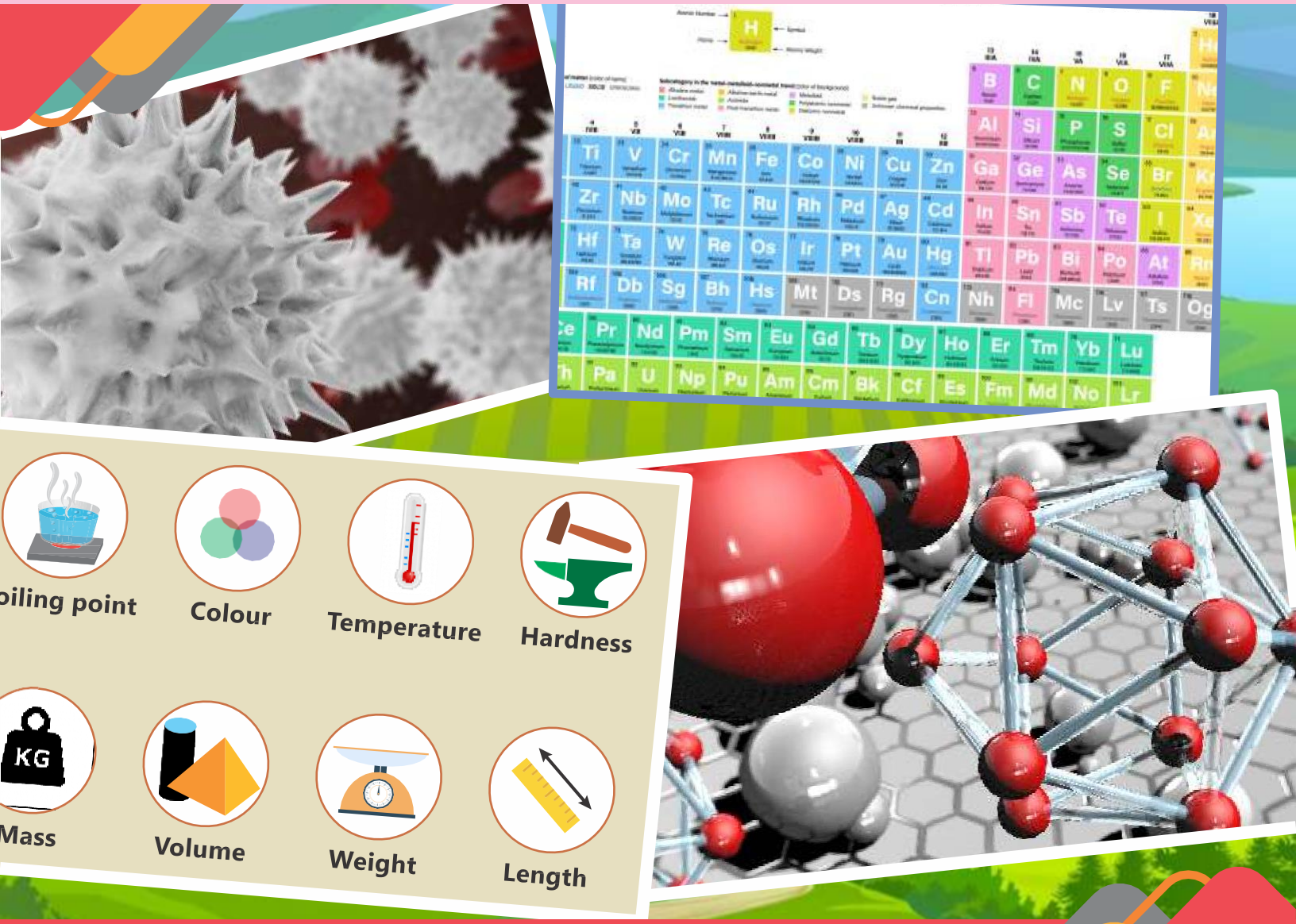
AFAQ SUN SERIES

Based on National Curriculum 2022

KEYBOOK

Science

GRADE 7



Term 1 Periodic Unit 1
Unit 1: Plant Systems

A. Choose the correct option.

1. Plants get all the energy they need to make food from the:
   a. moon
   b. sky
   c. soil
   d. Sun
   The correct answer is d.
2. The site for photosynthesis is:
   a. leaves
   b. roots
   c. stem
   d. flowers
   The correct answer is a.
3. Which one of the following do plants need to respire at night?
   a. water
   b. oxygen
   c. nitrogen
   d. carbon dioxide
   The correct answer is b.
4. Which one of the following supplies water to a plant?
   a. mesophyll
   b. xylem
   c. phloem
   d. cuticle
   The correct answer is b.
5. The mineral required for protein formation is:
   a. magnesium
   b. calcium
   c. nitrogen
   d. potassium
   The correct answer is c.
6. The statement that represents translocation is:
   a. absorption of water by roots and its movement through the xylem to leaves

b. loss of water from leaves as it evaporates into the air
c. movement of sucrose from leaves through phloems to the other parts of the plant
d. plants use the food produced by photosynthesis to obtain energy

The correct answer is c.

7. Chlorophyll is a green pigment that is important for:
   a. protection of cells
   b. transport of materials
   c. making food
   d. storage of food

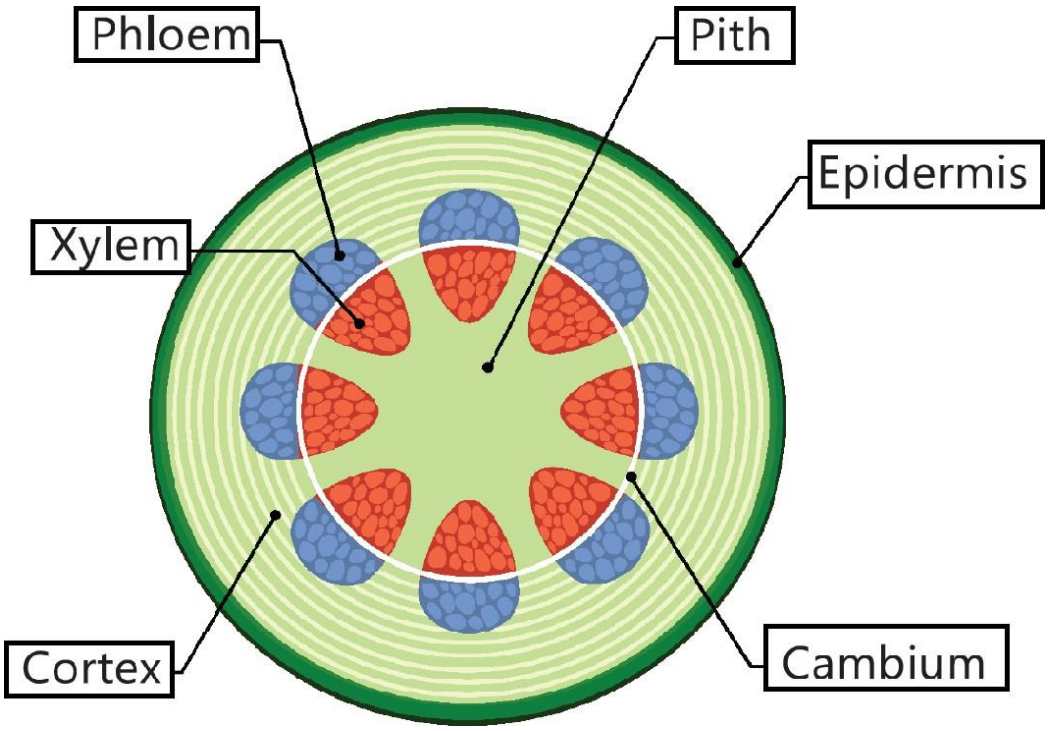
   The correct answer is c.
8. Transport of food to all parts of a plant is the job of:
   a. xylem cells
   b. phloem cells
   c. root cells
   d. stem cells

   The correct answer is b.
9. Most photosynthesis takes place in the:
   a. epidermis
   b. mesophyll
   c. stomata
   d. cuticle

   The correct answer is b.
10. Pith is the central part of:
    a. stems
    b. roots
    c. flowers
    d. leaves

    The correct answer is a.

B. Label the diagram of the internal structure of a stem.



C. Constructive response questions.

i. What are the sources of carbon dioxide and water? Explain how carbon dioxide and water reach leaves.

Answer:

Carbon dioxide gas and water both are used by plants during photosynthesis to produce glucose and oxygen gas.

Sources of carbon dioxide and water

Carbon dioxide is produced by living organisms during respiration, decomposition, and human activities. Water is present in various forms on Earth including oceans, lakes, rivers, groundwater, and water vapour.

In plants

To reach the leaves of a plant, both carbon dioxide and water are transported through the plant's vascular system. The roots of the plant absorb water from the soil and transport it through the xylem to the leaves.

Carbon dioxide enters the leaves of the plant through small pores called stomata present on the surface of the leaves.

ii. Describe the structure and function of the chloroplast.

Answer:

Chloroplasts are organelles found in plant cells. The structure and function of chloroplasts are closely related to their role in photosynthesis.

Structure of chloroplast

Chloroplasts have a double membrane structure that encloses a gel-like substance called the stroma. Within the stroma, there are thylakoid membranes that form a series of flattened, stacked discs called grana. The thylakoid membranes contain chlorophyll, which captures light energy during photosynthesis.

Function of chloroplast

The primary function of chloroplasts is to conduct photosynthesis, the process by which plants produce glucose and oxygen gas using sunlight, carbon dioxide, and water. Chloroplasts absorb sunlight through chlorophyll. The absorbed light energy is used to convert carbon dioxide and water into glucose, which is used by the plant for energy and growth. This process releases oxygen into the atmosphere.

iii. Nitrogen is a very important mineral. What is the role of nitrogen in plant growth?

Answer:

Role of nitrogen

The role of nitrogen in plant growth can be summarized as follows:

- Nitrogen is a key component of amino acids, which are the building blocks of proteins. Proteins are essential for cell division, growth, and repair in plants.
- Nitrogen is a major component of chlorophyll, the pigment that gives plants their green colour. Chlorophyll is essential for photosynthesis, the process by which plants produce their food.
- Nitrogen is also required for the synthesis of enzymes, which are essential for many metabolic processes in plants.
- Adequate nitrogen availability can increase plant biomass, leading to larger leaves, stems, and roots.

D. Answer the following questions briefly.

1. Differentiate between the xylem and phloem.

   Answer:

   Differences between the xylem and the phloem are:

Xylem	Phloem
Xylems are tubular-shaped structures that do not have cross walls.	Phloems are elongated tubular structures that have walls within their sieve tubes.
They pull water and minerals from the roots to the leaves of the plants.	They transport the prepared food to all parts of the plant.
The movement of water and minerals in the xylem is unidirectional.	The movement of the prepared food in the phloem is bidirectional.

2. What do mesophyll tissues do for plants?

   Answer:

   Mesophyll tissues are the main site for photosynthesis. They contain chloroplasts in them. The chloroplasts contain chlorophyll that gives green colour to the leaves. Chlorophyll captures sunlight and it helps in making food for plants.

3. What is the effect of transpiration pull?

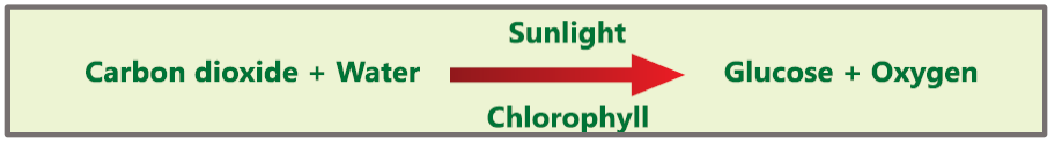
   Answer:

   Transpiration pull is the strong force that pulls water from the soil and moves upwards from the roots to the leaves. It maintains the water balance in plants. It also keeps plants cool by evaporating water.

