished rock formed by the scouring action of quartz
- **Ventifacts** - Heavier rock blocks left behind after wind has carried away all of the material

**Wind depositional features associated with deserts** - Sand dunes, seifs, barchan, ripples, loess
- **Sand Dunes** - Are hills of sand which have been deposited by the wind in a desert
- **Seifs** - Are long narrow ridges of sand which lie parallel to the direction of the prevailing wind
- **Barchans** - Crescent shaped sand dunes that are formed by an obstacle in the desert like a rocks
- **Loess** - Are a sediment formed by the accumulation of wind-blown particles that were carried by the wind beyond the desert limits
- **Ripples** - Small wavy structures commonly found between sand dunes

**Formation of sand dunes (or barchans and seifs) are influenced by** - The extent of vegetation cover, the size of the sand particles, the relief of the desert, the velocity of the wind

### 3.2.4 Artificial forces

### 3.3.0 Soil

#### 3.3.1 Soil formation

**Soil** - A natural body consisting of layers of mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, physical, chemical, and mineralogical characteristics

**Processes of soil formation** -
1. Weathering of rock to produce regolith
Regolith - Loose broken material due to weathering of rock or deposition of alluvium, drift loess and volcanic material

2. Formation of topsoil by adding water, gasses, living organisms, and decayed organic matter (humus)

Five major factors of soil formation - Time, parent materials, climate, living organisms, topography

3.3.2 Soil composition and properties
Components of soil - Organic matter (biota, 45%), inorganic matter (5%), soil water (25%), soil air (25%)
- Organic Matter - Made of decomposed plant and animal remains (humus) and living micro-organisms
- Inorganic Matter - Provide minerals required for plant growth
- Soil Water - Derived from rainfall and is important for regulating temperature, dissolving nutrients
- Soil Air - Plants and animals gain oxygen for metabolism from soil air

3.3.3 Soil profile and characteristics
Characteristics of soil are influenced by - Vegetation, parent rock, climate and weathering
Properties of soil - Soil profile, soil depth, soil colour, soil texture, soil porosity, soil structure
- Soil Profile - A vertical cross-section of the soil showing its horizons
- Soil Depth - Varying properties depending on the maturity of the soil and nature of rocks below
- Soil Colour - Colour is determined by mineralogical composition of the soil
- Soil Texture - The degree of coarseness or fineness of a soil
- Soil Porosity - Total volume of pores or empty spaces between particles of soil material
- Soil Structure - Refers to the arrangement of soil particles

Sources of soil pollution - Atmosphere, daily human activity, industrial activity, farms
- Atmosphere - Pollutants introduced through acid rain
- Daily Human Activity - Garbage like plastic, metals, bottles, cans are dumped on the soil
- Industrial Activity - Chemicals, radioactive materials and industrial waste are dumped
- Farms - Pesticides (DDT/fertilizers) and certain crops can damage the soil

Ways you can combat soil degradation - Good agricultural practices, mixed farming, crop rotation, avoid
- soil pollution, education of land users, avoid bush fires, ensuring soil moisture, avoid mass wasting

Factors influencing soil fertility - Presence of mineral plant nutrients, presence of water, presence of air, soil pH, soil, presence of colloids, presence of organisms

Loss of soil fertility - Leaching, over-cultivation, monoculture, soil pollution, soil erosion, mass wasting, loss of water in the soil

3.3.4 Simple soil classification
Podzol - The group of soils which occur mostly in moist cool temperate climates
- Clay Soil - Is a naturally occurring material composed primarily of fine-grained minerals
- Humus - Refers to any organic matter that has reached a point of stability, where it will break down no further and might, if conditions do not change, remain essentially as it is for centuries, if not millennia
- Laterites (Red Lateric Soil) - Are soil types rich in iron (causing red from oxidation) and aluminum, formed in hot and wet tropical areas
- Leaching - Is the loss of plant nutrients from the soil, contributes to groundwater contamination
- Loam - Is soil composed of sand, silt, and clay in relatively even concentration (about 40-40-20% concentration respectively)
- Residual Mountains - Owe their origin mainly to denudation
- Mulching - The practice of covering the soil with a layer of grass or plant remains
  - Advantages of mulching - Helps to conserve moisture in the soil by preventing evaporation, reduces loss of soil by erosion, rotting mulch adds organic matter to the soil, helps control the spread of weeds

