

CBSE EXAMINATION PAPER-2023

SCIENCE

(Solved)

Time allowed : 3 hours

Maximum Marks : 74

General Instructions :

Read the following instructions carefully and follow them :

- i. This question paper contains **34 questions**. All questions are **compulsory**.
- ii. This question paper is divided into **5 sections**.
- iii. **Section A** – questions number **1 to 12** are multiple choice questions Each question carries **1 marks**.
- iv. **Section B** – questions number **13 to 21** are very short answer Each question carries **2 marks**.
- v. **Section C** – questions number **22 to 29** are short answer Each question carries **3 marks**.
- vi. **Section D** – questions number **30 to 30** are case based questions
- vii. **Section E** – questions number **31 to 34** are long answer Each question carries **5 marks**.
- viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.
- ix. Use of calculator is NOT allowed.

Section A

Question 1.

In the experimental setup given below, it is observed that on passing the gas produced in the reaction in the solution 'X' the solution 'X' first turns milky and then colourless.

The option that justifies the above stated observation is that 'X' is aqueous calcium hydroxide and

[1 Marks]

(A) it turns milky due to carbon dioxide gas liberated in the reaction and after sometime it becomes colourless due to formation of calcium carbonate.

(B) it turns milky due to formation of calcium carbonate and on passing excess of carbon dioxide it becomes colourless due to formation of calcium hydrogen carbonate which is soluble in water.

(C) it turns milky due to passing of carbon dioxide through it. It turns colourless as on further passing carbon dioxide, sodium hydrogen carbonate is formed which is soluble in water.

(D) the carbon dioxide liberated during the reaction turns lime water milky due to formation of calcium hydrogen carbonate and after some time it turns colourless due to formation of calcium carbonate which is soluble in water.

Explanation: The correct option is that 'it turns milky due to formation of calcium carbonate and on passing excess of carbon dioxide it becomes colourless due to formation of calcium hydrogen carbonate which is soluble in water.' When carbon dioxide gas is passed through aqueous calcium hydroxide (lime water), it first reacts to form calcium carbonate, which is insoluble and causes the solution to turn milky. On further passing excess carbon dioxide, calcium carbonate reacts to form calcium hydrogen carbonate, which is soluble in water, causing the solution to become colourless.

Question 2.

The emission of brown fumes in the given experimental set-up is due to

[1 Marks]

(A) oxidation of lead nitrate forming lead oxide and nitrogen dioxide.

(B) thermal decomposition of lead nitrate which produces brown fumes of nitrogen dioxide.

(C) oxidation of lead nitrate forming lead oxide and oxygen.

(D) thermal decomposition of lead nitrate which produces brown fumes of lead oxide.

Explanation: The brown fumes observed during the heating of lead nitrate are due to the thermal decomposition of lead nitrate which produces nitrogen dioxide (NO_2) gas.

Nitrogen dioxide is a reddish-brown gas, which causes the brown fumes. The chemical reaction involved is the decomposition of lead nitrate into lead oxide (a solid that remains in the tube), nitrogen dioxide (brown fumes), and oxygen gas. Thus, the correct option is that the brown fumes are due to the thermal decomposition of lead nitrate producing brown fumes of nitrogen dioxide.

Question 3.

Select washing soda from the following:

[1 Marks]

(A) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

(B) NaHCO_3

(C) NaOH

(D) $\text{Na}_2\text{CO}_3 \cdot 5\text{H}_2\text{O}$

Explanation: The correct option is $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ because washing soda is the decahydrate form of sodium carbonate, meaning it contains 10 water molecules of crystallization. This is supported by the context which mentions $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ as washing soda and explains that recrystallisation of sodium carbonate gives washing soda. Other options such as NaHCO_3 (baking soda), NaOH (caustic soda), and $\text{Na}_2\text{CO}_3 \cdot 5\text{H}_2\text{O}$ do not represent washing soda.

Question 4.

An organism which breaks down the food material outside the body and then absorbs it is

[1 Marks]

(A) a bacteria, Rhizobium

(B) a plant parasite, Cuscuta

(C) a fungi, Rhizopus

(D) an animal parasite, Tapeworm

Explanation: Fungi like Rhizopus break down food material outside their body by releasing digestive enzymes, and then absorb the nutrients. This mode of nutrition is different from organisms that take in food and digest it inside their bodies. Therefore, the correct answer is fungi such as Rhizopus.