4. Write the word equation for photosynthesis.

   Answer:

   The word equation for photosynthesis is:

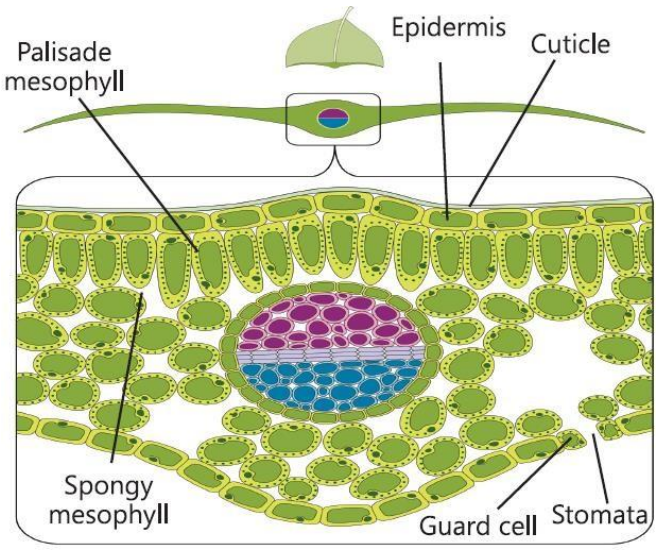


E. Investigating questions.

1. Draw the internal structure of a leaf and justify why leaves play a key role in photosynthesis.

Answer:

The labelled diagram of the internal structure of a leaf is given below:



Role of leaves in photosynthesis

Leaves play a key role in photosynthesis because they are the primary site of this process in most plants.

- Leaves have greater surface area for maximum reception of sunlight.
- Chloroplasts in leaves contain chlorophyll to capture light energy and make food for plants.
- The mesophyll layers of the leaf contain a large number of chloroplasts, making them highly efficient at photosynthesis.
- The stomata in the epidermis of the leaf allow for the exchange of carbon dioxide and oxygen, which are essential for photosynthesis to occur.
- Leaves play a crucial role in regulating the balance of gases in the atmosphere by taking in carbon dioxide and releasing oxygen.

The internal structure of a leaf and its high concentration of chloroplasts make it an ideal site for photosynthesis to occur, which is essential for plant growth and the production of oxygen in the atmosphere.

2. Place a cut stem in the coloured water. After three hours, cut the stem horizontally and tell which region of the stem is strained.
   Answer:
   When a cut stem is placed in coloured water, the stem absorbs the water through the process of osmosis. The coloured water travels through the xylem of the stem, and after three hours, the xylem region of the stem seems to be strained.
   The stem is strained at the bottom which indicates that the region of the stem responsible for transporting water and dissolved nutrients, i.e., the xylem, is strained. This is because the coloured water is transported up the stem through the xylem tissue, and stains the xylem tissue in the stem. Hence, by cutting the stem horizontally and observing the staining pattern, one can determine the location of the xylem tissue in the stem.

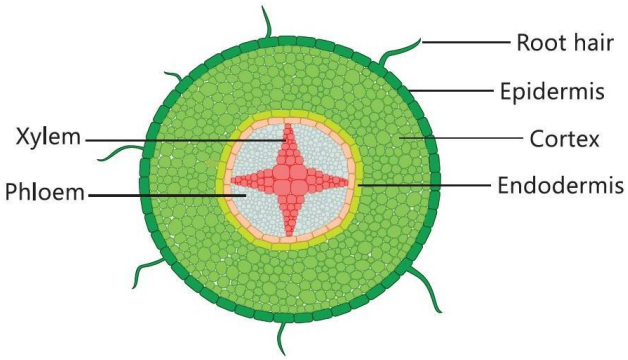
3. Imagine what would happen if plants were unable to use carbon dioxide during photosynthesis.
   Answer:
   If plants were unable to use carbon dioxide during photosynthesis, the entire process of photosynthesis would be hindered. Carbon dioxide is one of the essential components required for photosynthesis to occur. Plants would not be able to produce glucose, which is used as an energy source for growth and other metabolic processes. This would eventually lead to a decrease in the plant's overall growth rate and yield.
   Moreover, the unavailability of carbon dioxide would also have an extensive effect on the ecosystem. Since plants are the primary producers in the ecosystem, any interruption in their growth would ultimately affect the entire food chain, leading to a decline in the population of other organisms.

F. Answer the following questions in detail.

1. Explain the internal structure of a root using a diagram.
   Answer:
   Root
   Roots are the structure of the plant that grows below the ground. They anchor plants in the soil. They absorb water and minerals from the soil for the growth and development of the plants.
   The internal structure of the root has the following parts:

- Epidermis
- Endodermis
- Root hair
- Cortex
- Vascular bundles

Epidermis: It is the outermost layer of the root. It protects the root and contains root hairs.
The cortex: It is the largest cell region with multiple layers. It helps in storing food and water in it. It also helps in supporting the plant.
Endodermis: It is the innermost layer of the cortex. It protects the plant against bacteria moving into the vascular system. It controls the movement of water and minerals in and out of the vascular bundles.
Root hairs: These are responsible for absorbing water and nutrients from the soil. They increase the surface area for the absorption of water and nutrients.
Vascular bundles: These are comprised of the xylem and phloem. These are responsible for transporting water, minerals, and sugar to all the other parts of the plant.
The labelled diagram of the internal structure of the root is given below.



2. Derive an equation to show how plants break down food to produce energy during respiration. Also, describe the importance of respiration in our lives.
Answer:
Respiration in plants
It is the process of converting glucose into energy. This process takes place in the mitochondria of cells. In this process, plants use oxygen to break down glucose into water, carbon dioxide, and energy.

We can write this process as below:

Glucose + Oxygen → Carbon dioxide + Water + Energy

During respiration, the energy released is used by plants to perform various activities. Carbon dioxide and water are produced as by-products that leave the plant through its stomata.

Importance of respiration

During respiration, plants break food (glucose) down into smaller particles to get energy from it. This energy can be used to perform various activities such as growth, photosynthesis, and transport of water and minerals. Respiration is very important for plants. If they cannot respire, they will be unable to get energy from food. All activities inside the plants will stop and they will die eventually.

3. Predict what will happen if plants do not get nitrogen and magnesium. How can we provide them with these minerals?

Answer:

If plants do not get nitrogen and magnesium, it will affect their growth and development, and they may show signs of nutrient deficiency.

Importance of nitrogen in plants

Nitrogen is essential for the formation of proteins, nucleic acids, chlorophyll, and other essential molecules in plants. A lack of nitrogen can cause stunted growth, yellowing of leaves, and reduced productivity.

Importance of magnesium in plants

Magnesium is a vital component of chlorophyll, which is responsible for capturing light energy during photosynthesis. A lack of magnesium can lead to chlorosis or yellowing of the leaves, particularly between the veins.

Availability of nitrogen and magnesium for plants

We can provide nitrogen and magnesium to the plant in the following ways:

- We can use fertilizers to provide plants with nitrogen and magnesium. Fertilizers are compounds that are added to the soil to provide essential nutrients to plants.
- Nitrogen can be added to the soil in the form of ammonium nitrate or urea, while magnesium can be added in the form of magnesium sulfate or dolomite lime.

- Alternatively, we can use organic sources of nitrogen and magnesium. Compost, manure, and other organic matter can be added to the soil to improve soil fertility and provide essential nutrients to plants.
- It is also essential to maintain the correct pH of the soil, as nutrient availability is affected by soil pH. A pH between 6.0 and 7.0 is optimal for most plants, and adjusting the soil pH can help improve nutrient uptake by plants.

4. Compare and contrast the process of photosynthesis and respiration.
Answer:
Both photosynthesis and respiration are biological processes but they are the exact opposites to each other. A comparison is given in the table.

Photosynthesis	Respiration
Photosynthesis is the process by which plants and other autotrophs convert light energy into chemical energy (glucose).	Respiration is the process by which all living cells break down glucose to release energy.
It takes place in the presence of sunlight.	It takes place all the time.
Carbon dioxide + Water → Glucose + Oxygen	Glucose + Oxygen → Carbon dioxide + Water + Energy
It only occurs in plants.	It occurs in all organisms.
It synthesizes food for plants.	It breaks down food to provide energy to plants.
Its by-product is O_2.	Its by-products are CO_2 and H_2O.

5. Explain the shoot system and the role of the stem in the shoot system.
Answer:
Shoot system
The system contains the parts of the plant that grow above the soil such as the stem, leaves, flowers, and fruit is known as the shoot system.
Stem
The stem provides support to the plant. It bears leaves, flowers, and fruit. The stem has the following parts:

- Epidermis
- Cortex
- Vascular bundles
- Cambium
- Pith

Role of the stem in the shoot system

The different parts of the stem play the following role in the shoot system.

Epidermis: A single layer of cells that protect the stem is called the epidermis. It is the outer layer of the stem.

Pith: The large central area for storage and support in the stem is the pith.

Cambium: Cambium is present in the inner stem. It forms secondary tissues for support.

Cortex: The area between the cambium and epidermis is the cortex.

Xylem: Xylem is a tissue that conducts water from the roots to the leaves.

Phloem: Phloem conducts food usually down towards the root.

Term 1 Periodic Unit 1
Unit 2: Human Respiratory and Circulatory System

A. Choose the correct option.

1. Where does the gaseous exchange take place in the respiratory system?
   a. bronchus
   b. bronchioles
   c. alveoli
   d. trachea
   The correct answer is c.
2. Blood is supplied to cells through the:
   a. digestive system
   b. respiratory system
   c. circulatory system
   d. excretory system
   The correct answer is c.
3. Arteries and veins are linked with:
   a. valves
   b. capillaries
   c. muscles
   d. bones
   The correct answer is b.
4. The heart pumps oxygen-rich blood to the body through its:
   a. left side
   b. right side
   c. upper side
   d. lower side
   The correct answer is a.
5. The correct statement about the respiratory system is:
   a. It provides the body with carbon dioxide.
   b. It maintains the number of breaths per minute.
   c. It supplies oxygen to body tissues.
   d. It supplies oxygen and carbon dioxide to body tissues.
   The correct answer is c.
6. The correct statement about capillaries is:
   a. They are connected to veins only.

b. They are connected to arteries only.
c. They transport both oxygenated and deoxygenated blood.
d. They have thin walls and a large lumen.

The correct answer is c.

7. Which of the following makes the immune system of our body?
   a. red blood cells
   b. white blood cells
   c. platelets
   d. plasma

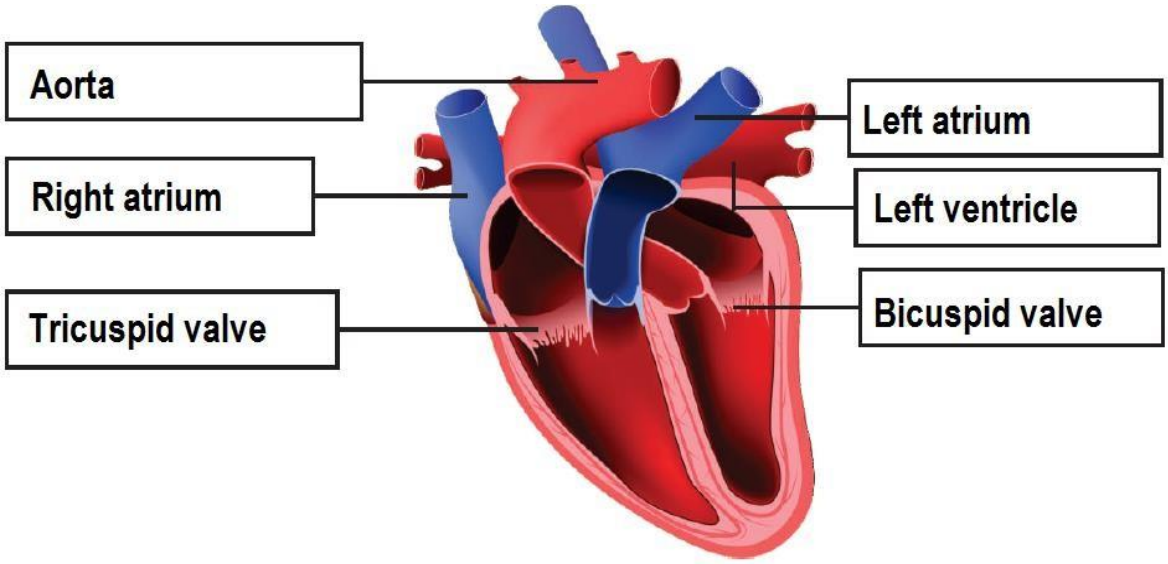
   The correct answer is b.
8. The organ which is involved in both the digestive and respiratory systems is the:
   a. nose
   b. pharynx
   c. larynx
   d. trachea

   The correct answer is b.
9. The organ in which oxygen is mixed with haemoglobin is the:
   a. kidney
   b. liver
   c. lung
   d. heart

   The correct answer is c.
10. Which of the following is/are not part of the respiratory system?
    a. lungs
    b. oesophagus
    c. pharynx
    d. larynx

    The correct answer is b.

