

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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Geography

Form 1

- 1.1.0 Concept of geography
 - 1.1.1 Meaning of geography phenomena
 - 1.1.2 Importance of geography
- 1.2.0 The solar system
 - 1.2.1 The concept of a solar system
 - 1.2.2 The sun
 - 1.2.3 Solar energy
 - 1.2.4 The planets
 - 1.2.5 Other bodies in the solar system
 - 1.2.6 The Earth
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- 1.3.0 Major features of the earth's surface
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- 1.6.0 Map work
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 - 2.1.2.1 Small scale agriculture
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 - 2.3.1 Types of forestry resources
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- 2.7.0 Sustainable use of power and energy resources
 - 2.7.1 Define power and energy
 - 2.7.2 Major sources of power
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 - 2.7.5 Problems facing power and energy production
 - 2.7.6 Focal studies on wind and solar power in the USA and HEP and biogas in Tanzania
- 2.8.0 Transport
 - 2.8.1 Main types of transport
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 - 2.8.3 Problems facing the transport industry
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Form 3

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 - 3.1.2 Types of rocks of the earth's crust
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- 3.2.0 Forces that affect the earth
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 - 3.2.2.3 Earthquakes
 - 3.2.3 External forces
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 - 3.2.3.3 Erosion and deposition by water, ice, wind and wave action
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	Form 4
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	4.5.2 Importance of environment
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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)

Order of the planets -

1. Mercury	2. Venus	3. Earth	4. Mars
5. Jupiter	6. Saturn	7. Uranus	8. Neptune

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

Earth's 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 30° and 35° 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**

Stratosphere
Mesosphere
Thermosphere
Exosphere

- Highest

1.4.2 Elements of weather

How to calculate Fahrenheit and Celsius -

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

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

Types of rainfall - Convictional rainfall, cyclonic rainfall, orographic rainfall

Convictional 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 when 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 Earth's 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

(Not present in exams)

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

Isobeth - 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 fish 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 floods, 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, 76°E at 4:30 pm. What would be the time for a town at Greenwich Mean Time (GMT)?

<p>Step 1: Find the difference in degrees of latitude $76^\circ - 0^\circ = 76^\circ$</p> <p>Step 2: Find the difference in time. Divide the difference of degrees of latitude by 15 $15^\circ = 1 \text{ hour}$ $x = 76^\circ$</p> $\frac{76}{15}$ <p>$x = 5\frac{1}{15} \text{ hours}$</p>	<p>Step 3: Change the fraction into minutes. Multiply the fraction by 60 since 1 hour is 60 minutes</p> $\frac{1}{15} * 60$ $x = 4 \text{ min}$ <p>Step 4: Find the difference. Moving west is subtraction, moving east is addition <i>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</i></p> $4:30\text{pm} - 5:04 = \mathbf{11:26 \text{ am}}$
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2. If the time at Place X, 45° E is 10:00 am, what will be the time at Place Y, 45° W?

<p>Step 1: Find the difference in degrees of latitude <i>Since one place is east and one is west, the numbers are added, this is because they lie on opposite sides of the GMT</i></p> <p>E + W $45^\circ + 45^\circ = 90^\circ$</p> <p>Step 2: Find the difference in time. Divide the difference of degrees of latitude by 15 $15^\circ = 1 \text{ hour}$ $x = 90^\circ$</p>	$\frac{90}{15}$ <p>$x = 6 \text{ hours}$</p> <p>Step 3: Change the fraction into minutes <i>In this problem there are no fractions to convert</i></p> <p>Step 4: Find the difference, moving west is subtraction, moving east is addition $10:00\text{pm} - 6 \text{ hours} = \mathbf{4\text{pm}}$</p>
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3. Micheweni is at sea level and has a temperature of 32°C. What is the temperature of Karatu at 1500m above sea level?