Types of soil - Azonal, intrazonal, zonal
- Azonal Soil - Are without well-developed characteristics due either to their youth or to some condition of relief or parent material which prevent soil development, Soils forming in recent eolian, alluvial and colluvial deposits are azonal
- Intrazonal Soil - Have well defined soil profile characteristics that reflect the dominant influence of some factor of relief or parent material over the classic zonal effects of climate and vegetation
- Zonal Soil - Soils with clearly distinguishable horizons which occur in definite regions of climate and vegetation

3.3.5 Soil erosion
Soil Degradation - Is the spoilage of the quality of soil through human activity. It is deterioration of the soil quality through loss of fertility, soil pollution, soil erosion and mass wasting
Soil Erosion - Is the physical removal of soil from one place to another by agents of erosion such as running water, wind, glacier, or waves

Soil erosion is caused by manmade and natural causes such as - Sheet erosion, gully erosion, splash erosion, rill erosion, climate, nature of soil, vegetation cover, topography, cultivation, excessive mining, construction activities, excessive deforestation by man, bush burning

Ways of preventing soil erosion - Contour farming, crop rotation, terrace farming, afforestation and reforestation, destocking, avoiding bush fires, growing cover crops

Ways to manage soil effectively - Education, training of farmers, planting better crops, afforestation/ reforestation, reducing chemical use in farming/industry, recycling

3.4.0 Elementary surveying and map making

3.4.1 Meaning and types of survey

Forms of surveying - Chain/tape, prismatic compass, plane table, leveling, cadastral, geodetic

Chain Surveying - Is a method of plane surveying which deals with the measurement of linear horizontal distances. The distances covered in chain surveys are normally short and straight

Plane Table Survey - Is the science of measuring and fixing positions of distant objects by intersection by considering the surface of the earth to be a plane (completely flat surface), curvature is ignored

Prismatic Compass Survey - Is the fixing of an objects position in the field by measuring the angles of bearing between the line of magnetic north and the line of sight of the object

Leveling - Is the process of measuring height differences between points on the ground by determining the relative altitudes of the two points

Cadastral Surveying - The kind of survey which collects data about the ownership of property

Geodetic Surveying - Precise type of surveying which covers large areas considering the curvature of the earth, uses triangulation/traversing/trilateration/leveling/astronomical direction fixing

Leveling - A process of determining the differences in elevation between two points

Uses of leveling - Construct contour maps, find the best level at which you should erect a building, create longitudinal section of roads/railways/canals/pipes/sewers in urban areas, determine proper human settlements

Tools used for leveling - Leveling instruments (i.e. theodolite, abney level, clinometer, alidade, dumpy level, tilting level etc), leveling staff, chain or tape, pegs, field sheets

Purpose of plane surveying - Determine horizontal distances between two or more points on the surface, to locate physical and nonphysical features on the surface, direction of various features of the surface, determine the area of a given region

Tools for a plane table survey - Plane table, alidade, plumb bob, trough compass, spirit level, clinometer

Advantages of a plane table survey - It is the best kind of survey used to measure and fix positions of distant objects, it is quick/accurate and allows quick sketching of details, it can cover very large land areas, less accumulation of errors than chain surveying, uses instruments which are easy to use, useful for cartography, booking is not required

Disadvantages of a plane table survey - Not suitable for a small area of land, not suitable for undulating surfaces, cannot be used during damp or rainy seasons, requires alidade which requires skills to use, a simple math error can cause all angle measurements to be incorrect, some instruments are expensive

Equipment used for prismatic compass surveying - Two prismatic compasses, ranging poles, tape measures, chains, metal markers, chalk, field sheets

Advantages of prismatic compass surveying - Rapid method, check can be made on all compass bearings, cumulative error is reduced/easily fixed, objects can be pin-pointed with accuracy, method can be combined with other methods

Disadvantages of prismatic compass surveying - Transport is needed if surveying over long distances, human error is involved in observations, magnetic rocks may affect readings

Alidade - Is a device that allows one to sight a distant object and use the line of sight to perform a task such as to draw a line on a plane table

Surveying - The science of measuring and recording distances, angles and heights on the Earth’s surface to obtain data from which accurate plans and maps are made

Topographic Maps - Colour contour maps showing the physical and manmade features such as rivers/roads/mountains/valleys/railways

Traversing - Consists of a series of lines whose lengths and directions are measured, connecting points whose positions are determined used to establish data benchmarks
**Triangulation** - Consists of a series of connected triangles which overlap each other, used to reduce the number of measurements that need to be taped or chained.

**Trilateration** - Is the use of electronic distance measuring equipment to directly measure the lengths of the sides of triangles from which angles can be calculated.