B. Label the different parts of the heart and write their functions.



Parts	Functions
Aorta	It transport oxygenated blood from heart to all parts of the body.
Right atrium	It receives deoxygenated blood from the body.
Tricuspid valve	It prevents the backflow of blood into the right atrium.
Left atrium	It receives oxygenated blood from the lungs.
Left ventricle	It pumps oxygenated blood to the body via the aorta.
Bicuspid valve	It prevents the backflow of blood into the left atrium.

C. Constructive response questions.

i. How many litres of blood are found in an adult human body? What is the composition of blood? If platelets are decreasing, what would happen to the human body?

Answer:

An average adult human body contains approximately 5-6 liters of blood.

Composition of blood

The composition of blood includes plasma, red blood cells, white blood cells, and platelets. Plasma is a yellowish fluid that makes up about 55% of blood volume, while the formed elements, including red blood cells, white blood cells, and platelets, make up the remaining 45%.

Effects of decrease in platelets

If platelets are decreasing, it causes a condition called thrombocytopenia. It can lead to excessive bleeding and bruising through different parts of the body. This is because platelets play a crucial role in blood clotting and preventing bleeding. Severe cases of thrombocytopenia can lead to internal bleeding and haemorrhage, which can be life-threatening.

ii. Explain the structure of the lungs.

Answer:

Lungs

The lungs are a pair of spongy, air-filled organs located in the chest cavity. In humans, the left lung is slightly smaller than the right lung to accommodate the heart in the cavity. They are covered with a thin membrane. They are responsible for the exchange of gases between the atmosphere and the blood.

Structure of lungs

The structure of the lungs can be described as follows:

Bronchi and bronchioles: The trachea branches into two tubes called the bronchi, one for each lung. The bronchi then divide into smaller and smaller tubes called bronchioles, which eventually lead to the air sacs or alveoli.

Alveoli: The alveoli are tiny, grape-like sacs within the lungs where gas exchange occurs. Oxygen from the air diffuses into the blood in the capillaries surrounding the alveoli, and carbon dioxide from the blood diffuses into the alveoli to be exhaled.

Pleura: The lungs are surrounded by a thin, double-layered membrane called the pleura. The space between the two layers is called the pleural cavity and is filled with a small amount of fluid that acts as a lubricant, allowing the lungs to expand and contract easily during breathing.

The structure of the lungs is highly specialized for efficient gas exchange, with a large surface area provided by the alveoli and a complex system of airways that bring air to and from the lungs.

iii. Name the blood vessels and explain the functions of each.

Answer:

There are three types of blood vessels in the human circulatory system.

- Arteries
- Veins
- Capillaries

Arteries

These are thick-walled, muscular blood vessels that carry oxygenated blood away from the heart to the various parts of the body. Arteries are strong and have a small lumen. The walls of arteries are elastic, which helps them to withstand the high pressure of blood pumped out by the heart. Arteries branch into smaller vessels known as arterioles. Blood in the arteries flows with high pressure.

Veins

These are thin-walled blood vessels that carry deoxygenated blood from the various parts of the body back to the heart. Veins have a large lumen for the flow of blood cells. Unlike arteries, veins have valves that prevent the backward flow of blood. Veins branch into smaller vessels known as venules. Blood in veins flows with low pressure.

Capillaries

These are the smallest blood vessels in the body and they are found in almost every tissue of the body. They are made up of only a single layer of cells. They are thin-walled and allow the exchange of gases, nutrients, and waste products between the blood and the tissues. Capillaries transport both oxygenated and deoxygenated blood. Capillaries connect arterioles and venules and form a network of blood vessels called capillary beds.

D. Answer the following questions briefly.

1. Differentiate between the process of breathing and respiration.

Answer:

Differences between breathing and respiration are:

Breathing	Respiration
Breathing is a physical process in which oxygen moves in and	Respiration is a biochemical process in which a food molecule

carbon dioxide moves out of the body through the nose.	is broken down in the presence of oxygen and energy is released from it.
Breathing occurs in the lungs.	Respiration occurs in the cells of the body.
The main purpose of breathing is to supply oxygen to the body and remove carbon dioxide from it.	The purpose of respiration is to produce energy for the body's functions.

2. Compare veins and arteries.
   Answer:
   Veins and arteries are blood vessels. A comparison between veins and arteries is given below.

Veins	Arteries
Veins carry deoxygenated blood toward the heart.	Arteries carry oxygenated blood away from the heart.
Bold in veins flow with low pressure.	Blood in arteries flows with high pressure.
They have thinner walls and large lumen.	They have thicker walls and a small lumen.

3. Predict what would happen if the valves between the atria and ventricles do not work properly.
   Answer:
   If the valves between the atria and ventricles do not work properly, the blood will flow back into the atria during pumping.

4. What prevents the mixing of oxygenated and deoxygenated blood in the heart? Infer your answer.
   Answer:
   Septum prevents the mixing of oxygenated and deoxygenated blood in the heart.

5. Ali took part in a racing competition, but during practice, he felt out of breath after covering a short distance. Why do you think this happened?
   Answer:
   If Ali is not regularly engaging in physical activities and doesn't have good cardiovascular fitness, it could be a reason for his feeling out of breath.

E. Investigating questions.

1. What is the role of blood cells? Predict what would happen if you do not have cells in the blood.
   Answer:
   Red blood cells, white blood cells, and platelets are the cells in the blood.
   Role of blood cells
   Blood cells have various roles in the body, including:
   - Red blood cells carry oxygen from the lungs to the body's tissues and transport carbon dioxide from the tissues back to the lungs.
   - White blood cells help the body fight against infections and diseases by destroying bacteria, viruses, and other foreign substances in the body.
   - Platelets are responsible for blood clotting which prevents excessive bleeding.

   Lack of blood cells in the body
   If there are no cells in the blood, it would not be able to perform these vital functions, and the body would be unable to transport oxygen, fight infections, and prevent excessive bleeding. This could lead to severe health complications and even death.

2. Investigate the change in the heart rate in different situations. Why does the heart rate change while we are resting and during exercise?
   Answer:
   Heart rate
   The heart rate is the number of times the heart beats per minute.
   Common situations affecting the heart rate
   Heart rate can vary depending on the situation, and it is controlled by the autonomic nervous system. Here are some common situations that can affect heart rate:

Resting: When we are resting, the heart rate is usually between 60 and 100 beats per minute. This is because the body requires less oxygen and nutrients.
Exercise: When we exercise, the heart rate increases to supply more oxygen and nutrients to the muscles. The heart rate can increase up to 150-200 beats per minute during intense exercise. This is because the muscles need more oxygen to produce energy, and the heart has to work harder to deliver it.
Stress: When we are under stress, the heart rate can increase due to the release of stress hormones. This prepares the body for the fight-or-flight response.
Illness: Certain illnesses or medical conditions can also affect the heart rate. For instance, fever, anaemia, and thyroid disorders can cause an increase in heart rate, while heart disease and certain medications can cause a decrease in heart rate.

F. Answer the following questions in detail.

1. Differentiate between aerobic and anaerobic respiration.
   Answer:
   Difference between aerobic and anaerobic respiration
   Differences between aerobic and anaerobic respiration are given in the table.

Aerobic respiration	Anaerobic respiration
Aerobic respiration occurs in the presence of oxygen.	Anaerobic respiration occurs in the absence of oxygen.
The word equation for aerobic respiration is: Glucose + Oxygen → Carbon dioxide + Water + Energy	The word equation for anaerobic respiration is: Glucose → Lactic acid + Energy
The end products of aerobic respiration are carbon dioxide and water.	The end product of anaerobic respiration in animals is lactic acid. Bacteria produce methane and hydrogen sulphide as end

	products.
Aerobic respiration occurs in the cytoplasm and mitochondria of the cell.	Anaerobic respiration occurs only in the cytoplasm of the cell.
Aerobic respiration generates a large amount of energy.	Anaerobic respiration generates a small amount of energy.
Gases are exchanged in aerobic respiration.	Gases are not exchanged in anaerobic respiration.
All multicellular organisms such as mammals have aerobic respiration.	Unicellular organisms such as bacteria and yeast use anaerobic respiration. In multicellular organisms, it occurs during heavy activities.

2. Demonstrate the mechanism of respiration in humans.

Answer:

Respiration

Respiration in humans involves the process of inhalation and exhalation, as well as the exchange of gases in the lungs and at the cellular level.

Mechanism of respiration

The mechanism of respiration in humans involves the following process.

Inhalation: The process of breathing air into the lungs is called inhalation. During inhalation, the diaphragm contracts, increasing the volume of the chest cavity and decreasing the air pressure in the lungs. This causes air to rush into the lungs, carrying oxygen with it.

Exchange of gases: In the lungs, oxygen from the air diffuses across the thin walls of the alveoli and into the bloodstream, where it binds to haemoglobin molecules in red blood cells. At the same time, carbon dioxide from the bloodstream diffuses into the alveoli to be exhaled.

Transportation of gases: Oxygen-rich blood is carried away from the lungs by the pulmonary vein and delivered to the heart, which pumps it out to the rest of the body via the aorta. Carbon dioxide-rich blood is carried back to the lungs by the superior and inferior vena cava to be exhaled.

Cellular respiration: In the cells, oxygen is used in a series of chemical reactions to break down glucose and produce energy, a process known as

cellular respiration. Carbon dioxide is produced as a waste product and diffuses out of the cells into the bloodstream, where it is transported back to the lungs for exhalation.

Exhalation: The process of breathing out air from the lungs is called exhalation. During exhalation, the diaphragm relaxes, decreasing the volume of the chest cavity and increasing the air pressure in the lungs. This causes air to be pushed out of the lungs, carrying carbon dioxide with it. Respiration in humans involves the exchange of gases between the lungs and the bloodstream, as well as the transport of oxygen and carbon dioxide to and from the body's cells, where they are used in cellular respiration to produce energy.

3. Describe the structure and function of the heart.

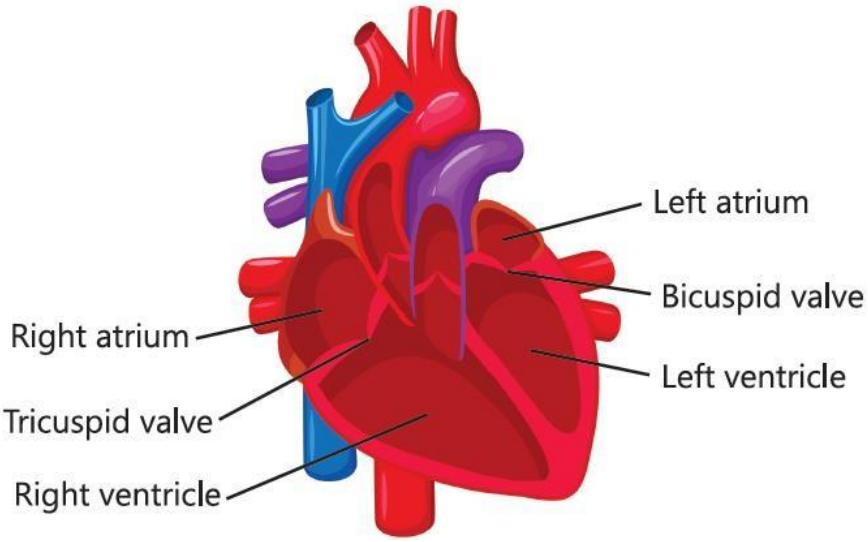
Answer:

Heart

The heart is the major organ in the circulatory system whose job is to pump blood throughout the body. The pumping of the heart produces a heartbeat. It can be measured by placing fingers on the wrist or neck. The throbbing you feel is called the pulse.

