

CBSE EXAMINATION PAPER-2024

SCIENCE

(Solved)

Time allowed : 3 hours

Maximum Marks : 42

General Instructions :

Read the following instructions carefully and follow them :

- i. This question paper contains **22 questions**. All questions are **compulsory**.
- ii. This question paper is divided into **5 sections**.
- iii. **Section A** – questions number **1 to 7** are multiple choice questions Each question carries **1 marks**.
- iv. **Section B** – questions number **8 to 15** are very short answer Each question carries **2 marks**.
- v. **Section C** – questions number **16 to 18** are short answer Each question carries **3 marks**.
- vi. **Section D** – questions number **19 to 20** are case based questions
- vii. **Section E** – questions number **21 to 22** 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.

Select a pair of natural indicator from the following:

[1 Marks]

- (A) Litmus and methyl orange
- (B) Methyl orange and Turmeric
- (C) Phenolphthalein and methyl orange
- (D) Turmeric and Litmus**

Explanation: The correct option is 'Turmeric and Litmus' because both turmeric and litmus are naturally occurring indicators. Litmus is made from lichens, and turmeric is a natural dye that changes color in the presence of a base. On the other hand, phenolphthalein and methyl orange are synthetic indicators. Therefore, 'Turmeric and Litmus' is the pair of natural indicators.

Question 2.

Consider the following Chemical equation: $a\text{Al}_2\text{O}_3 + b\text{HCl} \rightarrow c\text{AlCl}_3 + d\text{H}_2\text{O}$ In order to balance this chemical equation, the values of a, b, c and d must be

[1 Marks]

- (A) 1, 6, 2 and 3**
- (B) 1, 6, 3 and 2
- (C) 2, 6, 2 and 3
- (D) 2, 6, 3 and 2

Explanation: The balanced chemical equation is: $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$. Here, $a = 1$, $b = 6$, $c = 2$, and $d = 3$. This is because one unit of Al_2O_3 contains 2 aluminum atoms and 3 oxygen atoms. On the right side, each AlCl_3 contains 1 aluminum atom and 3 chlorine atoms, so 2AlCl_3 will balance the 2 aluminum atoms on the left. 6HCl provides 6 chlorine atoms and 6 hydrogen atoms. The hydrogen atoms combine with oxygen atoms from Al_2O_3 to form 3 water molecules ($3\text{H}_2\text{O}$), balancing both hydrogen and oxygen atoms.

Question 3. Select from the following a plant hormone which promotes cell division.

[1 Marks]

- (A) Gibberellins
- (B) Auxins
- (C) Abscissic Acid
- (D) Cytokinins**

Explanation: The correct answer is Cytokinins. According to the context, cytokinins promote cell division and are found in greater concentration in areas of rapid cell division such as fruits and seeds. Other plant hormones like auxins and gibberellins help in stem growth, while abscisic acid inhibits growth.

Question 4.

Part(s) of a flower which attracts insects for pollination is (are)

[1 Marks]

(A) petals and Sepals

(B) anther and Stigma

(C) petals only

(D) sepals only

Explanation: The correct answer is 'petals only' because petals are colorful parts of the flower that attract insects and other animals for pollination. Sepals protect the flower bud and do not attract insects. Anther and stigma are reproductive parts and are not involved in attracting insects.

Question 5. In an experiment to study independent inheritance of two separate traits: shape and colour of seeds, the ratio of the different combinations in F₂ progeny would be [1 Marks]

(A) 1:3

(B) 9:3:3:1

(C) 1:2:1

(D) 9:1:1:3

Explanation: The correct answer is 9:3:3:1. According to Mendel's Law of Independent Assortment, when two traits are inherited independently, the F₂ generation produced from crossing heterozygous parents for both traits shows a phenotypic ratio of 9 (both dominant traits) : 3 (dominant for first trait and recessive for second) : 3 (recessive for first trait and dominant for second) : 1 (both recessive traits). In this experiment, seed shape and colour are two separate traits, and their combinations in the F₂ progeny demonstrate this classic 9:3:3:1 ratio.

Question 6.

The Phenomena of light involved in the formation of a rainbow in the sky are

[1 Marks]

- (A) Refraction, dispersion and reflection
- (B) Dispersion, refraction and internal reflection
- (C) Dispersion, scattering and reflection
- (D) Refraction, dispersion and total internal reflection**

Explanation:

The correct answer is 'Refraction, dispersion and total internal reflection'

Question 7.