The three types of topographic surveying are chain surveying, prismatic compass surveying, and plane table surveying.

**Bearing** - The direction of a place in degrees from another place.

- **Bearing of SW** is - 225º
- **ESE** - 112.5º

### 3.4.2 Chain survey

**Instruments used in chain surveying** - Chain, tape, surveyor’s band, ranging poles, cross staff, pegs, arrows, optical square, notebook.

- **The Chain** - This chain is made up of pieces of steel which are connected by rings.
- **The Tape** - Used to measure horizontal distance on the ground.
- **Surveyor’s Band** - A long graduated strip made from steel or plastic, rolled in a metal frame.
- **Ranging Poles** - Locates a place temporarily during the chaining process.
- **Cross Staff** - Used to set a perpendicular line or right angles from the main line of survey.
- **Pegs** - Their major function is to mark points permanently on the ground.
- **Arrows** - Steel skewers which mark and locate temporary positions on the surface.
- **Optical Square** - Used for setting offsets from right angles from the line.
- **Notebook** - Good notebook for recording or booking all fieldwork information.

**Preparing a chain survey** - Must be well informed about the nature and location of the area, land configuration, presence of buildings or natural obstacles, preparation of instruments and personnel, prepare working schedule, transportation.

**Advantages of chain surveying** - Used to map small areas on flat ground, simple to conduct, used to add details to existing maps, needs few people to set up, uses simple tools like pegs, applicable to compass surveying also, only survey for measuring distances (the others measure angles and heights), does not require a lot of mathematical calculations.

**Disadvantages of chain surveying** - Time consuming, subject to the accumulation of errors.

### 3.5.0 Map reading and interpretation

#### 3.5.1 Concept of map reading

(Not in study guide)

#### 3.5.2 Reading and interpreting topographical maps

(Not in study guide)

### 3.6.0 Photograph reading and interpretation

#### 3.6.1 Types of photographs

(Not in study guide)

#### 3.6.2 Reading and interpreting photographs

(Not in study guide)

### 3.7.0 Application of statistics

#### 3.7.1 Concept of statistics

**Importance of studying statistics** - It helps to summarize massive data in simple figures, simplifies the process of data interpretation, helps to represent data in visual ways like charts and maps.

**Sources of Data** - Primary sources, secondary sources.

- **Primary Data Sources** - Data collected directly from the field, also known as first hand data.
- **Secondary Data Sources** - Data obtained from other people’s findings i.e. from books, journals etc.

**Continuous Data** - Are number that can be expressed with infinite figures of possible values that fall between any two observed values.

**Data** - Exact numerical values collected and arranged for a certain purpose.
Discrete Data - Consists of separate and indivisible categories of data
Group Data - Are values given in a range of numbers, data falls into certain classes
Single Data - Are statistics or values given for each individual item in a sample

3.7.2 Simple statistical measurement and interpretation
1. Use the following data to draw a group bar graph:

<table>
<thead>
<tr>
<th>Year</th>
<th>Tanzania</th>
<th>Kenya</th>
<th>Uganda</th>
</tr>
</thead>
<tbody>
<tr>
<td>1954</td>
<td>64</td>
<td>47</td>
<td>67</td>
</tr>
<tr>
<td>1958</td>
<td>59</td>
<td>42</td>
<td>64</td>
</tr>
<tr>
<td>1960</td>
<td>61</td>
<td>40</td>
<td>61</td>
</tr>
<tr>
<td>1965</td>
<td>54</td>
<td>38</td>
<td>59</td>
</tr>
</tbody>
</table>

To draw this graph you must first think about what the x and y axes will be. The x axis will be years because this will group together the percentages from each country. The y axis will be percentage because this is the value being compared between the various countries. A grouped bar graph is chosen because it shows the difference between each country’s GDP by year clearly.

Advantages - Enable easy comparisons, easy to interpret, no complicated calculations, detailed, contrasts clearly, gives visual impression about the totality
Disadvantages - Consumes time, does not give accurate impression of totals, erroneous conclusions can be made depending on the scale used, uses many colours

2. Use the data below to draw a compound line graph and a compound bar graph

<table>
<thead>
<tr>
<th>Year</th>
<th>Maize</th>
<th>Coffee</th>
<th>Beans</th>
<th>Sorghum</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>300</td>
<td>550</td>
<td>720</td>
<td>800</td>
<td>850</td>
</tr>
<tr>
<td>2002</td>
<td>290</td>
<td>540</td>
<td>530</td>
<td>810</td>
<td>830</td>
</tr>
<tr>
<td>2003</td>
<td>310</td>
<td>520</td>
<td>650</td>
<td>750</td>
<td>780</td>
</tr>
<tr>
<td>2004</td>
<td>250</td>
<td>530</td>
<td>660</td>
<td>700</td>
<td>770</td>
</tr>
<tr>
<td>2005</td>
<td>270</td>
<td>525</td>
<td>700</td>
<td>800</td>
<td>850</td>
</tr>
</tbody>
</table>