Structure of the heart

The heart is a hollow cone-shaped, muscular organ about the size of a fist which is made up of a special muscle called cardiac muscle. It consists of four chambers, two on each side, i.e. left and right. The upper two chambers are called atria (singular atrium), i.e. left and right atria. The lower two chambers are called ventricles, i.e. left and right ventricles. Atria are smaller in size than ventricles. The right side of the heart delivers blood to the lungs, whereas the left side of the heart supplies blood to the different parts of the body. Right-sided chambers are separated from left-sided chambers through a thin wall called a septum to prevent the mixing of blood. Valves connect the atria with the ventricles and prevent the backflow of blood during pumping.



The function of the heart

The heart is responsible for pumping oxygenated blood to the body's tissues and organs and returning deoxygenated blood to the lungs to be reoxygenated.

The heart works in two ways:

- The right atrium receives deoxygenated blood from the body and pumps it into the right ventricle. The right ventricle then pumps the blood to the lungs, where it is re-oxygenated. The oxygenated blood then returns to the left atrium and is pumped into the left ventricle.
- The left ventricle is the largest and most muscular chamber of the heart, responsible for pumping oxygenated blood to the rest of the body through the aorta.

Term 1 Periodic Unit 2
Unit 3: Immunity and Diseases

A. Choose the correct option.

1. A spore is a/an:
   a. antigen
   b. antibody
   c. pathogen
   d. immunoglobin
   The correct answer is c.
2. Tetanus injections develop this type of immunity:
   a. Active
   b. Innate
   c. Passive
   d. Adaptive
   The correct answer is c.
3. Antibodies are produced by:
   a. T cells
   b. B cells
   c. Red blood cells
   d. White blood cells
   The correct answer is b.
4. There are mainly _____classes of pathogens.
   a. 4
   b. 5
   c. 6
   d. 7
   The correct answer is b.
5. Inflammation-producing cells constitute:
   a. the first line of defence
   b. the second line of defence
   c. adaptive immune response
   d. the third line of defence
   The correct answer is b.
6. The disease caused by bacteria is:
   a. scurvy

b. obesity
c. AIDS
d. cholera

The correct answer is d.

7. The body defence that acts as a chemical barrier is:
   a. the mucus lining the airways
   b. antibody production
   c. skin
   d. hair in the nose

   The correct answer is b.
8. A disease-causing organism is called a/an:
   a. phagocyte
   b. antibody
   c. host
   d. pathogen

   The correct answer is d.
9. You catch or spread a viral infection if you:
   a. have handshakes with others
   b. wash your hands
   c. sanitize your hands
   d. wear masks

   The correct answer is a.
10. Our immune system is made up of:
    a. 2 components
    b. 3 components
    c. 4 components
    d. many components

    The correct answer is b.

B. Constructive response questions.

i. A pathogen is a microorganism that causes disease. Pathogens enter our body by direct contact or indirect transmission. Explain the types of indirect transmission.

Answer:

Indirect transmission refers to the transfer of pathogens from an infected individual to a susceptible person through environmental sources. There are several types of indirect transmission of pathogens:

Airborne transmission

Pathogens can be transmitted through the air in the form of droplets or dust particles. When an infected person coughs, sneezes, or talks, respiratory droplets containing the pathogens can be released into the air and inhaled by others. Examples of diseases transmitted through airborne transmission include influenza, tuberculosis, and COVID-19.

Vector-borne transmission

Some pathogens rely on vectors, such as mosquitoes, ticks, or fleas, for their transmission. The vector acts as a carrier of the pathogen, which can be present in their saliva or faeces. When the vector bites a person, the pathogen can be transmitted into the bloodstream. Examples of vector-borne diseases include malaria (transmitted by mosquitoes) and Lyme disease (transmitted by ticks).

Waterborne transmission

Pathogens can contaminate water sources, such as lakes, rivers, or wells, and can be transmitted when people consume or come into contact with the contaminated water. Waterborne diseases include cholera and typhoid fever.

Foodborne transmission

Pathogens can contaminate food during production, processing, or handling. When contaminated food is consumed, the pathogens can enter the digestive system and cause illness. Foodborne diseases include salmonellosis and E. coli infection.

Fomite transmission

Pathogens can survive on surfaces or objects, known as fomites, and can be transmitted when a person touches the contaminated surface and then touches their face or mouth. Common fomites include doorknobs, handrails, and utensils. Examples of diseases transmitted through fomite transmission include the common cold, flu, and COVID-19.

ii. Antibodies are produced by lymphocytes. An antigen is a protein or a carbohydrate on the surface of the pathogen. How do antibodies work?

Answer:

Role of antibodies

Antibodies play a role in the immune response by recognizing and neutralizing antigens found on the surface of pathogens or foreign substances. When the body is exposed to a pathogen, specific lymphocytes called B-cells are activated. These B-cells produce antibodies which bind to the antigen of the pathogen, marking them for destruction and initiating an immune response.

Working of antigens

- Antibodies have specific binding sites for antigens. They recognize and bind to the antigen on the surface of the pathogen, forming an antigen-antibody complex.
- Antibodies neutralize the pathogen and block the entry of the pathogen into cells.
- The binding of antibodies to the pathogen enhances phagocytosis, making it easier to engulf and eliminate the pathogen.
- Antibodies can activate the complement system, which is a group of proteins that help destroy pathogens through phagocytosis.
- After an initial infection or vaccination, the immune system retains memory B cells. They remember the specific antigen encountered before and can rapidly produce antibodies upon re-exposure to the same pathogen.

C. Answer the following questions briefly.

1. Differentiate between antigens and antibodies.

Answer:

Differences between antigens and antibodies are:

Antigens	Antibodies
Antigens are foreign particles that enter the human body and can trigger an immune response in the body.	Antibodies are the molecules that are produced in response to the antigens.

Antigens can be spores, pollen or some microorganisms.	Antibodies are specific for each antigen.
Antigens stimulate the immune response.	Antibodies are the immune system's response to antigens.
Antigens provoke an immune response by interacting with immune cells, such as B cells and T cells.	Antibodies neutralize and eliminate antigens from the body.

2. In the adaptive immune response, which cells play a similar role to natural killer cells?
   Answer:
   In the adaptive immune response, the cells that play a similar role to natural killer cells are cytotoxic T cells.

3. What are infectious diseases? Name some infectious diseases.
   Answer:
   Infectious diseases are illnesses caused by microorganisms, such as bacteria, viruses, fungi, or parasites, that can enter the body and multiply, leading to a harmful effect on the host.
   Examples of infectious diseases
   Some examples of infectious diseases include:
   - Influenza (Flu)
   - Tuberculosis (TB)
   - Malaria
   - Hepatitis
   - COVID-19
   - Measles
   - Dengue fever
   - Cholera

4. Give examples of passive immunity.
   Answer:
   We can provide immunity to the body by introducing antigens or antibodies in the body artificially to improve our defence mechanism. When weakened

antigens or antibodies produced outside are introduced into the body, the immunity developed is called passive immunity. This type of immunity is short-lived because there is not enough time for the production of more antibodies. These antibodies form a complex with the antigens and destroy them.
Passive immunity is the basic principle involved in the vaccination process. Passive immunity is used in vaccinations against rabies, tetanus, etc.

5. Name some pathogens that can cause disease in humans.
   Answer:
   Following are some pathogens that cause disease in humans.
   Bacteria: Examples include Escherichia coli (E. coli), Salmonella.
   Viruses: Examples include Influenza viruses, Hepatitis viruses (such as Hepatitis A, B, C) and Coronavirus.
   Fungi: Examples include Aspergillus (which can cause lung infections).
   Parasites: Examples include Plasmodium (which causes malaria).

6. Which cells produce a cell-mediated response?
   Answer:
   T-cells, a type of white blood cell, produce a cell-mediated response.

D. Investigating questions.

1. If we do not have B cells in our body, what will be its effect on the body?
   Answer:
   If we do not have B cells in our body, it has the following effects on the body.
   - B cells are the primary cells responsible for producing antibodies. Without B cells, the body would not be able to produce antibodies against pathogens. This would weaken the immune response and make it more challenging for the body to fight infections effectively.
   - Without B cells, the body's humoral immune response is affected which leads to a decrease in the ability of the immune system to neutralize pathogens and clear infections.
   - B cells are also involved in the development of immunological memory. Without B cells, the body's ability to develop immune memory would be

significantly impaired, making it harder to mount a rapid and effective response to recurring infections.

2. Why and how did Covid-19 become an epidemic? What are its preventive measures?

Answer:

COVID-19 caused by the coronavirus, became an epidemic due to several following factors.

- The coronavirus is highly contagious and spreads easily from person to person through respiratory droplets when an infected individual coughs, sneezes, talks, or breathes.
- One significant challenge with COVID-19 is that infected individuals can transmit the virus even before showing symptoms.
- Since COVID-19 is caused by a coronavirus, the global population had little to no pre-existing immunity against it. This meant that the virus could infect a large number of people without encountering significant immune resistance, facilitating its rapid spread.

Preventive measures

To prevent infection, we need to follow the given rules to prevent the spread of the coronavirus.

- Stay at home
- Wear face masks
- Wash our hands
- Avoid shaking hands
- Use hand sanitizers
- Distance ourselves from others
- Get vaccinated against COVID-19

In case of infection, we should stay in quarantine till our recovery.

E. Answer the following questions in detail.

1. What is immunity? How does our immune system work?

Answer:

Immunity

Immunity is a response generated against any foreign entity that enters the human body. The immune system recognises foreign particles and generates a response against them.

Working of the immune system

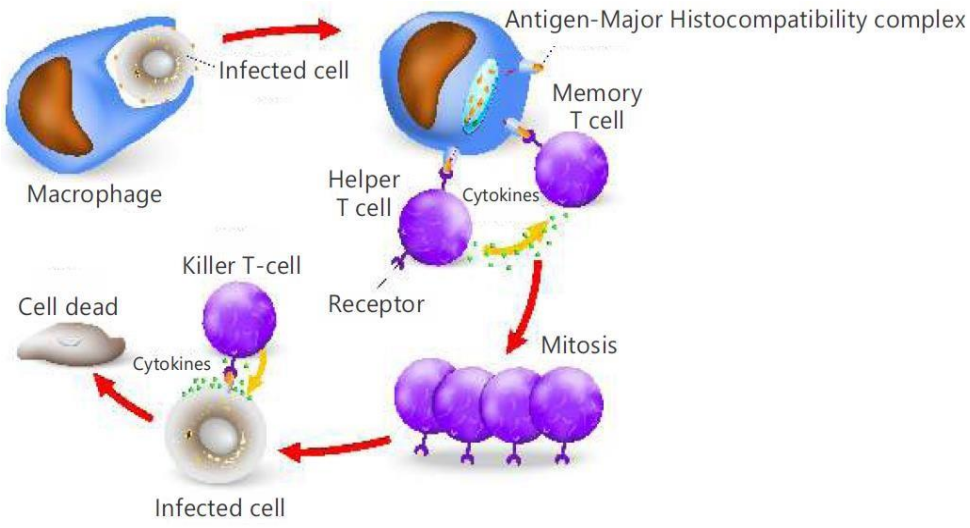
The pathogen that passes the mechanical barrier of skin, hair and mucous layers comes in contact with white blood cells that try to kill these pathogens. Natural killer cells are part of the innate immune response that kills pathogens on their entry along with other types of white blood cells such as macrophages. Some cells cause inflammation that results in swelling, which helps to entrap pathogens in a specific location. The increase in temperature helps to slow down the reproduction of organisms. If the pathogen still survives, the adaptive immune response is activated.