Question 5.

Consider the following statements about small intestine and select the one which is NOT correct:

[1 Marks]

(A) The villi of the small intestine absorb water from the unabsorbed food before it gets removed from the body via the anus.

(B) The length of the small intestine in animals differs as it depends on the type of food they eat.

(C) The small intestine receives secretions from liver and pancreas.

(D) The small intestine is the site of complete digestion of food.

Explanation: The statement 'The villi of the small intestine absorb water from the unabsorbed food before it gets removed from the body via the anus.' is NOT correct. According to the context, water is absorbed in the large intestine, not in the small intestine. The small intestine mainly absorbs nutrients and receives secretions from the liver and pancreas to complete digestion. The length of the small intestine does vary among animals based on their diet.

Question 6.

The statement that correctly describes the characteristic(s) of a gene is:

[1 Marks]

(A) In individuals of a given species, a specific gene is located on a particular chromosome.

(B) A gene is not the information source for making proteins in the cell.

(C) All the inherited traits in human beings are not controlled by genes.

(D) Each chromosome has only one gene located all along its length.

Explanation: The correct option is: 'In individuals of a given species, a specific gene is located on a particular chromosome.' This is because genes are functional segments of DNA located at specific positions on chromosomes. Genes carry the information required for making proteins, which control the characteristics or traits in an organism. Other options are incorrect because genes do serve as the information source for proteins, all inherited traits are controlled by genes, and chromosomes contain many genes, not just one.

Question 7.

Select from the following the correct statement about tropic movement in plants:

[1 Marks]

- (A) It is a growth related movement.
- (B) It is due to stimulus of touch and temperature.
- (C) It does not depend upon the direction of stimulus received.
- (D) It is observed only in roots and not in stems.

Explanation: The correct statement is 'It is a growth related movement.' Tropic movements in plants are directional growth movements in response to external stimuli like light and gravity. These movements depend on the growth of plant parts in a particular direction, making it a growth-related movement. Other options are incorrect because tropic movements do depend on the direction of the stimulus, are not solely due to touch and temperature, and are observed in both roots and stems.

Question 8.

Select the INCORRECT match (between the plant and its vegetative part) from the following:

[1 Marks]

- (A) Money-plant, stem
- (B) Bryophyllum, leaf
- (C) Potato, stem
- (D) Rose, root

Explanation: Bryophyllum propagates vegetatively through its leaves as it has buds on leaf margins. Potato propagates vegetatively through its stem as the tubers are modified stems. Money plant propagates through its stem as well. However, Rose does not propagate vegetatively through its roots; it typically propagates through stem cuttings or grafting. Therefore, the match 'Rose, root' is incorrect.

Question 9.

If four identical resistors, of resistance 8Ω , are first connected in series so as to give an effective resistance R_s , and then connected in parallel so as to give an effective resistance R_p , then the ratio R_s/R_p is

[1 Marks]

(A) 0.5

(B) 2

(C) 16

(D) 32

Explanation: When four identical resistors of 8Ω each are connected in series, the total resistance R_s is the sum of all resistances: $R_s = 8 + 8 + 8 + 8 = 32 \Omega$. When the same resistors are connected in parallel, the total resistance R_p is given by $1/R_p = 1/8 + 1/8 + 1/8 + 1/8 = 4/8 = 1/2$, so $R_p = 2 \Omega$. Therefore, the ratio $R_s / R_p = 32 / 2 = 16$. Hence, the correct option is 16.

Question 10.

1. In domestic electric circuits the wiring with 15 A current rating is for the electric devices which have

[1 Marks]

(A) lower power ratings such as fan.

(B) non-metallic bodies and low power

(C) higher power ratings such as geyser.

(D) metallic bodies and low power ratings.

Explanation: In a domestic electric circuit, wires with a 15 A current rating are used for devices that have higher power ratings, such as geysers and air coolers. This is because these devices draw more current compared to devices like bulbs and fans, which use wires with a lower current rating (e.g., 5 A). Using wiring with appropriate current rating prevents overheating and ensures safety.

Question 11.

Assertion (A): Blood clotting prevents excessive loss of blood.

Reason (R): Blood clotting is due to blood plasma and white blood cells present in the blood.

[1 Marks]

(A) Both A and R are true but R is not the correct explanation of A.