To draw a compound line graph you first plot the x and y axes. You start with the smallest number to draw the bottom portion of the graph (in this example it is maize), then you choose the next lowest until you have drawn a line for each variable. After this you shade down to the next line until you have completed

Advantages of compound graphs - Useful in comparing many variables, attracts readers with colours, detailed information is provided
Disadvantages of compound graphs - Needs knowledge of mathematics, needs more time to construct, if the same shading is used it may mislead the interpreter

3. Use the data below to show the enrolment of form 5 students using a divergent line and bar graph
To construct a divergent line or bar graph you must first calculate the mean deviations. This is done by calculating the mean then finding the difference between the number of students and the mean deviation.

**Finding the mean deviation**

**Step 1: Find the mean**

\[
\text{Mean (average)} = \frac{100 + 150 + 175 + 200 + 225 + 300}{6} = 191.7
\]

**Step 2: Find the deviation for each data**

- Ex. 1981: \(150 - 191.7 = -41.7\)
- Ex. 1983: \(200 - 191.7 = 8.3\)

<table>
<thead>
<tr>
<th>Year</th>
<th>No of Students</th>
<th>Mean Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>100</td>
<td>-91.7</td>
</tr>
<tr>
<td>1981</td>
<td>150</td>
<td>-41.7</td>
</tr>
<tr>
<td>1982</td>
<td>175</td>
<td>-16.7</td>
</tr>
<tr>
<td>1983</td>
<td>200</td>
<td>8.3</td>
</tr>
<tr>
<td>1984</td>
<td>225</td>
<td>33.3</td>
</tr>
<tr>
<td>1985</td>
<td>300</td>
<td>108.3</td>
</tr>
</tbody>
</table>

Since the answers are both negative and positive (because they lie on either side of the mean), you will use a graph that shows both positive and negative values, the divergent bar graph. You can also use a line graph, or a simple bar graph.

**Advantages:** It shows the increase or decrease of values over time, it is used for comparisons

**Disadvantages:** It does not deal with real numbers but rather only with mean deviations, it also needs extra calculations and is difficult to construct.

4. Construct a line graph and bar graph from the data below and discuss the definition of a line graph as well as its main types

**Line Graph** - Is a graphical representation of data which uses a line to join the points of the data being represented

**Four types of line graphs** - Simple line graph, compound line graph, group line graph, convergent line graph

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee Production (Tons)</td>
<td>2050</td>
<td>2600</td>
<td>1800</td>
<td>1950</td>
<td>3000</td>
</tr>
</tbody>
</table>
Advantages - Easy to construct/draw, illustrates variations, no difficult calculations, easy to interpret/read, saves, simple visual impression, wide variety of uses, exact values are easily estimated

Disadvantages - Inaccurate deductions can be made, easy to confuse X and Y variables, little space where X and Y axes meet, cannot represent more than one item

5. Create a pie chart using the data below of car types used in Tanzania

<table>
<thead>
<tr>
<th>Period</th>
<th>Datsan</th>
<th>Land rover</th>
<th>Isuzu</th>
<th>Toyota</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-10:30 AM</td>
<td>100</td>
<td>150</td>
<td>300</td>
<td>240</td>
<td>80</td>
</tr>
<tr>
<td>2:30-4:30 PM</td>
<td>40</td>
<td>60</td>
<td>70</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>6:30-8:30 PM</td>
<td>120</td>
<td>130</td>
<td>90</td>
<td>140</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>260</td>
<td>340</td>
<td>460</td>
<td>400</td>
<td>250</td>
</tr>
</tbody>
</table>

To create a pie chart you must calculate the degrees that each portion of the pie represents

Step 1: Calculate the sum total of angles. Add up the values in the Total row.

\[
260 + 340 + 460 + 400 + 250 = 1710
\]

Step 2: Calculate angles of each car type and then draw them with a protractor

Ex. Datsan

\[
\frac{260}{1710} \times 360^\circ = 54.7^\circ
\]

Advantages - Easy to interpret, easy to construct, illustrates statistical information accurately, gives a good visual representation, useful for comparing various commodities/sectors/items

Disadvantages - Difficult to read for getting exact values, trends and directions of change in value cannot be deduced from a pie chart, time consuming to calculate and construct, difficult to interpret or draw when there are numerous items

6. Make a population pyramid graph from the following data:

Simply plot males on one side and females on the other with each row of the graph representing one of the columns of data. On the X axis you start with 0 in the centre and write marks on either side of it.