Types of immune cells

Our body produces two types of cells including T cells (Thymus gland) and B cells (Bursa Fabricius).

Cell-mediated immune response

T cells are the type of white blood cells that are produced as a result of adaptive immunity. These cells ingest the antigens and kill them instantly. This type of response is called cell-mediated immune response.



Humoral immune response

B-cells are the type of white blood cells. These cells produce plasma clone cells. They produce antibodies that bind with the antigen and an antigen-antibody complex is formed. This increases phagocytic activity. These cells also produce antitoxins to neutralize toxins produced by pathogens. This type of response is called the humoral immune response. B lymphocytes also process the antigen to make it available for antibodies.

2. Give ways to improve your immune system.
   Answer:
   Ways to improve the immune system
   Our actions can help us strengthen our immunity. The use of masks and gloves adds a barrier to microbes. Hand sanitisers kill the pathogens on our hands that can enter our bodies during contact. Washing our hands is more favourable.
   To improve our immune system, we should do the following.
   - Maintain an adequate sleep cycle.
   - Eat healthy food especially rich in fruits and vegetables.
   - Keep a check on our body weight.
   - Exercise regularly.
   - Spend time on activities that help to reduce stress.
   - Drink plenty of water.
   - Get vaccinated against all diseases such as polio, measles, etc.

3. What are the three lines of defence in the human body and how do they work?
   Answer:
   Lines of defence
   Our body has different mechanisms against these infectious agents. These are called the lines of defence.
   There are three lines of defence against any foreign particle that enters the body.
   The first line of defence is a physical barrier that protects the body against outside invaders. Skin acts as a barrier from the outer environment. Tears, sweat, saliva and mucous produced by skin are also part of the physical barrier. The mucous layer entraps any particle that reaches the skin. The hair in the nostrils also entraps foreign particles.
   The second line of defence is provided by the cells of the body, such as white blood cells that perform their phagocytic activity, a process in which living cells eat or engulf other cells or particles. White blood cells kill the foreign particles directly. In addition to white blood cells, fever, inflammation and antimicrobial proteins are also part of the second line of defence.
   The third line of defence is our immune system.

4. Differentiate between innate and adaptive immunity.
   Answer:
   Difference between innate and adaptive immunity
   Differences between innate and adaptive immunity are given below.

Innate immunity	Adaptive immunity
Innate immunity has been present in our body since birth.	Adaptive immunity is developed after exposure to an antigen.
It is a non-specific immune response and is not targeted towards a specific entity.	Antigens trigger the production of specific antibodies as a response.
The innate immune response cannot differentiate between pathogens. It contains barriers that prevent harmful materials from entering the body.	Adaptive immunity only develops antibodies against foreign antigens but not against the body's molecules. Thus it can differentiate between foreign and the body's molecules.

Term 1 Periodic Unit 2
Unit 4: Structure of an Atom

A. Choose the correct option.

1. The mass number of an atom having 20 protons and 20 neutrons is:
   a. 0
   b. 20
   c. 40
   d. 400

   The correct answer is c.
2. The maximum number of electrons in the M shell is:
   a. 2
   b. 8
   c. 18
   d. 32

   The correct answer is c.
3. An atomic number is represented by:
   a. A
   b. N
   c. X
   d. Z

   The correct answer is d.
4. If the atomic number of an atom is 6, its outermost shell is:
   a. K
   b. L
   c. M
   d. N

   The correct answer is b.
5. The elements that belong to period 1 are:
   a. helium and neon
   b. hydrogen and helium
   c. hydrogen and neon
   d. helium and lithium

   The correct answer is b.
6. The atomic number of oxygen is:
   a. 4
   b. 8

c. 12
d. 16

The correct answer is b.

7. If an element has an atomic number 17, it belongs to:
   a. period 1
   b. period 2
   c. period 3
   d. period 4

   The correct answer is c.
8. Aluminium belongs to period:
   a. 1
   b. 3
   c. 5
   d. 7

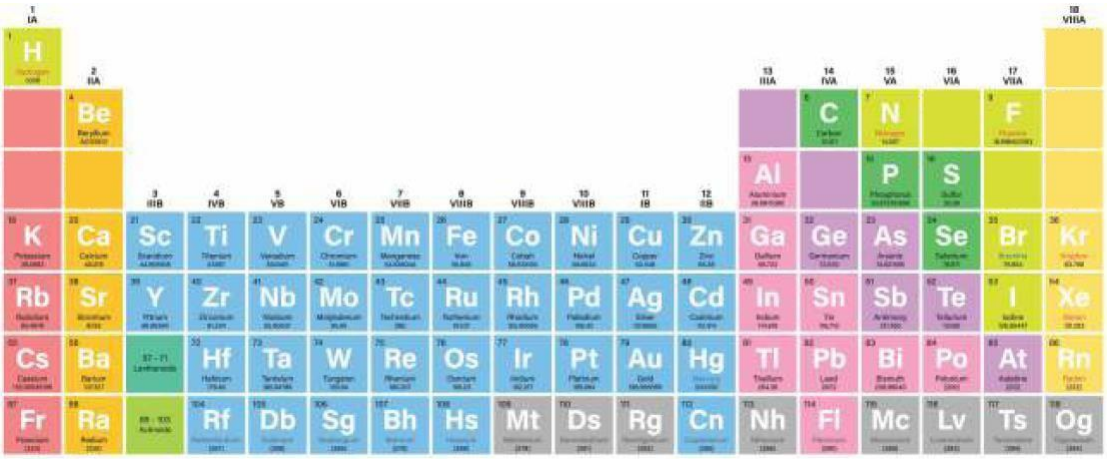
   The correct answer is b.
9. The configuration of electrons of carbon is:
   a. K
   b. K, L
   c. K, L, M
   d. K, L, M, N

   The correct answer is b.
10. An atom has 7 electrons, 7 protons and 7 neutrons. It is:
    a. carbon
    b. oxygen
    c. nitrogen
    d. argon

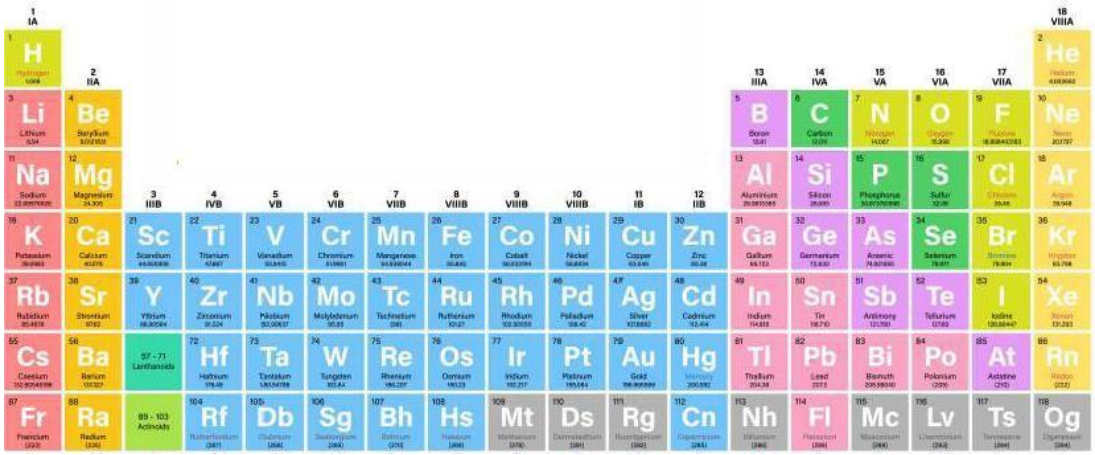
    The correct answer is c.

B. Constructive response questions.

i. Write the missing elements of the periodic table.



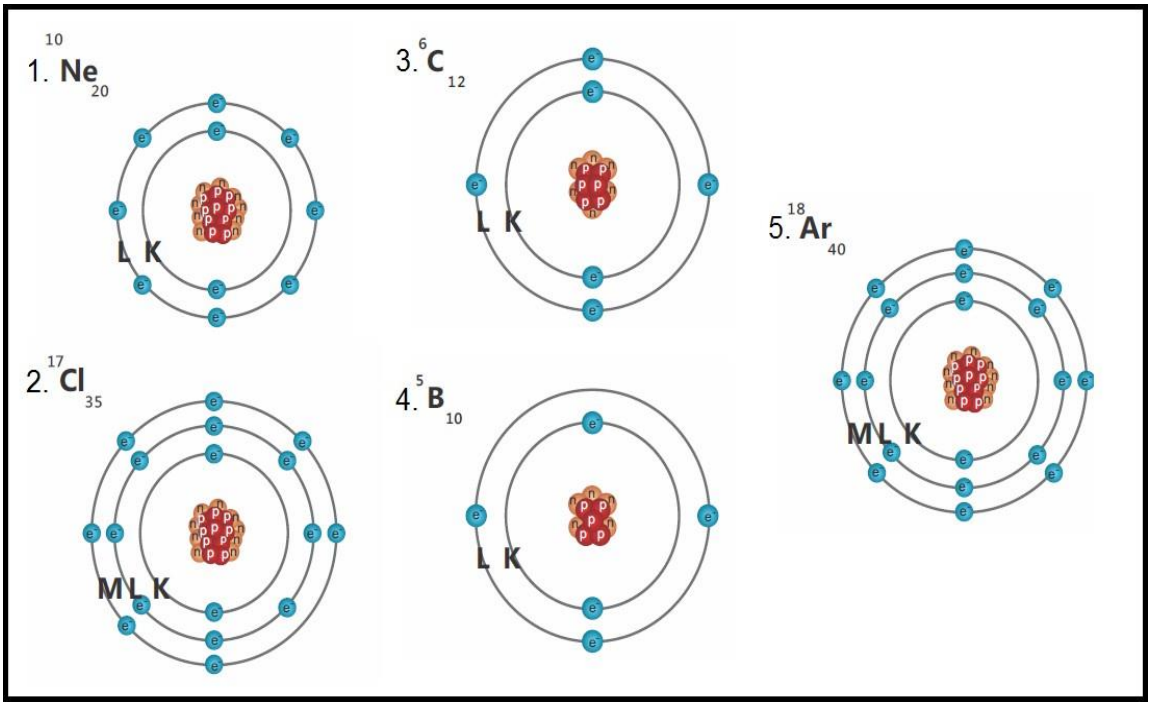
Answer:



ii. Draw the atomic structures of the following elements.

1. $^{10}Ne_{20}$ 2. $^{17}Cl_{35}$ 3. $^{6}C_{12}$ 4. $^{5}B_{11}$ 5. $^{18}Ar_{40}$

Answer:



C. Answer the following questions briefly.

1. An atom has 35 electrons and protons. Its mass number is 80. Calculate the number of neutrons in this atom.

   Answer:

   Given data

   Number of electrons = 35

   Number of protons = 35

   Mass number = 80

   To find

   The number of neutrons =?

   Solution

   To find the number of neutrons we use the following formula of mass number.

   Mass number = Number of protons + Number of neutrons

   Number of neutrons = Mass number - Number of protons

   Number of neutrons = 80 – 35

   Number of neutrons = 45

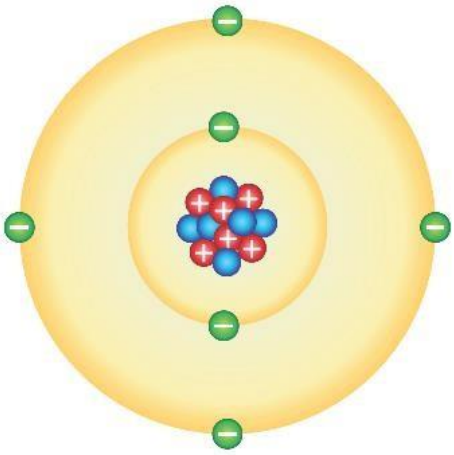
   Therefore, the atom has 45 neutrons.