<p>Step 1: Find the difference in altitude $1500\text{m} - 0\text{m} = 1500\text{m}$</p> <p>Step 2: Use temperature lapse rate to calculate temperature Temperature Lapse Rate: $100\text{m} = 0.6^\circ \text{C}$</p> <p>x is the difference in altitude from step 1 $x = 1500\text{m}$</p> <p>Step 3: Multiply the left sides together and right sides together of each equation</p> <p>Equation 1: $x = 1500\text{m}$ Equation 2: $100\text{m} = 0.6^\circ \text{C}$</p>	<p>Final Equation: $100x = 0.6^\circ \text{C} * 1500\text{m}$</p> <p>Step 4: Isolate x on the left side of the equation by dividing by 100 $100x = 0.6^\circ \text{C} * 1500\text{m}$ $x = \frac{0.6^\circ \text{C} * 1500\text{m}}{100\text{m}}$ $x = \mathbf{9^\circ \text{C}}$</p> <p>Step 5: Take x and subtract from the temperature of Micheweni, you subtract because Karatu has a higher altitude $32^\circ \text{C} - 9^\circ \text{C} = \mathbf{23^\circ \text{C}}$</p>
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4. What is the longitude of Morogoro if its local time is 10:00 pm, whereas the longitude of Accra in Ghana is 0° and the local time is 7:00pm?

<p>Step 1: Calculate the difference in time $10:00\text{pm} - 7:00\text{pm} = 3 \text{ hours}$</p> <p>Step 2: Find the difference in degree. Multiply the</p>	$x = 15^\circ * 3 \text{ hours}$ $x = \mathbf{45^\circ}$
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number of hours by 15

15° = 1 hour

x = 3 hours

Since Morogoro is East of Ghana, the longitude of Morogoro is **45° 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

Asthenosphere - 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

Internal forces operating in the Earth - Diastrophic 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 (orogenesis)

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, solfatara, 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 volcanicity - 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, fumarole, 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 which erupts frequently

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, mans 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 - Steeper 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) - Scarps, 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

Scarps/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), deferred 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 corrosion, 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

The erosive power of a river depends mainly upon its volume and speed

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-shaped 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 (gloop), 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 - Submergent coasts, emergent coasts, stable coasts, compound coasts

Submergent 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 - Mountaintop 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 moutonnée

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 Moutonnée - 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/pans), 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 - 225°
ESE - 112.5 °

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

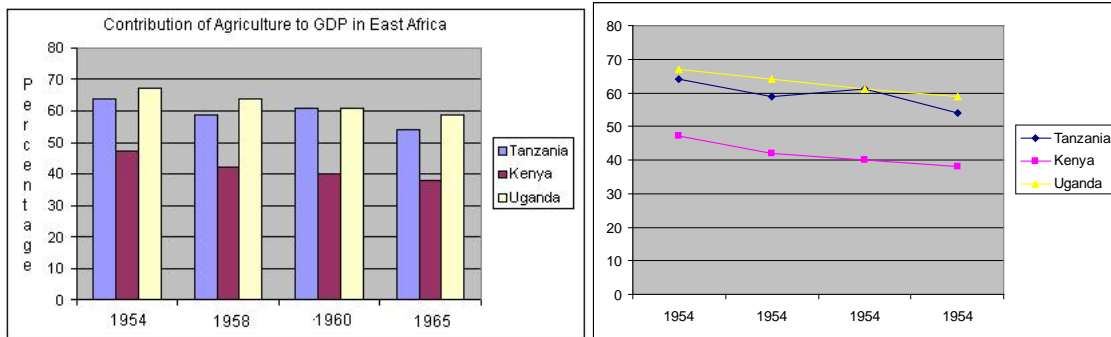
3.7.2 Simple statistical measurement and interpretation

1. Use the following data to draw a group bar graph:

Contribution of Agriculture to the Gross Domestic Product (GDP) in East Africa (in percentage)

Year	Tanzania	Kenya	Uganda
1954	64	47	67
1958	59	42	64
1960	61	40	61
1965	54	38	59

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.