(B) Both A and R are true and R is the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

Explanation: The assertion (A) is true because blood clotting helps prevent excessive loss of blood during injury by forming a plug. However, the reason (R) is false because blood clotting is primarily due to platelets, not blood plasma and white blood cells. Platelets are the cells responsible for clot formation by plugging leaks in blood vessels.

Question 12.

Assertion (A): The strength of the magnetic field produced at the centre of a current-carrying circular coil increases on increasing the number of turns in it.

Reason (R): The current in each circular turn has the same direction and the magnetic field due to each turn adds up.

[1 Marks]

(A) A is false but R is true.

(B) A is true but R is false.

(C) Both A and R are true and R is the correct explanation of A.

(D) Both A and R are true but R is not the correct explanation of A.

Explanation: Both Assertion (A) and Reason (R) are true, and Reason (R) correctly explains Assertion (A). This is because the magnetic field produced by a current-carrying coil is directly proportional to the number of turns in the coil. Since the current in each turn flows in the same direction, the magnetic fields from each turn add up, resulting in a stronger magnetic field at the centre of the coil when the number of turns increases.

Section B

Question 13.

(i) A compound 'X' which is prepared from gypsum has the property of hardening when mixed with proper quantity of water.

Identify 'X' and write its chemical formula.

(ii) State the difference in chemical composition between baking soda and baking powder.

[2 Marks]

Answer: (i) Compound 'X' is Plaster of Paris, which is prepared by heating gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). Its chemical formula is $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$. When mixed with water, it hardens due to formation of gypsum.

(ii) Baking soda is sodium hydrogencarbonate with the formula NaHCO_3 . Baking powder is a mixture of baking soda (NaHCO_3) and a mild edible acid like tartaric acid. Baking powder releases CO_2 gas on heating or mixing with water, helping dough rise.

Question 14.

Write balanced chemical equation for the reaction that occurs when:

(i) blue coloured copper sulphate crystals are heated and

(ii) Sodium hydrogen carbonate is heated during cooking.

[2 Marks]

Answer: (i) When blue coloured copper sulphate crystals are heated, they lose water of crystallization and turn into white anhydrous copper sulphate.

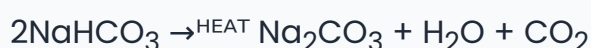
Copper sulphate pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) $\xrightarrow{\text{HEAT}}$ Anhydrous copper sulphate (CuSO_4) + $5\text{H}_2\text{O}$ (water vapour)

Balanced equation:



(ii) When sodium hydrogen carbonate (NaHCO_3) is heated during cooking, it decomposes to form sodium carbonate (Na_2CO_3), water (H_2O) and carbon dioxide (CO_2).

Balanced equation:



This reaction is used in cooking to make cakes rise as the carbon dioxide gas produced helps in leavening.

Question 15.

- (a) Write the role of insulin in regulating blood sugar levels in human body. Mention the disease caused due to it.
- (b) How is the timing and the amount of release of insulin in the blood regulated?

[2 Marks]

Answer:

- (a) Insulin is a hormone produced by the pancreas that helps regulate blood sugar levels in the human body. It allows cells to absorb glucose from the blood to use as energy or store for later use, thereby lowering the sugar level in the blood. If insulin is not secreted properly, blood sugar levels rise, leading to a disease called diabetes.
- (b) The timing and amount of insulin released into the blood are controlled by a feedback mechanism. When blood sugar levels rise, pancreas cells detect this increase and produce more insulin. As blood sugar levels fall, insulin secretion decreases. This ensures that the blood sugar level is maintained within a normal range.

Question 16.

Name the type of blood (oxygenated / deoxygenated) transported by each of the following mentioning the path (i.e. from one organ (which place) to another (which place)).

- (i) Vena cava
- (ii) Pulmonary artery

[2 Marks]

Answer: i) Vena cava carries deoxygenated blood from the body to the right atrium of the heart. It collects blood low in oxygen from various parts of the body and transports it to the heart for oxygenation. ii) Pulmonary artery carries deoxygenated blood from the right ventricle of the heart to the lungs. This blood is low in oxygen and needs to pick up oxygen from the lungs. The pulmonary artery is unique because it carries deoxygenated blood away from the heart to the lungs for oxygenation.

Question 17.