<table>
<thead>
<tr>
<th>Age</th>
<th>0-4</th>
<th>5-9</th>
<th>10-14</th>
<th>15-19</th>
<th>20-24</th>
<th>25-29</th>
<th>30-34</th>
<th>35-39</th>
<th>40-44</th>
<th>45-49</th>
<th>50-54</th>
<th>55-59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>6000</td>
<td>5000</td>
<td>4000</td>
<td>3700</td>
<td>3500</td>
<td>3400</td>
<td>3200</td>
<td>3100</td>
<td>3000</td>
<td>2800</td>
<td>2400</td>
<td>2000</td>
<td>1700</td>
</tr>
<tr>
<td>Female</td>
<td>6000</td>
<td>5800</td>
<td>4500</td>
<td>4200</td>
<td>4000</td>
<td>3900</td>
<td>3700</td>
<td>3600</td>
<td>3500</td>
<td>3200</td>
<td>3000</td>
<td>2500</td>
<td>2200</td>
</tr>
</tbody>
</table>
Advantages - Enables one to analyze the structure of a given population, forms a basis for predicting population structure in the future, used to estimate or evaluate current/future needs, easy to construct and interpret, used to compare structure of different populations, used to compare between males and females

Disadvantages - Involves a lot of calculation, not easy to choose convenient horizontal scales, five year age groups generalize groups, can take a lot of space if there are too many age groups

7. a) From the data below calculate the mean, mode, median, modal class, and standard deviation

8, 22, 18, 20, 22, 8, 8, 13, 16, 21, 22, 30, 16, 8, 4, 6, 2, 10, 12, 14, 15, 16, 22, 22, 27, 26, 22, 18, 4

First order all of the numbers
2, 4, 4, 6, 8, 8, 8, 8, 10, 12, 13, 14, 15, 16, 16, 16, 18, 18, 20, 21, 22, 22, 22, 22, 22, 22, 23, 26, 27, 30

Finding the Mean (Average)
Step 1: Sum all numbers
\[
\sum nums = 475
\]
Step 2: Divide by number of values
Number of values = 30
Step 3: Divide sum by number of values
\[
\frac{475}{30} = 15.8
\]

Finding the Median
Median - The median is the number which divides the distribution of numbers into two equal parts (halves)
Solution: Since there are 30 numbers, the middle value is in between the 15th and 16th numbers, so you must find the average of these two values. In this case the 15th and 16th values are the number 16
\[
\frac{16 + 16}{2} = 16
\]
Mean (Avg) = 15.8
Mode = 22
Median = 16

8. b) Finding the modal class and standard deviation for the above set of numbers

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>F</th>
<th>X</th>
<th>F * X</th>
<th>X²</th>
<th>F*X²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>5 - 9</td>
<td>5</td>
<td>7</td>
<td>35</td>
<td>49</td>
<td>245</td>
</tr>
<tr>
<td>10 - 14</td>
<td>4</td>
<td>12</td>
<td>48</td>
<td>144</td>
<td>576</td>
</tr>
<tr>
<td>15 - 19</td>
<td>6</td>
<td>17</td>
<td>102</td>
<td>289</td>
<td>1734</td>
</tr>
<tr>
<td>20 - 24</td>
<td>9</td>
<td>22</td>
<td>198</td>
<td>484</td>
<td>4356</td>
</tr>
<tr>
<td>25 - 29</td>
<td>2</td>
<td>27</td>
<td>54</td>
<td>729</td>
<td>1458</td>
</tr>
<tr>
<td>30 - 34</td>
<td>1</td>
<td>32</td>
<td>32</td>
<td>1024</td>
<td>1024</td>
</tr>
<tr>
<td>(\sum f = 30)</td>
<td>(\sum fx = 475)</td>
<td>(\sum fx^2 = 9405)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How to calculate the values found in the table above:
- Chosen with a class size of 5
- Found by looking at the ordered data
- The average of each class level

\(X = \frac{12}{4} = 3\)
\(X^2 = 3^2 = 9\)
\(FX^2 = 12 * 9 = 108\)
\(\sum f = 30\)
\(\sum fx = 475\)
\(\sum fx^2 = 9405\)
Finding the Modal Class
The Modal Class is the class with the highest frequency \( (F) \)