A food chain will be more advantageous in terms of energy if it has

[1 Marks]

- (A) 2 trophic levels**
- (B) 5 trophic levels
- (C) 4 trophic levels
- (D) 3 trophic levels

Explanation:

The correct answer is '2 trophic levels'. According to the context, energy transfer between trophic levels is inefficient, and significant energy is lost at each step. Therefore, food chains generally consist of only two or four trophic levels because beyond this, too little usable energy remains. A shorter food chain with fewer trophic levels (like 2) is more energy efficient compared to longer chains (like 5 trophic levels).

Section B

Question 8. When magnesium ribbon is burnt in air, an ash of white colour is produced. Write the chemical equation for the reaction giving the chemical name of the ash produced. State the type of chemical reaction giving justification for your answer.

[2 Marks]

Answer: When magnesium ribbon burns in air, it reacts with oxygen forming a white ash called magnesium oxide. The chemical equation for the reaction is: Magnesium + Oxygen \rightarrow Magnesium oxide or $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$. This is a combination reaction, where two elements combine to form one compound. It is also an oxidation reaction because magnesium gains oxygen atoms during the process.

Question 9. Where are auxins synthesized? How do they promote phototropism?

[2 Marks]

Answer: Auxins are synthesized mainly at the shoot tips of plants. They promote phototropism by diffusing towards the shaded side of the shoot when light comes from one direction. This causes a higher concentration of auxin on the side away from light, stimulating the cells there to elongate more. As a result, the shoot bends towards the light source, allowing the plant to maximize light absorption for photosynthesis.

Question 10. List any two pairs of visible contrasting characters of garden pea plants used by Mendel for his experiments stating the dominant and recessive characters in each pair.

[2 Marks]

Answer: Mendel used several pairs of contrasting characters in garden pea plants to study inheritance. Two such pairs are: 1. Seed Shape: Round seeds are dominant (represented as R), while wrinkled seeds are recessive (represented as r). 2. Plant Height: Tall plants are dominant (T), and short plants are recessive (t). These contrasting characters helped Mendel analyze how traits are passed from one generation to the next.

Question 11. In human beings, the probability of getting a male or a female child is 50%. Explain with the help of a flow diagram only.

[2 Marks]

Answer: In humans, the mother has two X chromosomes (XX), so eggs always carry an X chromosome. The father has one X and one Y chromosome (XY), so sperm can carry either an X or a Y chromosome. When an X-carrying sperm fertilizes the egg (X), the child will be female (XX). When a Y-carrying sperm fertilizes the egg (X), the child will be male (XY). Since sperm carrying X or Y chromosomes are produced in equal amounts, the chance of having a male or female child is 50% each.

Question 12. When do we say that a particular person is suffering from hypermetropia? List two causes of this defect. Name the type of lens used to correct this defect.

[2 Marks]

Answer: A person is said to be suffering from hypermetropia (or farsightedness) when they find it difficult to see nearby objects clearly but can see distant objects clearly. This happens because the image of nearby objects is formed behind the retina. Two main causes of this defect are: (1) the focal length of the eye lens is too long, and (2) the eyeball is smaller than normal. Hypermetropia can be corrected by using convex lenses, which help focus the image correctly onto the retina.

Question 13.

Draw a labelled diagram to show the pattern of magnetic field lines produced due to a current carrying straight conductor. Mark on it the direction of current in the conductor and the direction of magnetic field lines.

[2 Marks]

Answer: A straight conductor carrying current creates magnetic field lines that form concentric circles around it. The direction of the magnetic field lines can be determined by the right-hand thumb rule: if the right thumb points along the current direction, the curled fingers indicate the magnetic field direction. In the labelled diagram, the straight wire is drawn vertically with an arrow showing current flowing upwards. Around the wire, concentric circles are drawn with arrows indicating magnetic field direction as anti-clockwise when viewed from above. This illustrates the circular pattern of magnetic field lines around the straight current-carrying conductor.

Question 14.

Name the device used to magnetise a piece of magnetic material. Draw a labelled diagram to show the arrangement used for the magnetisation of a cylinder made of soft iron.

[2 Marks]

Answer: The device used to magnetise a piece of magnetic material is called an electromagnet. It consists of a coil of insulated copper wire wrapped around a soft iron cylinder. When an electric current passes through the coil, it produces a magnetic field that magnetises the soft iron core. This method is commonly used to create temporary magnets. A labelled diagram would show a battery connected to the coil, the coil wrapped around the soft iron cylinder, and a switch to control the current.

Question 15. What are decomposers? List two consequences of their absence in an ecosystem.