With the help of a schematic flow chart, show the breakdown of glucose in a cell to provide energy -

- (i) in the presence of oxygen
- (ii) in lack of oxygen

Answer:

(i) Breakdown of glucose in the presence of oxygen (Aerobic respiration):

Glucose enters the cell and undergoes glycolysis in the cytoplasm, where it breaks down into two molecules of pyruvate. The pyruvate then enters the mitochondria, where in the presence of oxygen, it is further broken down to produce carbon dioxide, water, and a large amount of energy (ATP).

(ii) Breakdown of glucose in the lack of oxygen (Anaerobic respiration):

When oxygen is not available, glucose is still broken down by glycolysis into pyruvate in the cytoplasm. However, instead of entering mitochondria, pyruvate is converted into lactic acid (in muscles) or alcohol and carbon dioxide (in some microorganisms), releasing less energy compared to aerobic respiration.

Question 18.

Name the part of the human excretory system where nephrons are found.

Write the structure and function of nephrons.

[2 Marks]

Answer: Nephrons are found in the kidneys, which are the main organs of the human excretory system. A nephron consists of two main parts: the renal corpuscle and the renal tubule. The renal corpuscle includes the glomerulus, a network of capillaries where blood is filtered. The renal tubule is a long, winding tube where important substances like glucose, salts, and water are reabsorbed into the blood, while waste products remain to form urine. Nephrons filter blood, remove wastes and excess substances, and produce urine, helping maintain the body's internal balance.

Question 19.

A narrow beam XY of white light is passing through a glass prism ABC as shown in the diagram:

Trace it on your answer sheet and show the path of the emergent beam as observed on the screen PQ.

Name the phenomenon observed and state its cause.

[2 Marks]

Answer: When a narrow beam XY of white light passes through the glass prism ABC, it bends at the surface because light changes speed when it moves from air into glass. Inside the prism, light moves straight but slower. When it comes out of the prism on the

other side, it bends again and splits into many colors forming a spectrum on the screen PQ. This splitting of white light into its colors is called dispersion. Dispersion happens because different colors (wavelengths) of light bend by different amounts while refracting through the glass prism.

Question 20.

It is observed that the power of an eye to see nearby objects as well as far off objects diminishes with age.

- (i) Give reason for the above statement.
- (ii) Name the defect that is likely to arise in the eyes in such a condition.
- (iii) Draw a labelled ray diagram to show the type of corrective lens used for restoring the vision of such an eye.

[2 Marks]

Answer:

- (i) The power of the eye to see nearby and far off objects diminishes with age because the ciliary muscles weaken and the eye lens loses its flexibility. This reduces the eye's ability to adjust its focal length for clear vision at various distances, a process known as accommodation.
- (ii) This condition is called presbyopia.
- (iii) To correct presbyopia, convex lenses (converging lenses) are used. They assist the eye lens by converging light rays before they enter the eye, helping to focus the image on the retina clearly.

Question 21.

How do harmful chemicals get accumulated progressively at each trophic level in a food chain?

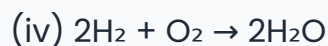
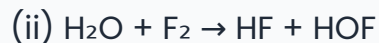
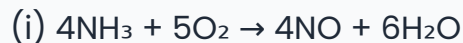
[2 Marks]

Answer: Harmful chemicals enter the food chain through polluted soil and water. Plants absorb these chemicals from soil and water and become the first trophic level or producers. As herbivores eat these plants, the chemicals accumulate in their bodies. When carnivores eat herbivores, the chemicals accumulate more and increase progressively at each trophic level. Since these chemicals are not degradable, their concentration magnifies as we move up the food chain. This process is called biological magnification.

Section C

Question 22.

(a) Identify the reducing agent in the following reactions:



(b) Define a redox reaction in terms of gain or loss of oxygen.

[3 Marks]

Answer: (a) The reducing agents in the given reactions are:

(i) NH_3 as it loses hydrogen and is oxidised to NO .

(ii) H_2O as it loses oxygen and is oxidised when reacting with F_2 .

(iii) CO as it loses oxygen and is oxidised to CO_2 .

(iv) H_2 as it loses electrons and is oxidised to H_2O .

(b) A redox reaction is a chemical reaction in which oxidation and reduction occur simultaneously. In terms of oxygen, oxidation is the gain of oxygen by a substance, while reduction is the loss of oxygen by a substance.

Question 23.