Class 20 - 24 has the highest frequency \( (F) \) of 9

Calculating standard deviation
There are two formulas for calculating standard deviation; the summations come from the table above

\[
\begin{align*}
\sum f &= 30 \\
\sum fx &= 475 \\
\sum fx^2 &= 9405
\end{align*}
\]

**Formula 1**

\[
SD = \sqrt{\frac{\sum fx^2 - \left( \frac{\sum fx}{\sum f} \right)^2}{\sum f}}
\]

\[
SD = \sqrt{\frac{9405 - \left( \frac{475}{30} \right)^2}{30}} = 7.9
\]

**Formula 2**

\[
SD = \sqrt{\frac{\sum fx - \left( \frac{\sum fx}{\sum f} \right)^2}{n - 1}}
\]

\[
SD = \sqrt{\frac{9405 - (475)^2}{30 - 1}} = 8.0
\]

4.1.0 Introduction to research

4.1.1 Concept of research

Types of Research - Descriptive, analytical, applied, fundamental (pure), quantitative, qualitative, conceptual, empirical

Descriptive - Research which deals with description a state that exists presently

Analytical - Use of facts or existing information and then analyzing them to make critical evaluations

Applied - Aims to find a solution to an immediate problem facing a society or an organization

Fundamental - Research which deals with generalizations or formation of theory

Quantitative - Research which deals with the measurement of quantity or amount in numerical form

Qualitative - Deals with the quality of a phenomenon

Conceptual - The research which deals with abstract ideas or theory, so as to develop new concepts

Empirical - The research which relies on experience or observation without regarding system or theory

Objectives of Research - To be familiar with a phenomenon, to reveal accurate features of certain aspects of social life, test or approve hypotheses of casual relationships between phenomena

Importance of Research - Provides policy makers with accurate information about the subject matter, used to provide accurate solutions to social problems, used to direct social activities, providing reliable information to the data bank, members of society become well informed about their society

The benefits and problems of research - Benefits: Helps remove preconceived ideas in the researchers mind, creates a spirit of investigation, finds accurate solutions to problems, provides sources for future
Research, used to improve production. **Problems:** Takes a lot of time, research may be unsuccessful or useless, research is often only applicable to intellectuals.

**Why conducting field research is important:** The method is systematic, objective, specific to a certain problem, encourages collection of original data.

**Problems that can be encountered during field research:** Transport problems, climatic problems, language problems, instruments not being available, diseases, lack of human needs.

**Objectives of field research:** Discovery of new knowledge, explanation of phenomena, description of a phenomenon, prediction of new principles or theories, theory development.

**How to conduct field research:** Identify the problem, form a hypothesis, collect data, analyze data, data recording and presentation, testing the hypothesis, generalization.

**How to prepare yourself for field research:** Understand the problem in well defined terms, know objectives of the research, awareness of geographical region, know types of data required and how to obtain them, know the sample of population to be studied, prepare tools for analysis, prepare a budget/work plan/time schedule.

**Important uses of research findings:** Used to solve social problems, used by agricultural experts, preparing teaching materials and methods, improving governance, helps distribute social services, controlling diseases, to report data to the population, used by businessmen to develop business.

**Sampling Techniques:** Method of getting samples from a population; random sampling, systematic sampling, stratified sampling.

**Quantitative Research:** Based on the measurements of quantities or amounts of variables of a phenomenon.

**Research:** Is the systematic collection of data used to understand a problem or phenomenon.

**Research Tools:** Methods of data collection including observation, interviews, questionnaires.

**Non-probability sampling (Non-random sampling):** The elements chosen in the sample are not given an equal chance of being selected. (E.g. Handpicked sampling, snowball sampling, volunteer sampling).

**Probability Sampling (Random Sampling):** States that each element in the population has an equal chance of being selected. (E.g. Simple random sampling, systematic sampling, stratified random sampling, cluster sampling).

**Sampling:** Is the process of selecting a small portion of the total population which will represent the entire population statistically.

**Hypothesis:** Is a statement of speculation about the outcomes of research. It is the expected result of research by the researcher before going to the field to collect data.

**Field Research:** Process of collection of data in a systematic manner with the aim of solving a problem.

**4.1.2 Stages of research work**

**Stages of conducting research:** Identify problem, formulate hypothesis, labeling variable, establish a study design, data collection, analysis of information, report writing, conclusion.