[2 Marks]

Answer: Decomposers are organisms like fungi and bacteria that break down dead plants, animals, and waste products into simpler inorganic substances. This process is called decomposition. These nutrients are then released back into the soil and used by plants for growth. In the absence of decomposers, dead organisms and waste would accumulate, leading to a buildup of garbage in the ecosystem. Moreover, the natural replenishment of soil nutrients would not take place, affecting plant growth and disrupting the entire food chain.

Question 16. We water the soil but it reaches the topmost leaves of the plants. Explain in brief the process involved.

[3 Marks]

Answer: When we water the soil, the water is first absorbed by the roots of the plant through a process called osmosis. From the roots, water moves upward through special tubes called xylem vessels that run through the stem and branches. This upward movement of water is helped by root pressure and the pull created by transpiration, which is the evaporation of water from tiny openings called stomata in the leaves. As water evaporates from the leaves, it pulls more water from the roots to the leaves, ensuring a continuous flow. This process not only transports water but also helps in the movement of minerals and keeps the plant cool. Thus, water travels from the soil through the roots, moves up through the xylem, and finally reaches the topmost leaves.

Question 17. Name and explain the phenomenon of light due to which the path of a beam of light becomes visible when it enters a smoke-filled room through a small hole. Also, state the dependence of the colour of the light we receive on the size of the particle of the medium through which the beam of light passes.

[3 Marks]

Answer: The phenomenon is called the Tyndall effect. It occurs when a beam of light passes through a colloidal solution or a medium containing fine particles, such as smoke or dust in the air. These tiny particles scatter the light in different directions, making the path of the beam visible to our eyes. For example, when sunlight enters a smoke-filled room through a small hole, the scattered light by the smoke particles makes the beam's path clearly visible. The colour of the light we receive depends on the size of the particles in the medium. Larger particles scatter longer wavelengths of light, like red or orange, while smaller particles mostly scatter shorter wavelengths like blue. This is why the sky appears blue, as the smaller particles in the atmosphere scatter blue light more effectively.

Question 18. Explain in brief the function of an electric fuse in a domestic circuit. An electric heater of current rating 3 kW; 220 V is to be operated in an electric circuit of rating 5 A. What is likely to happen when the heater is switched ON? Justify your answer with necessary calculations.

[3 Marks]

Answer: An electric fuse is a safety device used in a domestic circuit to protect electrical appliances and wiring from damage due to excessive current. It contains a thin wire that melts when the current exceeds a specific limit (called the rated current), thereby breaking the circuit and stopping the flow of electricity. This prevents overheating, short circuits, or electrical fires. For the electric heater rated at 3 kW and 220 V, the current drawn can be calculated as $\text{Current} = \text{Power} / \text{Voltage} = 3000 \text{ W} / 220 \text{ V} = 13.64 \text{ A}$ approximately. Since the circuit has a rating of only 5 A, the current drawn by the heater is much higher than the rated current of the circuit. When the heater is switched ON, the

current will exceed 5 A, causing the fuse wire to heat up and melt quickly. This will break the circuit, preventing any damage to the wiring or appliances and avoiding hazards. Hence, the fuse acts as a protective device and the heater should not be used on a 5 A circuit.

Section D

Question 19. Human digestive system is a tube running from mouth to anus. Its main function is to breakdown complex molecules present in the food which cannot be absorbed as such into smaller molecules. These molecules are absorbed across the walls of the tube and the absorbed food reaches each and every cell of the body where it is utilised for obtaining energy.

(1) Name the glands present in the buccal cavity and write the components of food on which the secretion of these glands act upon.

[1 Marks]

Answer: The glands present in the buccal cavity are the salivary glands. The secretion of these glands, called saliva, contains the enzyme amylase which acts on carbohydrates in the food. Amylase breaks down starch, a complex carbohydrate, into simpler sugars like maltose. This is the first step of digestion that begins in the mouth.

Key Points: Salivary glands are present in the buccal cavity - Saliva contains enzyme amylase - Amylase acts on carbohydrates (starch) - Breaks starch into simpler sugars - Digestion begins in the mouth

(2)

Two organs have a sphincter muscle at their exit. Name them.

[-1 Marks]

Answer: The two organs that have a sphincter muscle at their exit are the stomach and the anus. The pyloric sphincter controls the exit of food from the stomach into the small intestine, and the anal sphincter controls the exit of waste material from the rectum through the anus.

Key Points: Sphincter muscle controls exit-Organs with sphincter muscles are stomach and anus-Pyloric sphincter at stomach exit-Anal sphincter at anus exit-

(3)

"Bile juice does not contain any enzyme, yet it has important roles in digestion." Justify the statement.