(a) Suggest one remedial measure each to counteract the change in pH in human beings in following cases :

(i) Production of too much acid in stomach during indigestion

(ii) Stung by a honey bee / nettle leaves

(b) Fresh milk has a pH of 6. When it changes into curd will its pH increase or decrease ? Why?

[3 Marks]

Answer: (a)(i) To counteract excess acid in the stomach caused by indigestion, one can take antacids like magnesium hydroxide (milk of magnesia). These are mild bases that neutralize the excess hydrochloric acid, relieving pain and irritation.

(a)(ii) When stung by a honey bee or nettle leaves, the affected area becomes acidic. To neutralize this acidity and reduce pain and swelling, one can apply a mild base such as baking soda solution or toothpaste.

(b) Fresh milk has a pH of around 6, which is slightly acidic. When milk turns into curd, its pH decreases and becomes more acidic due to the formation of lactic acid by bacteria during fermentation. Hence, the pH of curd is lower than that of fresh milk.

Question 24.

- (i) State the role of ATP in cellular respiration.
- (ii) What ensures sufficient exchange of gases in plants?
- (iii) State the conditions on which the direction of diffusion of gases in plant depend upon.

[3 Marks]

Answer:

(i) Role of ATP in cellular respiration:

ATP (Adenosine Triphosphate) acts as the energy currency of the cell. During cellular respiration, energy is released by breaking down glucose in the presence of oxygen. This energy is captured and stored in the form of ATP molecules. ATP then provides energy required for various cellular activities, including metabolic reactions, growth, and repair.

(ii) What ensures sufficient exchange of gases in plants?

Sufficient gas exchange in plants is ensured by tiny pores called stomata present mainly on leaves. Additionally, large intercellular spaces inside the leaf provide contact of all cells with air. Gases such as oxygen and carbon dioxide diffuse through the stomata, allowing plants to exchange gases effectively for photosynthesis and respiration.

(iii) Conditions affecting the direction of diffusion of gases in plants:

The direction of gas diffusion depends on environmental conditions and the plant's requirements. For example, during photosynthesis, plants take in carbon dioxide and release oxygen, so carbon dioxide diffuses inside while oxygen diffuses out. During respiration, oxygen is consumed and carbon dioxide is released, influencing the diffusion direction accordingly.

Question 25.

- (a) Complete the following ray diagram to show the formation of image
- (b) Mention the nature, position and size of the image formed in this case.
- (c) State the sign of the image distance in this case using the Cartesian sign convention.

[3 Marks]

Answer: (a) To complete the ray diagram for image formation by a concave mirror when the object is placed between the focal point (F) and the mirror, extend the reflected rays

backward behind the mirror. Two rays are usually drawn: one parallel to the principal axis which reflects through the focal point, and another passing through the focal point that reflects parallel to the principal axis. These reflected rays diverge in front of the mirror but their extensions meet behind the mirror, forming a virtual image.

(b) The image formed in this case is virtual because the reflected rays do not actually meet but appear to diverge from a common point behind the mirror. The virtual image is erect (upright), larger than the object, and located behind the mirror (between the mirror and the focal point).

(c) According to the Cartesian sign convention, the image distance (v) is taken negative if the image forms on the same side as the object, which for a virtual image formed by a concave mirror is behind the mirror. Therefore, the image distance is negative in this case.

Question 26.

(i) State the rule used to find the force acting on a current carrying conductor placed in a magnetic field.

(ii) Given below are three diagrams showing entry of an electron in a magnetic field. Identify the case in which the force will be (1) maximum and (2) minimum respectively. Give reason for your answer.

[3 Marks]

Answer:

(i) The rule used to find the force acting on a current carrying conductor in a magnetic field is Fleming's Left-Hand Rule. According to this rule, if you stretch the thumb, the forefinger, and the middle finger of your left hand such that they are mutually perpendicular to each other, then:

- The First finger points in the direction of the Magnetic Field (from North to South).
- The seCond finger points in the direction of the Current (from positive to negative).
- The thuMb shows the direction of the Motion or the force acting on the conductor.

(ii) To identify the cases where force acting on the electron is maximum or minimum, we consider the direction of velocity of the electron relative to the magnetic field.

- The force on a charged particle moving in a magnetic field is given by the Lorentz force, which depends on the sine of the angle between velocity of the particle and magnetic field.
- When the velocity is perpendicular to the magnetic field (angle 90°), $\sin(90^\circ) = 1$, so the force is maximum.