**Research Techniques:** Observation, measurement, interview, questionnaires, focus groups.

**Observation:** Use of eyes to look at phenomena to record what is seen.

**Measurement:** The way data is obtained by using equipment.

**Interview:** Conduct a verbal interaction between an interviewer and interviewee.

**Questionnaire:** Prepared questions to be answered by a respondent set by a researcher.

**Focus Group Discussion (FGD):** Involves intensive discussion about a particular issue done in a small group of people.

**Types of Hypothesis:** Null, alternative.

**Null:** One that is stated in negation, can be said to be true or false.

**Alternative:** Indicates an actual expectation or relationship.

**Characteristics of a good hypothesis:** States clearly the relationship between the variables, must provide sound rationale, consistent with commonly accepted notions, must be testable, must be related to empirical phenomenon, must be consistent with purpose of research, simple and concise.

**Purpose of hypotheses:** Provides direction, ensures collection of evidence to answer research problem, sensitizes the investigator to certain aspects of the situation, enables researcher to access information they have collected from respondents, permits researcher to understand problem with greater clarity and use it to find a solution, provides a framework for the ultimate conclusion of the research.

**Research Proposal:** A systematic plan which plans what will be needed to accomplish the main objective of the research.

**Functions of a research proposal:** Guideline to show how to proceed with a project, shows where the research should end, shows how the research will be evaluated in the future.

**Components of a research proposal:** Title, problem and setting, hypothesis, literature review, work plan, budget chart, references.

**Qualities of a good research proposal:** Should be clearly written, precise, reasonable length, worth time/money being used.
4.2.0 Climate and natural regions

4.2.1 World climatic types and their characteristics
(Not present in exams)

4.2.2 Natural regions of the world
Trees of tropical rainforests and coniferous forests are evergreen
Tropical rain forests consist primarily of hard wood

4.3.0 Human population

4.3.1 Concepts of population
Age Structure of a Population - The distribution of ages of people in a society
Birth Rate - The number of live births per year per 1000 people in the population
Death Rate - The number of deaths per year per 1000 people in the population
Family Planning - Is the process of improving conditions of the family by ensuring an appropriate number of children and a proper spacing of time between one child and another
Growth Curve - The curve shape produced when the rate of growth of an organism or population is plotted on a graph
Infant Mortality Rate - Number of deaths of children below one year old per 1000 people in the population
Landlocked Countries - Countries without suitable harbours or access to oceans
Population - Is the number of people available in a given geographical area
Rural-Urban Migration - Movement of people, especially young people, from rural areas to towns and cities
Urbanization - Is the process of transformation in which a rural area develops into a town, from trade, modern buildings, population increase

Factors determining age structure in a population - Birth rate, death rate, infant mortality rate, migration, marriage status and rates
Explain the effects of rapid population growth on small scale agriculture - Causes deforestation, desertification, land conflict, food shortage, land degradation, water pollution, soil pollution
Effects of overpopulation on human and natural resources in East Africa - Not enough doctors/teachers for the large population, overexploitation of natural resources like water/land, lower standards of living, poor housing/social services
Characteristics of human populations - Population size, population density, population distribution, sex ration, age distribution, population growth rate, population change
Factors that influence population distribution - Physical factors like topography/climate/soil/vegetation, pests/diseases, war/government policies, economic factors like employment/industry
The aims of introducing family planning - To improve the living standards of the family, control population pressure, improve health of mothers and children, avoid STDs and unwanted pregnancy
The main problems facing family planning in Tanzania - Poverty, ignorance, cultural beliefs, religious beliefs, poor means of transport and communication to spread the message, lack of education, poor organization of groups spreading this message, laws such as allowing girls to marry at 15
Factors influencing rapid human population growth and distribution - Availability of food supplies, availability of clean/safe water supplies, pollution-free environment, availability of health services, availability of social services i.e. schools/markets, availability of infrastructure, availability of employment
Factors influencing population changes - Migration, death, birth, governmental policy

4.4.0 Settlements

4.4.1 Concept of settlement
Linear Settlement - is a pattern of settlement where homes are along a road or railway system
Nucleated Settlement - is a pattern of settlement where homes are situated close to each other
Scattered Settlement - is a pattern of settlement where homes are situated far apart
Migration - is the movement of people from one region to another

4.4.2 Growth of settlements
Settlement patterns are influenced by - **Physical Factors**: Climate/soil/topography, biological factors: pests/diseases/vegetation, **Political Factors**: War/policies/economics/culture