2. Why are elements arranged in the periodic table?
   Answer:
   The arrangement of elements in ascending order of atomic numbers in a table is called the periodic table**.** Elements are arranged in the periodic table to study the similarities and differences among them. Elements are arranged in a systematic order in the periodic table. Elements in the same columns have similar properties.

3. Read the periodic table carefully and write the names of elements of period 3.
   Answer:
   The names of elements of period 3 are:
   - Sodium (Na)
   - Magnesium (Mg)
   - Aluminium (Al)
   - Silicon (Si)
   - Phosphorous (P)
   - Sulphur (S)
   - Chlorine (Cl)
   - Argon (Ar)

4. What are the benefits of arranging elements in the periodic table?
   Answer:
   The arrangement of elements in the periodic table has several benefits.
   - The periodic table provides a systematic and organized way to classify elements based on their atomic number, electron configuration and chemical properties.
   - It allows scientists to easily locate and identify specific elements and group them based on their similarities.
   - The periodic table allows scientists to predict the properties of newly discovered elements based on their position in the table.
   - It shows the progression of atomic numbers and the filling of electron shells, which leads to similarities in chemical behaviour.

5. Look at the picture and write the number of protons, electrons and neutrons. Calculate its atomic number and mass number.



Answer:
The number of protons: 6
The number of electrons: 6
The number of neutrons: 6
Atomic number = number of protons
Atomic number = 6
Mass number = number of protons + number of neurons
Mass number = 6 + 6
Mass number = 12

D. Investigating questions.

1. Why is it better to arrange elements based on their atomic numbers instead of atomic masses? Investigate and explain with examples.
   Answer:
   Arranging elements based on their atomic numbers rather than atomic masses is a more accurate and reliable approach. Here are some reasons.
   - The periodic table ensures consistency and accuracy in element placement with atomic numbers, as it remains constant for a specific element. On the other hand, atomic masses vary due to the presence of isotopes.
   - Atomic numbers determine the order of electron filling in orbitals, resulting in similar properties within groups. If elements were arranged

by atomic mass, the periodicity of electron configuration and chemical properties would be disrupted.

- The periodic table allows for the prediction of the properties of an element based on its position. Elements in the same group typically exhibit similar chemical behaviour.
- By arranging elements based on atomic numbers, scientists can accurately predict the properties of newly discovered elements based on their position in the table.
- There are instances where elements with similar atomic masses have significantly different chemical properties. For example, iodine (I) has a higher atomic mass than tellurium (Te), but iodine exhibits properties similar to other halogens (Group 17), while tellurium shares similarities with other chalcogens (Group 16). By arranging elements based on atomic numbers, such anomalies can be resolved.
- The periodic trends in properties, such as atomic radius, ionization energy, and electronegativity, are consistent when elements are arranged by atomic numbers.

2. Investigate how many elements in the periodic table have an L shell as their outermost shell. Write their names and atomic numbers.

   Answer:

   In the periodic table, elements with an L shell as their outermost shell are found in Period 2. There are eight elements in Period 2.

   The names and atomic numbers of the first ten elements are given in the following table.

Elements	Symbols	Atomic number
Lithium	Li	3
Beryllium	Be	4
Boron	B	5
Carbon	C	6
Nitrogen	N	7

Oxygen	O	8
Fluorine	F	9
Neon	Ne	10

E. Answer the following questions in detail.

1. Draw the structure of an atom and describe how an atom is neutral.

Answer:

Structure of an atom

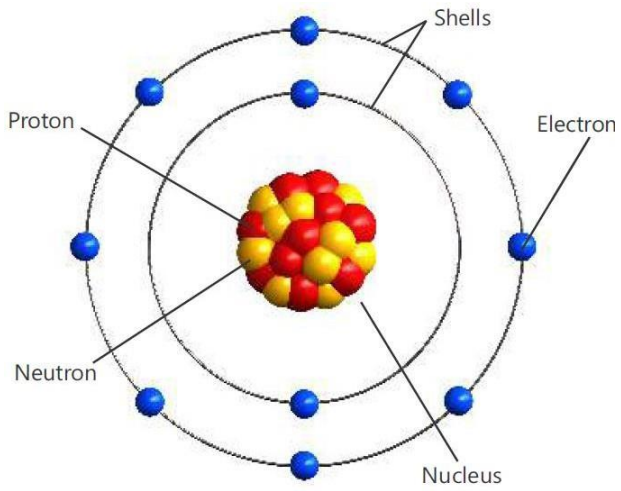
According to the proposed model by Rutherford, an atom has two regions, i.e., the nucleus and the outer region.

Nucleus: The nucleus is present in the centre of an atom.

Outer region: The region around the nucleus is called the outer region.

Particles of an atom

Different kinds of particles are found in an atom. These are called subatomic particles. The following are the three different types of subatomic particles found in an atom i.e., protons, electrons and neutrons.



Electrons: Electrons are present in the outer region of an atom called shells/orbits. Each electron has a negative charge on it.

Protons: Protons are positively charged particles and are present inside the nucleus of an atom. With the discovery of protons, it was found that its mass is 1800 times greater than that of an electron.

Neutrons: The neutral particles present in the nucleus of an atom are neutrons. They have no charge. Their mass is equal to that of protons.

Atom as a neutral entity

Subatomic particles like proton and electron have opposite charges on them and neutron has no charge on it which makes an atom neutral. The number of positively charged particles is always the same as the number of negatively charged particles in an atom.

Examples

Some examples are given below:

- A hydrogen atom has 1 electron in its outer shell and 1 proton in its nucleus. So, the net charge on a hydrogen atom is zero.



Hydrogen atom

- A helium atom has 2 protons and 2 electrons. It also has 2 neutrons and the net charge on a helium atom is also zero.



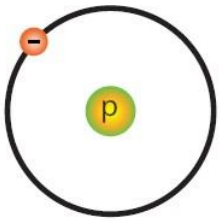
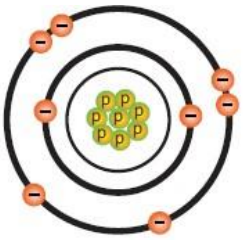
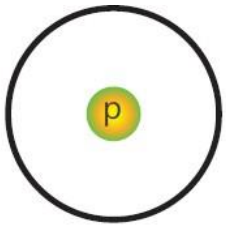
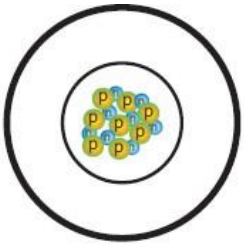
Helium atom

2. Differentiate between an atomic number and a mass number.

Answer:

Difference between atomic number and mass number

The difference between atomic number and mass number is given in the table.

Atomic number	Mass number
The number of protons in an atom is its atomic number. The number of protons is equal to the number of electrons in an atom.	The mass number is the sum of the number of protons and neutrons in the nucleus of an atom.
It is denoted by **Z**.	It is denoted by **A**.
The atomic number of an element is written at the top-left corner of that element, i.e. $^{Z}\mathbf{X}$.	The mass number of an element is written at the bottom-right corner of the element, i.e. $\mathbf{X_A}$.
If an atom has 3 protons, its atomic number will be ^{3}X. An atom having 8 protons will have 8 as its atomic number. It will be written as ^{8}X.	An atom having 6 protons and 6 neutrons in its nucleus has a mass number of X_{12}. The mass number of an atom with 17 protons and 18 neutrons is 35. It will be written as X_{35}.
The atomic numbers of some atoms are shown below.  Hydrogen atom ^{1}H  Oxygen atom ^{8}O	The mass numbers of some atoms are given below.  Hydrogen atom H_1  Oxygen atom O_{16}

3. Explain the periodic table in terms of periods and groups.

Answer:

Periods and groups in the periodic table

Elements are arranged in the periodic table in rows and columns.

Periods

The horizontal rows of the periodic table are called periods. There are seven periods in the periodic table, each starting from the far left of the table. These are designated numbers as 1, 2, 3 and so on.

- **Period 1** comprises only 2 elements.
- **Periods 2** and **3** have eight elements.
- **Periods 4** and **5** contain eighteen elements.
- **Periods 6** and **7** contain thirty-two elements.

Groups

The vertical columns of the periodic table are called groups. There are eighteen groups in the periodic table. They are given numbers starting from left to right. The first group on the left is 1 and the last group is 18.

Term 2 Periodic Unit 1
Unit 5: Physical and Chemical Changes

A. Choose the correct option.

1. In an old shed, you find a rusty, bent nail. What kind of change has the nail undergone?
   a. Physical change
   b. Chemical change
   c. Physical and chemical change
   d. Neither chemical nor physical



   The correct answer is c.
2. Which group represents physical properties?
   a. boiling point, flammability
   b. colour, texture
   c. odour, reactivity
   d. solubility, acidity

   The correct answer is b.
3. The condition which supports rusting is:
   a. dry air
   b. moist air
   c. carbon dioxide
   d. smoke

   The correct answer is b.
4. The condition essential for combustion is:
   a. the presence of fuel
   b. the presence of light
   c. the presence of oxygen
   d. chain flame reactions

   The correct answer is c.
5. Ali is given a sample of an unknown liquid to test in the laboratory. Ali thinks the liquid might be water. The physical properties most helpful for Ali to determine the identity of the liquid are:
   a. boiling point
   b. melting point
   c. taste/colour
   d. flammability

The correct answer is a.

6. To protect iron pipes from corrosion, they are galvanised with:
   a. silver
   b. aluminium
   c. zinc
   d. copper

   The correct answer is c.
7. A freshly cut piece of apple turns brown, it is a:
   a. biological change
   b. chemical change
   c. physical change
   d. reversible change

   The correct answer is b.
8. Acid rain is formed by:
   a. sulphur oxides and carbon oxides
   b. nitrogen oxides and sulphur oxides
   c. carbon dioxide and carbon monoxide
   d. nitrogen oxides and carbon oxides

   The correct answer is b.
9. A physical change is:
   a. always reversible
   b. usually reversible
   c. always irreversible
   d. usually irreversible

   The correct answer is b.
10. Conversion of milk into curd is an example of a/an:
    a. physical and reversible change
    b. irreversible change
    c. chemical and irreversible change
    d. reversible change

    The correct answer is c.

B. Identify the following changes as physical or chemical.

Change	Physical or Chemical
When the matter undergoes such a change, the substances it is made of stay the same	Physical change
When the matter undergoes such a change, the substances it is made of change into new substances	Chemical change
Water turns into steam	Physical change
Cutting of paper into pieces	Physical change
Burning of wood	Chemical change
Heating a metal rod	Physical change
Baking bread	Chemical change
Cracking almonds for cooking	Physical change

C. Constructive response questions.

i. Combustion is a chemical process. Combustion increases the number of harmful gases. These gases cause global warming. Explain the effects of global warming.

Answer:

The complete combustion of fossil fuels produces a large amount of carbon dioxide which goes into the atmosphere. Carbon dioxide is a greenhouse gas, which is responsible for global warming.

Following are some effects of global warming on Earth.

- Global warming is a rise in the overall temperature of the Earth's surface.
- As temperatures rise, glaciers and ice caps melt, leading to the melting of polar ice sheets.
- The melting of ice due to global warming contributes to the rise in sea levels.

- Global warming causes extreme weather events such as storms, heat waves, droughts and heavy rainfall.
- The changes caused by global warming can have detrimental effects on agriculture, water availability and overall ecosystem health.

ii. The formation of clouds and the burning of paper are two changes. Compare them.

Answer:

The formation of clouds is a physical change and the burning of paper is a chemical change.

A comparison between the formation of clouds and the burning of paper is given below.