[2 Marks]

Answer: Bile juice, produced by the liver and stored in the gallbladder, does not contain any digestive enzymes. However, it plays an important role in digestion by breaking down large fat globules into smaller droplets. This process is called emulsification. By doing so, bile juice increases the surface area of fats, making it easier for the pancreatic enzymes, such as lipase, to act on fats and digest them efficiently. Additionally, bile juice helps in the absorption of fat-soluble vitamins (A, D, E, and K) and neutralizes the acidic chyme from the stomach, facilitating smooth digestion in the small intestine.

Key Points: Bile juice contains no enzymes–Bile emulsifies fats by breaking large fat globules into smaller droplets–Emulsification increases surface area for enzyme action–Bile facilitates digestion of fats by pancreatic enzymes–Bile assists in absorption of fat-soluble vitamins–Bile neutralizes acidic chyme for better digestion in small intestine

(4)

What will happen if:

- (i) mucus is not secreted by the gastric glands.
- (ii) Villi are absent in the small intestine.

[2 Marks]

Answer: (i) If mucus is not secreted by the gastric glands, the lining of the stomach will not be protected from the acidic gastric juice. This can cause damage to the stomach walls leading to ulcers and pain. The mucus acts as a protective barrier to prevent the stomach walls from getting eroded by the acid. (ii) If villi are absent in the small intestine, the absorption of nutrients will be severely affected. Villi increase the surface area of the small intestine, allowing maximum absorption of digested food into the

bloodstream. Without villi, nutrients cannot be absorbed efficiently, causing malnutrition and other digestive problems.

Key Points: Role of mucus in protecting stomach lining from acid damage - Consequences of no mucus secretion like ulcers - Function of villi in small intestine for nutrient absorption - Impact on nutrient absorption if villi are absent - Importance of villi in increasing surface area for absorption

Question 20. In a domestic circuit five LED bulbs are arranged as shown. The source voltage is 220 V and the power rating of each bulb is marked in the circuit diagram. Based on the following circuit diagram, answer the following questions:

(1) (a) State what happens when (i) key K_1 is closed. (ii) key K_2 is closed.

[1 Marks]

Answer: (i) When key K_1 is closed, the circuit through the LEDs it controls is completed, allowing electric current to flow. As a result, the LED bulbs connected in that part of the circuit light up. (ii) When key K_2 is closed, the circuit through the LEDs it controls is completed. Therefore, the LEDs connected to this part of the circuit receive electric current and begin to glow.

Key Points: Closing key K_1 completes the circuit allowing current flow - LED bulbs connected with K_1 light up - Closing key K_2 completes its respective circuit - LEDs connected with K_2 light up - A bulb glows only when the circuit is closed and current flows

(2)

Find the current drawn by the bulb B when it glows.

Answer: To find the current drawn by bulb B, we use the formula relating power, voltage, and current: Power (P) = Voltage (V) \times Current (I). Rearranging, Current $I =$ Power $P /$ Voltage V . Given the power rating of bulb B (which needs to be taken from the circuit diagram) and the source voltage of 220 V, we calculate the current by dividing the power rating by 220 V. For example, if bulb B has a power rating of 11 W, then the current drawn by bulb B is $I = 11 \text{ W} / 220 \text{ V} = 0.05 \text{ A}$. Therefore, bulb B draws a current of 0.05 amperes when it glows.

Key Points: Use the formula $I = \text{Power} / \text{Voltage}$ —Identify the power rating of bulb B from the circuit diagram—Voltage supply is 220 V—Calculate the current value by dividing power rating by 220 V—State the current unit as amperes

(3)

What would happen to the glow of all the bulbs in the circuit when keys K_1 and K_2 both are closed and the bulb C suddenly get fused? Give reason to justify your answer.

[2 Marks]

Answer: When keys K_1 and K_2 are both closed, bulbs A, B, D, and E are connected in the circuit along with bulb C. If bulb C suddenly gets fused (its filament breaks), the circuit through bulb C will be broken. As a result, no current will flow through the path containing bulb C. However, depending on the arrangement of the bulbs in the circuit (whether they are in series or parallel), the glow of the other bulbs will be affected differently. If bulbs are connected in series, the fusing of bulb C will cause the entire circuit to break and all bulbs will go off. If bulbs are connected in parallel, only bulb C will stop glowing while the other bulbs will continue to glow brightly, as the parallel paths will still carry current. Therefore, the effect on the other bulbs depends on how they are connected in the circuit. The reason is that for a bulb to glow, electric current must flow through it, and a break in the circuit stops current flow in that path.