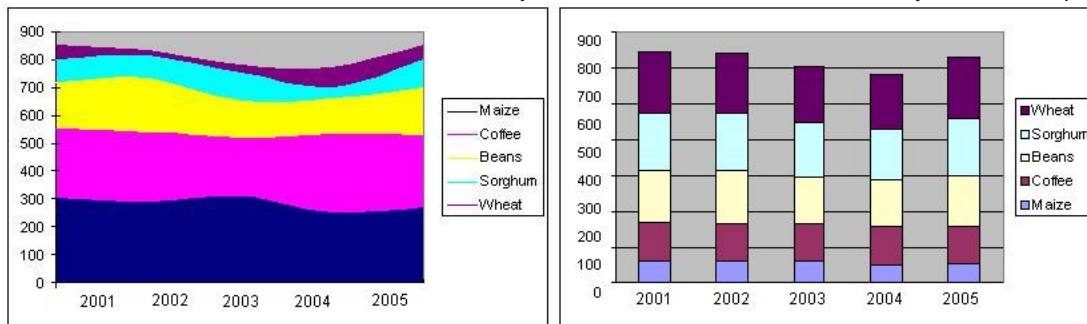
Advantages - Enable easy comparisons, easy to interpret, no complicated calculations, detailed, contrasts clearly, gives visual impression about the totality

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

Year	Maize	Coffee	Beans	Sorghum	Wheat
2001	300	550	720	800	850
2002	290	540	530	810	830
2003	310	520	650	750	780
2004	250	530	660	700	770
2005	270	525	700	800	850

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

Year	Number of students
1980	100
1981	150
1982	175
1983	200
1984	225
1985	300

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

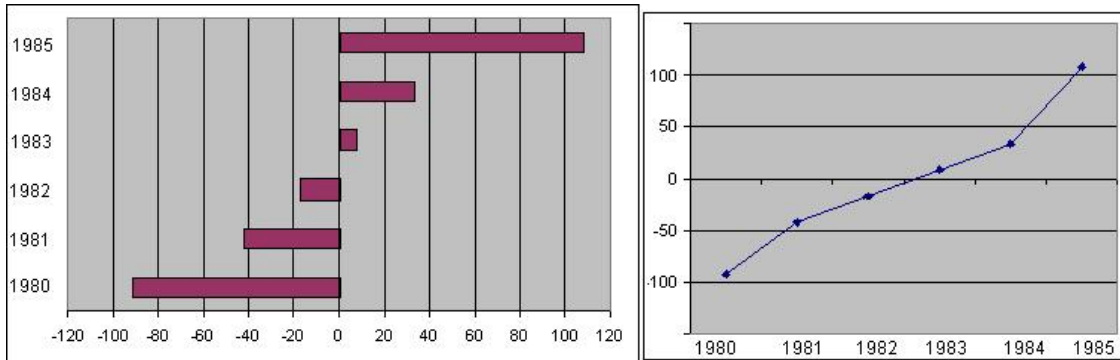
$$200 - 191.7 = 8.3$$

Year	No of Students	Mean Deviation
1980	100	-91.7
1981	150	-41.7
1982	175	-16.7
1983	200	8.3
1984	225	33.3
1985	300	108.3

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

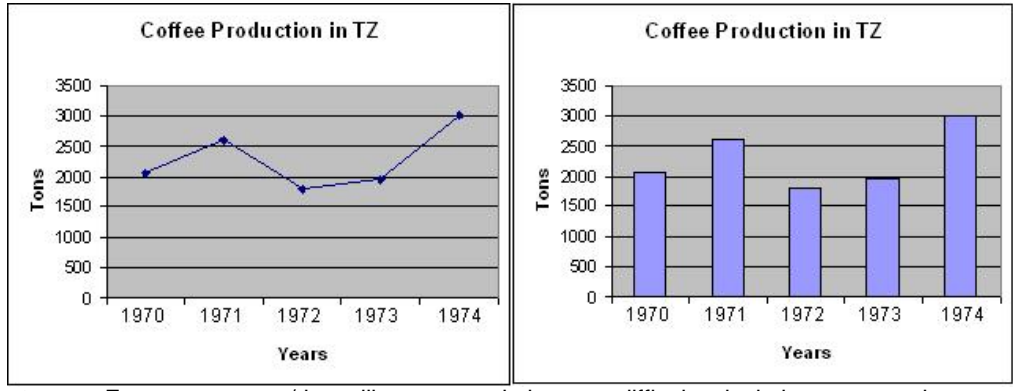


4. Construct a line graph and bar graph from the data below and discuss the definition of a line graph as well as its main types