Properties	Formation of clouds	Burning of paper
Nature of change	The formation of clouds involves physical change. Water vapour in the air condenses into tiny water droplets or ice crystals, resulting in the visible formation of clouds.	The burning of paper involves a chemical reaction where the paper undergoes combustion, combining with oxygen in the air to produce heat, light, carbon dioxide, water vapour and ash.
Reversibility	The formation of clouds is generally a reversible process. Clouds can form and dissipate.	The burning of paper is an irreversible process. Once a paper is burned, it is converted into different chemical compounds and cannot be restored to its original form.
Environmental impact	The formation of clouds plays a crucial role in the Earth's water cycle and climate regulation. They also contribute to the formation of precipitation.	The burning paper releases carbon dioxide, contributing to greenhouse gas emissions and potentially impacting air quality depending on the presence of pollutants

		in the paper.

D. Answer the following questions briefly.

1. Write the comparison between physical and chemical changes.
   Answer:
   A comparison between physical and chemical changes is given in the table.

Physical change	Chemical change
When a substance undergoes a physical change, its composition remains the same despite its molecules being rearranged.	When a substance undergoes a chemical change, its molecular composition is changed entirely. Thus, chemical changes involve the formation of new substances.
A physical change is a temporary change.	A chemical change is a permanent change
A physical change is when matter changes its form but not its chemical identity.	A chemical change is when substances change their chemical identity.
Physical changes involve cutting, chopping, melting, freezing, and shredding.	Chemical changes involve burning, cooking, rusting, and rotting.
It is reversible.	It is irreversible.
Examples: Freezing of water, melting of wax and boiling of water.	**Examples:** Digestion of food, the burning of coal and rusting of iron.

2. The characteristics of a substance never change during a physical change.
   Answer:
   During a physical change, the chemical composition of a substance remains the same.

3. Why are iron objects protected from rusting?
   Answer:
   Iron is widely used in the construction of many structures and machines. Therefore, the prevention of the corrosion of iron is very important.

4. The volume of a sample of oxygen gas increased from 10 ml to 100 ml as the temperature increased. Is this a chemical or physical change?
   Answer:
   The volume of a sample of oxygen gas increasing from 10 ml to 100 ml as the temperature increases represents a physical change. The volume expands because the oxygen molecules are moving faster and farther apart, leading to an increase in volume. However, the chemical composition of the oxygen gas remains the same throughout the process.

5. Differentiate between complete and incomplete combustion. What are their products? Which one causes air pollution?
   Answer:
   The difference between complete and incomplete combustion is:

Complete combustion	Incomplete combustion
Complete combustion occurs when a fuel burns in the presence of excess oxygen, resulting in the production of carbon dioxide (CO_2) and water (H_2O).	Incomplete combustion occurs when a fuel burns in a limited oxygen supply, leading to the production of carbon monoxide (CO) and water (H_2O).
Complete combustion is a more desirable and cleaner process, resulting in fewer harmful byproducts.	Incomplete combustion is the process that causes air pollution, releasing harmful gases and particulate matter.

E. Investigating questions.

1. Explain the impact of combustion reactions on the environment.
   Answer:
   A chemical reaction that includes the burning of a substance in the presence of oxygen is called a combustion reaction.
   Impact of combustion reactions in everyday life
   An increase in the consumption of fossil fuels leads to harmful effects on the environment. The following are some of the effects in everyday life.
   - **Increase in carbon monoxide gas**

When fuels are burnt in a limited supply of oxygen, carbon monoxide is formed. This gas is very dangerous as it is poisonous.

- **Global warming**
  The complete combustion of fossil fuels produces a large amount of carbon dioxide which goes into the atmosphere. Carbon dioxide is a greenhouse gas, which is responsible for global warming. Global warming is a rise in the overall temperature of the Earth's surface.
- **Acid rain**
  The burning of coal and diesel produces sulphur dioxide gas. Petrol gives off oxides of nitrogen. The oxides of sulphur and nitrogen get dissolved in rainwater and form acids. This is known as acid rain. This water is very harmful to plants, animals, and buildings made of limestone and marble.

2. Investigate how physical and chemical changes impact everyday situations.
   Answer:
   Physical and chemical changes impact everyday situations in numerous ways. Following are a few examples of physical and chemical changes in everyday life.
   Cooking
   Cooking involves various physical and chemical changes. When heating water, it undergoes a physical change from a liquid to a gas during boiling. When food is cooked, chemical changes occur, such as the boiling of eggs and caramelization of sugars, which alter the taste, texture, and nutritional properties of the food.
   Combustion in vehicles
   The combustion of fuel in vehicle engines involves both physical and chemical changes. The fuel undergoes a chemical change, combining with oxygen to release energy and produce carbon dioxide (CO_2) and other combustion byproducts.
   The expansion of gases during combustion results in physical changes, converting chemical energy into mechanical energy, which powers the vehicle.
   Rusting of metals
   The rusting of metal, such as iron, is a chemical change. When iron reacts with oxygen and moisture in the air, it forms iron oxide (rust), leading to a change in the physical and chemical properties of the metal.

Formation of clouds

The formation of clouds is a physical change. When warm air containing water vapour rises, it cools down, causing the water vapour to condense into tiny water droplets or ice crystals.

F. Answer the following questions in detail.

1. Explain the role of oxygen in rusting and tarnishing.

Answer:

Role of oxygen in rusting and tarnishing

Oxygen plays a crucial role in both rusting and tarnishing processes.

Rusting

The rusting of iron refers to the formation of rust, a mixture of iron oxides, on the surface of iron objects. The rust on iron is formed from a reaction between oxygen and iron in an environment containing water. The rusting of iron is characterised by the formation of a layer of a brown substance that easily crumbles into a powder.

Role of oxygen in rusting

Oxygen is necessary for rusting, as iron can form iron oxide when it is combined with oxygen, forming a ferrous oxide that is rust.

Conditions for rusting

The necessary conditions for rusting are:

i. Presence of oxygen
ii. Presence of moisture

Tarnishing

The spoiling or discolouring of the surface of a piece of metal is called tarnishing. Shiny metal surfaces lose their shiny appearance due to chemical reactions on the surface.

Example

For example, silver articles become black after long exposure to atmospheric air.

Role of oxygen in tarnishing

Tarnishing is a reaction due to oxygen. Only metals which react with oxygen such as copper, magnesium and silver react.

Example

As gold never reacts with oxygen, it will not rust or tarnish.

2. Discuss any two methods for the prevention of rusting of iron.
   Answer:
   Methods for the prevention of rusting of iron
   Two effective methods for preventing rusting of iron are galvanization and coatings.
   Galvanization
   Galvanization is the process of applying a protective layer of zinc to a metal. This can be done by dipping the metal to be protected in hot, molten zinc or by the process of electroplating. The zinc layer corrodes instead of iron.
   Coatings
   Applying protective coatings creates a barrier between the iron surface and moisture or oxygen. These coatings on metals prevent corrosion. Common examples of coatings that prevent corrosion include paints, wax tapes, and varnish. Many machines and tools made of iron are coated with a layer of grease, which lubricates the metal to reduce friction and prevent rusting at the same time.

3. Taking the examples of water, paper, iron and food, distinguish between their physical and chemical properties.
   Answer:
   Physical and chemical properties
   The distinction between the physical and chemical properties of water, paper, iron and food are given below.
   - **Water**
     Physical properties
     Water is a colourless, odourless liquid at room temperature. It has a specific boiling point (100°C) and freezing point (0°C). It can exist in three states: solid (ice), liquid (water), and gas (water vapour).
     Chemical properties
     Water consists of two hydrogen atoms and one oxygen atom (H_2O). It can undergo many chemical reactions.
   - **Paper**
     Physical properties
     Paper is a thin, flat material made from wood. It is lightweight, flexible, and can be written on or printed with ink. It has a certain colour and texture.

Chemical properties

Paper is primarily composed of cellulose fibres. Chemically, it can undergo combustion, oxidization, or degradation processes.

- **Iron**

  Physical properties

  Iron is a lustrous, silver-grey metal. It is malleable and ductile. It is a good conductor of heat and electricity. It has a high melting point and density.

  Chemical properties

  Iron is a reactive metal that can undergo chemical reactions, particularly with oxygen and moisture in the air, leading to rusting. It can also react with certain acids.

- **Food**

  Physical properties

  Food can have various physical properties depending on its type and composition. It can have different colours, textures, tastes, and smells. Food can exist in different states, such as fruits and vegetables, liquids such as beverages or semi-solid such as yoghurt.

  Chemical properties

  Food is composed of many different compounds. It undergoes chemical changes during digestion and metabolic processes in the body.

Term 2 Periodic Unit 1
Unit 6: Chemical Bonds

A. Choose the correct option.

1. Which of the following is an ionic compound?
   a. water
   b. common salt
   c. ammonia
   d. carbon dioxide
   The correct answer is b.
2. How many electrons are being shared between the two carbon atoms in the compound ethyne C_2H_2?
   a. 1
   b. 2
   c. 3
   d. 6
   The correct answer is b.
3. Forces of attraction in covalent compounds are _____than in ionic compounds.
   a. weaker
   b. stronger
   c. unstable
   d. reactive
   The correct answer is a.
4. The number of electrons an aluminium atom has to lose or gain to obtain a noble gas structure is:
   a. 3 (lose)
   b. 3 (gain)
   c. 5 (gain)
   d. 5 (lose)
   The correct answer is a.
5. The bond present between the aluminium and oxygen atoms in Al_2O_3 is a/an:
   a. ionic bond
   b. single covalent bond
   c. double covalent bond

d. triple covalent bond

The correct answer is a.

6. Electrons from each element are shared by both of the elements in a compound. Which compound matches this description?
   a. copper oxide
   b. sodium chloride
   a. iron bromide
   b. water

   The correct answer is d.
7. Sodium chloride is an ionic solid. The incorrect statement is:
   a. sodium chloride is highly soluble in water.
   b. sodium chloride can conduct electricity in solid form.
   c. sodium chloride has a high melting point.
   d. sodium chloride forms crystals

   The correct answer is b.
8. The molecule which contains only single covalent bonds is:
   a. Cl_2
   b. N_2
   c. CO_2
   d. O_2

   The correct answer is a.
9. The correct statement about ammonia, NH_3 is:
   a. Each hydrogen atom donates a pair of electrons to a nitrogen atom.
   b. There are double covalent bonds between the nitrogen atom and the hydrogen atoms.
   c. There are single covalent bonds between its hydrogen atoms.
   d. There are three shared pairs of electrons in the molecule.

   The correct answer is d.
10. Carbon has an atomic number of 6 and _____valence electrons.
    a. 0
    b. 2
    c. 4
    d. 6

    The correct answer is c.

B. Constructive response questions.

i. Sodium chloride NaCl is an ionic compound and CH_4 is a covalent compound. Discuss their properties such as the physical state at room temperature, melting and boiling points, and solubility.

Answer:

The properties in terms of physical state at room temperature, melting and boiling points, and solubility of sodium chloride (NaCl) and methane (CH_4) are given below.

Properties of sodium chloride (NaCl)

- **Physical state at room temperature:** NaCl is typically found as a solid at room temperature. It forms a crystalline structure.
- **Melting point:** NaCl has a relatively high melting point of 801°C (1474°F).
- **Boiling point:** NaCl has a high boiling point of 1413°C (2575°F).
- **Solubility:** NaCl is highly soluble in water. When NaCl crystals are dissolved in water, the water molecules surround its ions, causing them to dissociate and form a solution.

Properties of methane (CH_4)

- **Physical state at room temperature:** Methane is a gas at room temperature and standard atmospheric pressure. It is colourless and odourless.
- **Melting point:** Methane does not have a distinct melting point at atmospheric pressure because it does not exist as a solid under these conditions.
- **Boiling point:** Methane has a boiling point of -161.5°C (-258.7°F).
- **Solubility:** Methane is relatively insoluble in water. Methane can dissolve to some extent in organic solvents.

ii. What is the octet rule? How can magnesium and oxygen have complete octets? Explain.

Answer:

The octet rule describes the elements that tend to have a stable energy level by having eight electrons in their outermost shell. The octet rule is a guideline in chemistry that states that atoms tend to gain, lose, or share electrons to achieve a stable electron configuration with a full outer electron shell, typically containing eight electrons.