Key Points: Bulb filament fusing breaks the circuit path—current stops through that bulb—Effect depends on series or parallel connection—Series: all bulbs go off—Parallel: only fused bulb goes off, others glow normally—Electric current required for bulb to glow

(4)

Calculate

(i) the resistance of bulb B, and

(ii) total resistance of the combination of four bulbs B, C, D and E.

[2 Marks]

Answer: (i) To calculate the resistance of bulb B, use the formula: Resistance (R) = Voltage (V) squared divided by Power (P). Assuming bulb B has a power rating of P_B watts and the supply voltage is 220 V, Resistance of bulb B, $R_B = (220 \times 220) / P_B = 48400 / P_B$ ohms. (ii) To find the total resistance of bulbs B, C, D, and E combined, first

find the resistance of each bulb using the same formula $R = \frac{220^2}{\text{Power of the respective bulb}}$. Then, depending on the arrangement of the bulbs (series or parallel), calculate the total resistance: - For series, total resistance is the sum of individual resistances. - For parallel, total resistance is given by $\frac{1}{R_{\text{total}}} = \frac{1}{R_B} + \frac{1}{R_C} + \frac{1}{R_D} + \frac{1}{R_E}$. Finally, compute the total resistance accordingly.

Key Points: Use the formula Resistance $R = \frac{\text{Voltage}^2}{\text{Power}}$ to find resistance of each bulb—Calculate resistance of bulb B using its power rating—Calculate resistance of bulbs C, D, and E similarly—Know the bulb arrangement (series or parallel) to find total resistance—Use sum of resistances for series and reciprocal of sum of reciprocals for parallel—Apply these to find total resistance of bulbs B, C, D, and E

Section E

Question 21.

Name and state in brief the process which is used to prepare sodium hydroxide from sodium chloride. In this process along with the main product two gases 'X' and 'Y' are also given off at the two electrodes. Name 'X' and 'Y' specifying the name of their respective electrode at which each gas is obtained. One of these gases when reacts with dry calcium hydroxide produces a compound 'Z' which is widely used in water treatment plants and textile industries. Name 'Z' and write chemical equation for the reaction involved in its formation.

[5 Marks]

Answer:

The process used to prepare sodium hydroxide from sodium chloride is called the chlor-alkali process. In this process, an aqueous solution of sodium chloride, known as brine, undergoes electrolysis. When electric current passes through the brine, it decomposes to form sodium hydroxide, chlorine gas, and hydrogen gas. The overall reaction is:

$$2\text{NaCl (aqueous)} + 2\text{H}_2\text{O (liquid)} \rightarrow 2\text{NaOH (aqueous)} + \text{Cl}_2 \text{ (gas)} + \text{H}_2 \text{ (gas)}.$$

In this electrolysis process, chlorine gas (Cl_2) is released at the anode (the positive electrode), and hydrogen gas (H_2) is released at the cathode (the negative electrode). Sodium hydroxide solution is formed near the cathode.

The two gases produced are X = Chlorine (Cl_2) at the anode and Y = Hydrogen (H_2) at the cathode.

When chlorine gas reacts with dry calcium hydroxide ($\text{Ca}(\text{OH})_2$), it produces calcium oxychloride (called bleaching powder), represented as compound 'Z'. This compound is widely used for disinfecting water in water treatment plants and also in the textile industry.

The chemical reaction for the formation of bleaching powder is:



Question 22.

Draw a ray diagram to show the path of the reflected ray in each of the following cases:

A ray of light incident on a convex mirror

- (1) parallel to its principal axis, and
- (2) is directed towards its principal focus

[5 Marks]

Answer:

A convex mirror always diverges light rays, meaning the reflected rays spread out. When drawing ray diagrams for convex mirrors, we need to consider that the focal point is virtual and located behind the mirror.

Case 1: Ray parallel to the principal axis

When a ray of light is incident parallel to the principal axis on a convex mirror, it reflects off the mirror such that the reflected ray appears to come from the principal focus (F) located behind the mirror. To represent this in a diagram, draw the incident ray parallel to the principal axis, then the reflected ray diverging outwards. By extending the reflected ray backward behind the mirror, it should pass through the focal point (F).

Case 2: Ray directed towards the principal focus

If the incident ray is directed towards the principal focus (F) behind the mirror, it reflects from the convex surface and travels parallel to the principal axis. In the diagram, you will show the incident ray heading towards the focal point behind the mirror, and after reflection, the ray runs parallel to the principal axis.

Thus, in both cases, the law of reflection applies: angle of incidence equals angle of reflection, and the behavior of rays for a convex mirror shows that parallel rays appear to diverge from the virtual focus behind the mirror.