**Explain the basic factors involved in setting up rural settlements** - Availability of land and economic activities, climate, availability of water sources, vegetation, topography, pests/diseases, safety

**Functions in an urban settlement** - Administrative and economic centres, defensive functions, provision of higher education/health services, production centres, markets, entertainment, financial services

**Negative impacts of rural-urban migration** - Depopulation, failure of local economic activities, shortage of food production, breaking of family ties, environmental pollution in urban areas, unemployment, inadequate social services, increase in crime in urban areas as people struggle to survive

**Main factors causing rural to urban migration** - Absence of employment opportunities, land shortage, poor health services in rural areas, poor infrastructure, poor educational services, low income

Pure Nomadic Pastoralism - Pastoralists have no permanent residence and are in constant movement grazing from one place to another

Semi-nomadic Pastoralism - Farmers have permanent residence but during the dry season they travel long distances to look for pasture and water, have some level of cultivation to supplement income/food

The disadvantages of nomadic pastoralism in northern Kenya - Contributes to soil erosion from movement of herds, desertification from eating vegetation, does not allow farmers to settle, source of conflict between farmers and nomads over land use, animal diseases spread easily

Characteristics of nomadic pastoralism in East Africa - Not confined to a single area, animals are for subsistence purposes, poor health of animals, causes soil erosion/desertification, conflict between pastoralists and farmers, requires little capital

How to improve pastoralism in East Africa - Provision of education to farmers of modern ways of keeping livestock, adopt a range system to avoid desertification and soil erosion, provide health services to animals, provide storage facilities to farmers and livestock producers, improve transportation, have separate land for farmers and pastoralists

Factors which cause the different types of internal migration - More developed areas have more job opportunities, low agricultural productivity, poverty/hunger/underemployment, rapid increase in population, development of projects, government policies, war/violence, better social/health services

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**4.5.0 Environmental issues and management**

**4.5.1 Concept of environment**

Ecosystem - Is a network of living organisms and non-living things interacting with each other

Features adopted by plants to survive in hot deserts - Long roots to penetrate to underground water, succulent leaves and stems for storage of extra water, waxy or needlelike leaves to prevent loss of water, seeds which are dormant for years until rainfall occurs

Cacti - Typical plants of a hot desert area, have long roots, thorny steps, needle shaped leaves, wax or hair

**4.5.2 Importance of environment**

(Not present in exams)

Importance of the environment - Natural resources, human health, farming, tourism, beauty, biodiversity

**4.5.3 Environmental problems**

Environmental problems facing Tanzania - Environmental pollution from industry/agriculture/human activities, desertification, soil erosion, land degradation, deforestation from economic activities like charcoal production, loss of biodiversity

Examples of environmental hazards - Earthquakes, floods, bush fires, drought, volcanic eruption, tsunami, pollution, environmental degradation, desertification, deforestation

Environmental Degradation - The gradual or rapid decline of the quality of the environment required for animals or plants to live

Environmental Hazards - Are toxic materials or incidences which are harmful to humans or other animals, they can be caused by human activity or by natural occurrences

Acid Rain - Is rain which results from the mixture of moisture in the air with oxides of nitrogen and sulfur forming nitric acid, sulphuric acid, and carbonic acid

Effects of acid rain - Death of plants and animals, fills lakes/rivers/dams with acidic water, reduces quality of soil for agriculture, speeds up the rate of erosion of rocks, causes corrosion of infrastructure

Deforestation - The excessive massive cutting down of trees by humans for economic activity

Forestry - Is an economic activity which deals with the production of wood products and cutting of forests

**4.5.4 Environmental conservation**
Measures taken to solve environmental problems in Tanzania - Environmental education in schools/colleges/universities, reforestation, protection of national forests, laws, restriction of harmful chemicals, restrictions on hunting

Ways to avoid environmental degradation in Central Tanzania - Afforestation and reforestation, destocking, proper farming methods, alternative sources of fuel (non charcoal), encourage irrigation, diversify economic activities, increase education

Explain soil conservation measures in Kondoa District - Destocking, crop rotation, afforestation, reforestation, intercropping, filling gullies with brushwood

Causes of the loss of biodiversity - Human activities like agriculture or industry, expansion of grazing land into new habitats, urbanization, overexploitation of forests/oceans, fishing with dynamite, pollution

Biodiversity - Refers to the variety of life on earth in all its forms

Coniferous - They are cone-bearing seed plants with vascular tissue; all extant conifers are woody plants, the great majority being trees with just a few being shrubs

Deciduous - Consists of broad leaves and are found in temperate regions