- When the velocity is parallel or antiparallel to the magnetic field (angle 0° or 180°), $\sin(0^\circ) = \sin(180^\circ) = 0$, so the force is minimum (zero).

Therefore, among the three diagrams, the case where the electron enters the magnetic field perpendicularly experiences the maximum force, and the case where the electron enters parallel to the magnetic field experiences the minimum force.

Question 27.

- (i) Draw the pattern of magnetic field lines of
- (1) a current carrying solenoid
 - (2) a bar magnet
- (ii) List two distinguishing features between the two fields.

[3 Marks]

Answer:

(i) The magnetic field lines of a current-carrying solenoid are similar to those of a bar magnet. Inside the solenoid, the magnetic field lines are nearly parallel, close together, indicating a strong and uniform magnetic field. Outside the solenoid, the lines spread out and loop from one end of the solenoid to the other, forming closed loops. The direction of the magnetic field inside the solenoid is from the south pole to the north pole (as formed by the current direction).

The magnetic field lines of a bar magnet emerge from the north pole and curve around to enter the south pole, forming closed loops outside the magnet. Inside the bar magnet, the field lines run from the south pole back to the north pole. The pattern looks similar with field lines forming continuous loops in both cases.

(ii) Two distinguishing features between the magnetic field of a solenoid and a bar magnet are:

1. The magnetic field inside a solenoid is strong and uniform, whereas inside a bar magnet it may not be perfectly uniform.
2. The polarity of the solenoid's magnetic field can be changed by reversing the direction of the current, but the poles of a bar magnet are fixed and cannot be reversed easily.

Question 28.

- (i) Why does a kitchen garden called an artificial ecosystem while a forest is considered to be a natural ecosystem?
- (ii) While designing an artificial ecosystem at home, write any two things to be kept in mind to convert it into a self-sustaining system. Give reason to justify your answer.

Answer:

(i) A kitchen garden is called an artificial ecosystem because it is made and maintained by humans. People plant and care for the plants, control the growth of other organisms, and manage the ecosystem manually. In contrast, a forest is a natural ecosystem as it develops and sustains itself without human intervention. Forests contain various plants, animals, and microorganisms interacting naturally, maintaining a balanced environment.

(ii) While designing an artificial ecosystem at home, two important things to keep in mind are maintaining a balance between producers and consumers, and ensuring proper recycling of nutrients. Producers like plants create food through photosynthesis which supports consumers such as insects or small animals. Also, decomposers must be present to break down dead matter, recycling nutrients back into the soil. This balance helps the ecosystem to sustain itself by providing energy and nutrients continuously.

Question 29.

(i) Construct a food chain of four trophic levels comprising the following:

Hawk, snake, plants, rat.

(ii) 20,000 J of energy was transferred by the producers to the organism of second trophic level. Calculate the amount of energy that will be transferred by organisms of the third trophic level to the organisms of the fourth trophic level.

[3 Marks]

Answer: (i) Food Chain Construction:

Plants → Rat → Snake → Hawk

Here, plants are producers and form the first trophic level. Rats, which eat plants, represent the second trophic level (primary consumers). Snakes, which eat rats, form the third trophic level (secondary consumers). Hawks, which feed on snakes, are the fourth trophic level (tertiary consumers).

(ii) Energy Transfer Calculation:

The energy transferred from producers (plants) to the second trophic level (rat) is given as 20,000 joules. According to the 10% energy transfer rule, only 10% of the energy is passed to the next trophic level at each step.

Energy transferred from the second trophic level (rat) to the third trophic level (snake) = 10% of 20,000 J = 2,000 J.

Energy transferred from the third trophic level (snake) to the fourth trophic level (hawk) = 10% of 2,000 J = 200 J.

Therefore, 200 joules of energy will be transferred from the third trophic level to the fourth trophic level.

Section D

Question 30. Almost all metals combine with oxygen to form metal oxides. Metal oxides are generally basic in nature. But some metal oxides show both basic as well as acidic behaviour. Different metals show different reactivities towards oxygen. Some react vigorously while some do not react at all.

(1) What happens when copper is heated in air? Give the equation of the reaction involved.

[1 Marks]

Answer: When copper is heated in air, it reacts with oxygen present in the air to form copper(II) oxide. This copper oxide is black in color and forms as a layer on the surface of copper. The chemical reaction involved is: $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$. Here, copper (Cu) combines with oxygen (O_2) to form copper oxide (CuO).