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

Year	1970	1971	1972	1973	1974
Coffee Production (Tons)	2050	2600	1800	1950	3000



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

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

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

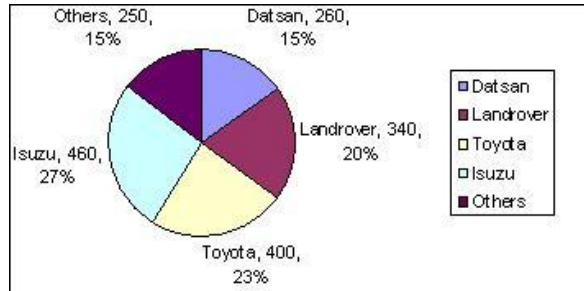
Step 1: Calculate the sum total of angles. Add up the values in the Total row.

$$260 + 340 + 460 + 400 + 250 = 1710$$

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

Ex. Datsan

$$\frac{260}{1710} * 360^\circ = 54.7^\circ$$



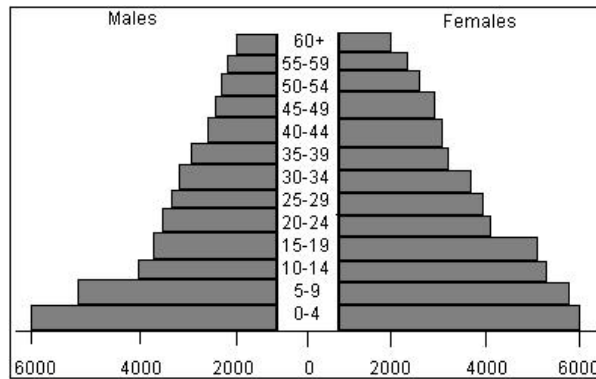
Advantages - Easy to interpret, easy to construct, illustrates statistical information accurately, gives a good visual representation, useful for comparing various commodities/sectors/items

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.

Age	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
Male	6000	5000	4000	3700	3500	3400	3200	3100	3000	2800	2400	2000	1700
Female	6000	5800	4500	4200	4000	3900	3700	3600	3500	3200	3000	2500	2200



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, 23, 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, 22, 23, 26, 27, 30

Finding the Mean (Average)

Step 1: Sum all numbers

$$\sum \text{nums} = 475$$

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 Mode

Step 1: Find the value with the highest frequency

Mode = 22, it was found 6 times

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

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

How to calculate the values found in the table above:

Class Interval

- Chosen with a class size of 5

F is the frequency of numbers

- Found by looking at the ordered data

X is the average of each class level

Ex. Class 10-14

$$X = 12$$

$$XF = 4 * 12 = 48$$

X² is the square of X

Ex. Class 10-14

$$X = 12$$

$$X^2 = 12^2 = 144$$

FX² is the product of F times X²

$\frac{10 + 14}{2} = 7$ <p>FX is the product of F times X <i>Ex. Class 10-14</i> F = 4</p>	<i>Ex. Class 10-14</i> F = 4 $X^2 = 144$ $F * X^2 = 4 * 144 = 576$
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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

$$\begin{aligned} \sum f &= 30 \\ \sum fx &= 475 \\ \sum fx^2 &= 9405 \end{aligned}$$

Formula 1	Formula 2
$SD = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$	$SD = \sqrt{\frac{\sum fx - \frac{(\sum fx)^2}{n}}{n - 1}}$
$SD = \sqrt{\frac{9405}{30} - \left(\frac{475}{30}\right)^2}$	$SD = \sqrt{\frac{9405 - \frac{(475)^2}{30}}{30 - 1}}$
$SD = \sqrt{313.5 - (15.5)^2}$	$SD = \sqrt{\frac{9405 - 7520.8}{29}}$
$SD = \sqrt{63.6}$ <p>SD = 7.9</p>	$SD = \sqrt{64.9}$ <p>SD = 8.0</p>

Form 4

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, sensitize 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 ratio, 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

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 stems, 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 Kondo 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