Magnesium (Mg) and oxygen (O) can achieve complete octets through different means:

Magnesium

Magnesium has two valence electrons in its outermost energy level. To achieve a complete octet, it can lose these two electrons. By losing two valence electrons, magnesium achieves a complete octet.

Oxygen

Oxygen has six valence electrons in its outermost energy level. To achieve a complete octet, oxygen can gain two electrons. By gaining two electrons, oxygen has a complete octet in its outermost shell.

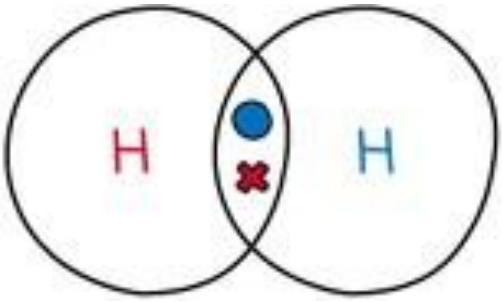
iii. Draw the structure of the following molecules. Hydrogen molecule H2, oxygen molecules O2, nitrogen molecule N2 and methane CH4. You can use a dot (●) to express the electrons of one atom of the molecule and a cross (x) to express the other atom of that molecule.

Answer:

The structures for the given molecules are given below.

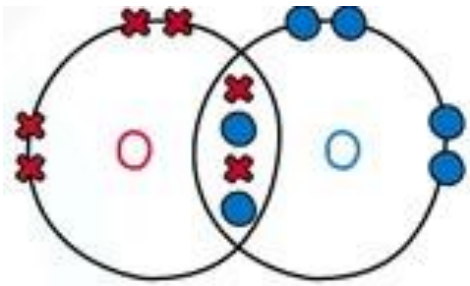
Hydrogen molecule (H_2)

H – H



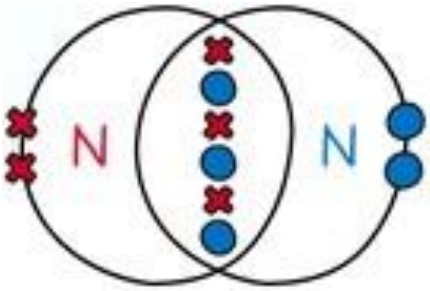
Oxygen molecule (O_2)

O = O



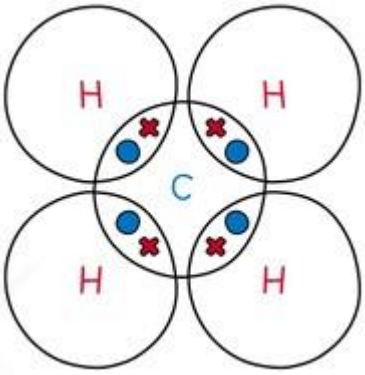
Nitrogen molecule (N_2)

$N \equiv N$



Methane (CH_4)

H
|
H – C– H
|
H



C. Answer the following questions briefly.

1. Define valency. Give examples with the help of atomic structures.

Answer:

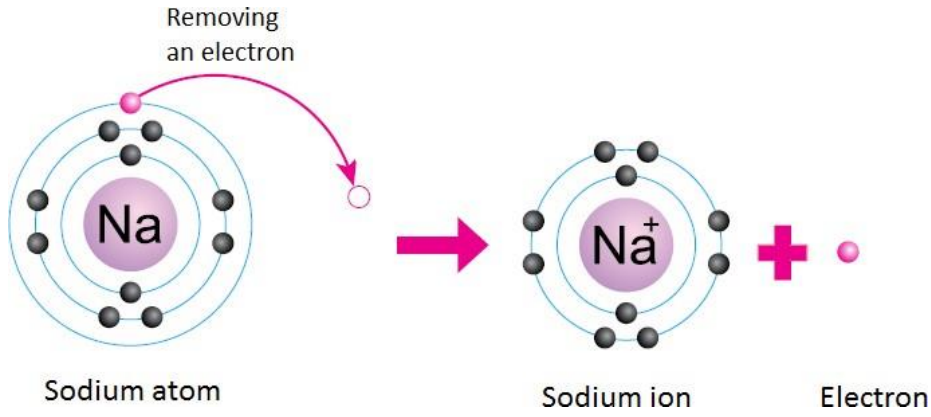
Valency

The tendency of an atom to lose, gain or share its valence shell electrons is called valency. Valency is the measure of the combined capacity of atoms or molecules.

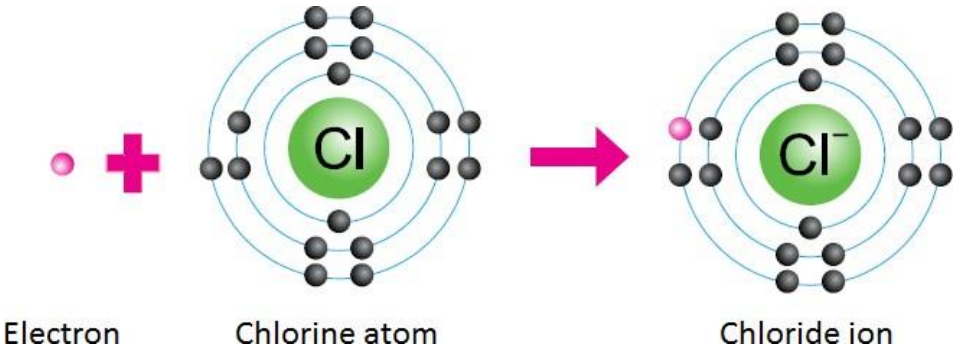
When atoms approach one another, they tend to stabilise themselves by losing, gaining or sharing electrons to achieve the electronic configuration nearest to the noble gases. The electrons that take part in this interaction are called valence electrons.

Examples

The sodium atom has an atomic number 11 (2,8,1), with 1 electron in its outermost shell. It is easier for a Na atom to lose its outermost electron to attain stability. The outermost electrons determine the valency, therefore, the valency of Na is 1.



Chlorine has an atomic number 17 (2,8,7), which means it contains 7 electrons in its outermost shell. A Cl atom requires one more electron for its stability. Therefore, the valency of Cl is also 1.



2. Write chemical formulae on the basis of the valency of the constituent elements of water, salt, ammonia, carbon dioxide and carbon monoxide.
Answer:

Compounds	Chemical formulae	Valency
Water	H_2O	Hydrogen: 1
		Oxygen: 2
Salt	NaCl	Sodium: 1

		Chlorine: 1
Ammonia	NH_3	Nitrogen: 3
		Hydrogen: 1
Carbon dioxide	CO_2	Carbon: 4
		Oxygen: 2
Carbon monoxide	CO	Carbon: 2
		Oxygen: 2

3. Compare ionic and covalent compounds and write three differences between them.

Answer:

A comparison between ionic and covalent compounds is given below.

Ionic compounds	Covalent compounds
The type of chemical bond formed from the electrostatic force of attraction between oppositely charged ions in a chemical compound is called an ionic bond.	The type of chemical bond that results from the sharing of an electron pair between two atoms is called a covalent bond.
They have high melting and boiling points.	They have low melting and boiling points.
Ionic solids are insulators. However, ionic compounds are often capable of conducting electricity in molten or solution form when the ions are free to move.	Covalent compounds do not conduct electricity.
Ionic compounds are highly soluble in water, for example, NaCl or common salt readily dissolves in water.	Covalent compounds are insoluble in water but soluble in organic solvents.

4. Why do solid covalent compounds have low melting points?
   Answer:
   Solid covalent compounds have low melting points due to the nature of their bonding. The bonding of covalent compounds arises from the weak electrostatic forces of attraction between them. They require a very small amount of energy to break the bonds between two or more molecules. That is why they have low melting and boiling points.

5. Explain why ionic compounds are formed when metal bonds with non-metals, but covalent compounds are formed when two non-metals bond together.
   Answer:
   An ionic bond usually occurs between metal and non-metal ions. Metals can lose electrons easily and become positively charged ions. While non-metals can gain electrons easily and become negatively charged ions. The electrostatic attraction between the oppositely charged ions results in the formation of an ionic bond.
   The covalent bond is most commonly formed between two non-metals. Non-metals have a higher tendency to gain electrons, so they mutually share electrons and form covalent bonds. The shared electrons create a strong electrostatic attraction between the atoms, resulting in the formation of a covalent compound.

D. Investigating questions.

1. Common salt readily dissolves in water. Investigate and explain the reason for this phenomenon.
   Answer:
   NaCl or common salt readily dissolves in water due to the strong attraction between the ions in the salt and the water molecules.
   When NaCl is dissolved in water, the following process occurs:
   - Water molecules are converted into hydrogen positively charged atoms and oxygen negatively charged atoms.
   - The sodium ions (Na^+) of NaCl are attracted to the negative oxygen atoms of water molecules.
   - Similarly, the chloride ions (Cl^-) of NaCl are attracted to the positive hydrogen atoms of water molecules.

- As a result of these attractive forces, the ionic bonds in the salt crystal are weakened and eventually broken, allowing the Na^+ and Cl^- ions to separate and become dispersed in the water.
- The dispersed Na^+ and Cl^- ions throughout the water form a solution, where each ion is surrounded by water molecules.
- This process of dissolving NaCl in water is facilitated by the nature of water and the strong electrostatic attraction between the salt ions and water molecules. The water molecules effectively separate and disperse the Na^+ and Cl^- ions, leading to the dissolution of salt.

2. How are the properties of a newly formed compound different from the properties of its constituent elements? Investigate and explain with the help of examples.

Answer:

The properties of a newly formed compound are different from the properties of its constituent elements. This is due to the formation of new chemical bonds and the arrangement of atoms in the compound. These can lead to new chemical and physical properties that are different from those of its constituent elements.

Example

The property of sodium chloride is different from its constituent elements (sodium and chlorine), as chlorine is a poisonous gas that has been used as a chemical weapon and sodium is a highly reactive metal that is mildly explosive with water.

E. Answer the following questions in detail.

1. Explain the role of valency in chemical bonding and how ions are formed.

Answer:

Valency

The tendency of an atom to lose, gain or share its valence shell electrons is called valency. The electrons that take part in this interaction are called valence electrons. The valency of some atoms is given in the table.

Atom	Valency
Na	1
K	1
Mg	2
C	4

Atom	Valency
F	1
O	2
S	2
N	3

Role of valency

Valency plays a crucial role in chemical bonding as it determines how atoms will interact with each other to form compounds.

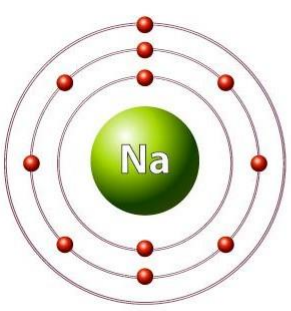
- Valency is the measure of the combined capacity of atoms or molecules.
- It indicates the number of atoms that gain or lose electrons to attain a stable electron configuration.
- It determines the placement of electrons on the orbitals of the atom.

Example

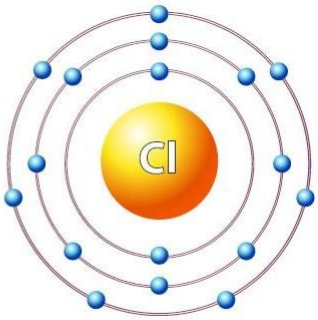
The sodium atom has an atomic number 11 (2,8,1), with 1 electron in its outermost shell. While chlorine has an atomic number 17 (2,8,7), that means it contains 7 electrons in its outermost shell. A Cl atom requires one more electron for its stability and it is easier for a Na atom to lose its outermost electron for attaining stability. The outermost electrons determine the valency, therefore, the valency of Na is 1 and of Cl is 1.

Formation of ions

Ions are formed when an atom gains or loses electrons to achieve a complete outer electron shell. When an atom loses one or more electrons, it becomes a positively charged ion or cation. On the other hand, when an atom gains one or more electrons, it becomes a negatively charged ion or anion.



Sodium atom



Chlorine atom