Key Points: Copper reacts with oxygen on heating - copper oxide formed is black in color - chemical reaction: $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$ - copper oxide forms on the surface of copper - copper oxide is an example of a basic metal oxide

(2) Why are some metal oxides categorized as amphoteric? Give one example.

[1 Marks]

Answer: Some metal oxides are categorized as amphoteric because they can react both with acids and bases to form salts and water. This means they show both acidic and basic properties. For example, aluminium oxide (Al_2O_3) is an amphoteric oxide. It reacts with hydrochloric acid to form aluminium chloride and water, showing basic behaviour. It also reacts with sodium hydroxide to form sodium aluminate and water, showing acidic behaviour.

Key Points: Amphoteric oxides react with both acids and bases-They produce salts and water on reacting with acids and bases-Example of amphoteric oxide is aluminium oxide (Al_2O_3)-Aluminium oxide reacts with acid to give aluminium salt and water-Aluminium oxide reacts with base to give complex salt and water

(3)

Complete the following equations:



[2 Marks]

Answer: (i) Sodium oxide reacts with water to form sodium hydroxide: $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2 \text{NaOH}$ (ii) Aluminium oxide is an amphoteric oxide and reacts with sodium hydroxide to form sodium aluminate and water: $\text{Al}_2\text{O}_3 + 2 \text{NaOH} \rightarrow 2 \text{NaAlO}_2 + \text{H}_2\text{O}$

Key Points: Sodium oxide is a basic oxide-It reacts with water to form sodium hydroxide (a base)-Aluminium oxide is amphoteric-It reacts with both acids and bases-When aluminium oxide reacts with sodium hydroxide, it forms sodium aluminate and water

(4)

On burning sulphur in oxygen a colourless gas is produced.

(i) Write chemical equation for the reaction.

(ii) Name the gas formed.

(iii) State the nature of the gas.

(iv) What will be the action of this on a dry litmus paper?

[2 Marks]

Answer: (i) The chemical equation when sulphur burns in oxygen is: $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$ (ii) The gas formed is Sulphur dioxide (SO_2). (iii) The nature of the gas sulphur dioxide is acidic. (iv) When sulphur dioxide gas comes in contact with dry litmus paper, there is no change in the color of the dry litmus paper because dry litmus paper only shows change in color in presence of moisture.

Key Points: 1. Sulphur combines with oxygen to form sulphur dioxide. 2. The reaction chemical equation: $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$. 3. Sulphur dioxide is an acidic oxide. 4. Dry litmus paper does not change color when exposed to acidic oxides as moisture is necessary for the gas to affect the litmus paper.

Section E

Question 31.

A saturated organic compound A belongs to the homologous series of alcohols.

On heating A with concentrated sulphuric acid at 443K, it forms an unsaturated compound B with molecular mass 28 u.

The compound B on addition of one mole of hydrogen in the presence of nickel changes to a saturated hydrocarbon C.

- (i) Identify A, B and C.
- (ii) Write the chemical equations showing the conversion of A into B.
- (iii) What happens when compound C undergoes combustion?
- (iv) State one industrial application of hydrogenation reaction.
- (v) Name the products formed when compound A reacts with sodium.

[5 Marks]

Answer: (i) Identification of compounds:

Compound A is ethanol (C_2H_5OH), a saturated alcohol.

Compound B is ethene (C_2H_4), an unsaturated hydrocarbon with molecular mass 28 u formed by dehydration of ethanol.

Compound C is ethane (C_2H_6), a saturated hydrocarbon formed by hydrogenation of ethene.

(ii) Chemical equation for conversion of A into B:



Explanation: Ethanol on heating with concentrated sulphuric acid undergoes dehydration to form ethene and water.

(iii) Combustion of compound C:



Explanation: Ethane burns in excess oxygen to produce carbon dioxide, water and release energy.

(iv) Industrial application of hydrogenation reaction:

Hydrogenation is used in the food industry to convert vegetable oils (unsaturated fats) into margarine and other solid fats.

(v) Products formed when A reacts with sodium:



Explanation: Ethanol reacts with sodium to form sodium ethoxide and hydrogen gas.

Question 32.

(i) With the help of diagram, show the formation of micelles when soap is applied on oily dirt.

(ii) Take two test tubes X and Y with 10 mL of hard water each. In test tube X add a few drops of soap solution and in test tube Y add a few drops of detergent solution. Shake both for the same period.

(1) In which test tube will the formation of foam be more? Why?

(2) In which test tube is a curdy solid formed? Why?

[5 Marks]

Answer:

(i) Formation of Micelles:

Soap molecules consist of two parts: a hydrophobic tail which is water-repellent and a hydrophilic head which is water-attracting. When soap is applied on oily dirt, the hydrophobic tails of soap molecules attach themselves to the oil/dirt particles, while the hydrophilic heads remain in the water. This arrangement forms tiny spherical structures called micelles, where the oily dirt is trapped inside the micelle. This allows the dirt to be emulsified and washed away with water, thus effectively cleaning the dirt.

[Diagram Description: Micelles showing soap molecules with tails attached to oily dirt inside and heads facing outward towards water]

(ii) Testing Soap and Detergent in Hard Water:

(1) Formation of Foam:

Foam formation will be more in test tube Y, which contains detergent solution. This is because detergents do not react with the calcium and magnesium salts present in hard water and thus produce good foam. On the other hand, soap reacts with these salts forming an insoluble substance that reduces foam formation.

(2) Formation of Curdy Solid:

Test tube X, containing soap solution, will form a curdy white solid called 'scum.' This happens because soap reacts with calcium and magnesium ions present in hard water, forming insoluble calcium or magnesium salts. These precipitates appear as a sticky curdy solid, which decreases the cleaning efficiency of soap in hard water.

Question 33.

- (a) Name the parts of a bisexual flower that are not directly involved in reproduction.
- (b) Differentiate between self pollination and cross pollination. List any two significance of pollination.
- (c) What is the fate of ovules and ovary after fertilization in a flower?

[5 Marks]

Answer:

(a) The parts of a bisexual flower that are not directly involved in reproduction are the *sepals* and *petals*. Sepals protect the flower before it blooms, while petals attract pollinators such as bees and butterflies.

(b) *Self-pollination* occurs when pollen from the anther of a flower falls on the stigma of the same flower. This means the flower fertilizes itself with its own pollen. In contrast, *cross-pollination* happens when pollen is transferred from the anther of one flower to the stigma of a different flower, usually from another plant of the same species. Cross-pollination helps increase genetic diversity in plants.

Two significances of pollination are: (1) It helps in the process of fertilization by bringing male gametes to the female part of the flower, ensuring seed formation. (2) It aids in the production of fruits and seeds, which are crucial for the reproduction and survival of plant species.

(c) After fertilization, the ovules inside the ovary develop into seeds, which contain the embryonic plant. The ovary itself matures and changes into a fruit that protects the seeds and helps in their dispersal.

Question 34.

- (a) An electric iron consumes energy at a rate of 880 W when heating is at the maximum rate and 330 W when the heating is at the minimum. If the source voltage is 220 V, calculate the current and resistance in each case.
- (b) What is heating effect of electric current ?
- (c) Find an expression for the amount of heat produced when a current passes through a resistor for some time.

[5 Marks]

Answer: (a)

Given power P and voltage V , the current I can be calculated using the formula $I = P / V$.

For the maximum heating:

Power $P = 880$ W, Voltage $V = 220$ V

Current $I = 880 / 220 = 4$ A

$$\text{Resistance } R = V / I = 220 / 4 = 55 \text{ ohms}$$

For the minimum heating:

$$\text{Power } P = 330 \text{ W, Voltage } V = 220 \text{ V}$$

$$\text{Current } I = 330 / 220 = 1.5 \text{ A}$$

$$\text{Resistance } R = 220 / 1.5 \approx 146.67 \text{ ohms}$$

(b)

The heating effect of electric current refers to the phenomenon where an electric current passing through a conductor produces heat. This happens because the moving electrons collide with the atoms of the conductor, causing them to vibrate and generate heat energy. This effect is the basis for many electrical appliances like electric irons, heaters, and toasters, which convert electrical energy into heat energy.

(c)

The amount of heat produced (H) when a current (I) passes through a resistor (R) for some time (t) is given by the formula:

$$H = I^2 \times R \times t$$

This equation shows that the heat produced is directly proportional to the square of the current, the resistance, and the time for which the current flows through the resistor.
