CBSE EXAMINATION PAPER-2024

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 45

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **28 questions.** All questions are **compulsory.**

ii. This question paper is divided into **4 sections.**

iii. **Section A** – questions number **1 to 11** are multiple choice questions Each question carries **1 marks.**

iv. **Section B** – questions number **12 to 19** are very short answer Each question carries **2 marks.**

v. **Section C** – questions number **20 to 25** are short answer Each question carries **3 marks.**

vi. **Section D** – questions number **26 to 28** are case based questions

vii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

viii. Use of calculator is NOT allowed.

Section A

Question 1. Solid Calcium oxide reacts vigorously with water to form Calcium hydroxide accompanied by the liberation of heat. From the information given above it may be concluded that this reaction is:

[1 Marks]

(A) is endothermic and pH of the solution formed is more than 7.

(B) is exothermic and pH of the solution formed is 7.

(C) is endothermic and pH of the solution formed is 7.

(D) is exothermic and pH of the solution formed is more than 7.

Explanation: The reaction between solid calcium oxide and water to form calcium hydroxide releases heat, which means it is an exothermic reaction. Also, the product calcium hydroxide is a base, so the pH of the solution formed is more than 7 (alkaline). Therefore, the correct conclusion is that the reaction is exothermic and the pH of the solution formed is more than 7.

Question 2. Juice of tamarind turns blue litmus to red. It is because of the presence of an acid called:

[1 Marks]

(A) methanoic acid

(B) acetic acid

(C) tartaric acid

(D) oxalic acid

Explanation: Tamarind juice is acidic and turns blue litmus paper red due to the presence of tartaric acid. Acids turn blue litmus red, indicating their acidic nature. Among the given options, tartaric acid is commonly found in tamarind, which makes the juice acidic.

Question 3.

Select from the following a process in which a combination reaction is involved:

[1 Marks]

(A) Black and White photography

(B) Burning of methane

(C) Burning of coal

(D) Digestion of food

Explanation:

The correct option Burning of coal coal is a combination reaction. Coal is primarily carbon (C). When it burns, it reacts with oxygen (O_2) from the air to form carbon dioxide (CO_2).

This is represented by the chemical equation: ($C+O_2 \rightarrow CO_2$). In this reaction, two reactants (C) and (O_2) combine to form a single product (CO_2).

Question 4.

Identify the correct statement about the following reaction

$2H_2S + SO_2 \rightarrow 2H_2O + S$:

[1 Marks]

(A) SO_2 is oxidized to sulfur.

(B) H_2S is reduced to sulfur.

(C) SO_2 is the oxidizing agent and H_2 is the reducing agent.

(D) H_2S is the oxidizing agent and $O_2$is the reducing agent.

Explanation: In the reaction $2H_2S + SO_2 \rightarrow 2H_2O + S$, hydrogen sulfide ($H_2S$) loses sulfur atoms and is oxidized to elemental sulfur (S), while sulfur dioxide (SO_2) gains hydrogen and is reduced to water (H_2O). Therefore, SO_2 acts as the oxidizing agent and H_2S acts as the reducing agent.

Question 5.

Consider the following statements about homologous series of carbon compounds:

All succeeding members differ by a CH_2 unit.

Melting point and boiling point increase with increasing molecular weight.

The difference in molecular masses between two successive members is 16u.

C_2H_2 and C_3H_4 are NOT the successive members of alkene series.

[1 Marks]

(A) (a) and (b)

(B) (a) and (c)

(C) (c) and (d)

(D) (b) and (c)

Explanation: The correct option is (a) and (b) because, according to the homologous series, all succeeding members differ by a CH_2 unit, and melting and boiling points increase with molecular weight. The statement (c) is incorrect because the difference in

molecular masses between two successive members is due to a CH_2 unit, which is 14 u (12 for carbon + 2 for hydrogen), not 16 u. Statement (d) is correct as well since C_2H_2 (acetylene) and C_3H_4 are not successive alkenes, but given the options, (a) and (b) best fits the given context.

Question 6. Select out of the following a gland which does NOT occur as a pair in the human body:

[1 Marks]

(A) Pituitary

(B) Ovary

(C) Testis

(D) Adrenal

Explanation: The pituitary gland is a single gland in the human body, attached to the brain, and does not occur as a pair. In contrast, the ovaries and testes occur as pairs in females and males respectively, and the adrenal glands also occur in pairs, located above each kidney. Hence, the correct answer is Pituitary.

Question 7. In the human respiratory system, when a person breathes in, the position of ribs and diaphragm will be:

[1 Marks]

(A) lifted ribs and curve/dome shaped diaphragm.

(B) lifted ribs and flattened diaphragm.

(C) relaxed ribs and flattened diaphragm.

(D) relaxed ribs and curved dome shaped diaphragm.

Explanation: During inhalation, the ribs move up and outwards (lifted ribs) and the diaphragm contracts and moves downwards, causing it to flatten. This increases the space in the chest cavity, allowing the lungs to expand and air to rush in. Therefore, the correct position during inhalation is lifted ribs and flattened diaphragm.

Question 8.

Identify the mode of asexual reproduction in the following organism:

[1 Marks]

(A) Budding

(B) Binary fission

(C) Multiple fission

(D) Fragmentation

Explanation:

The correct option Budding

Question 9.

The maximum resistance of a network of five identical resistors of 1/5 Ω each can be:-

[1 Marks]

(A) 0.5Ω

(B) 0.25 Ω

(C) 0.1 Ω

(D) 1Ω

Explanation: The maximum resistance is obtained when all the resistors are connected in series. In series, the total resistance is the sum of the individual resistances. Each resistor has a resistance of 1/5 Ω = 0.2 Ω. Therefore, the maximum resistance = 5 × 0.2 Ω = 1 Ω.

Question 10.

Study the I-V graph for three resistors of resistances R_1, R_2, and R_3 and select the correct statement from the following:

[1 Marks]

(A) $R_2 > R_3 > R_1$

(B) $R_3 > R_2 > R_1$

(C) $R_1 = R_2 > R_3$

(D) $R_1 = R_2 = R_3$

Explanation: According to Ohm's law, the resistance R = V/I. In an I-V graph, the slope is related to the resistance. Given the resistances R_1 = 5 Ω, R_2 = 10 Ω, and R_3 = 30 Ω, the correct order of resistance from greatest to smallest is $R_3 > R_2 > R_1$. Hence, the correct statement is $R_3 > R_2 > R_1$.

Question 11. Strength of magnetic field produced by a current carrying solenoid does NOT depend upon:

[1 Marks]

(A) number of turns in the solenoid

(B) radius of solenoid

(C) direction of the current flowing through it

(D) material of the core of the solenoid

Explanation: The magnetic field inside a solenoid is given by $B = \mu (N/L) I$, where μ is the permeability of the core material, N is the number of turns, L is the length of the solenoid, and I is the current flowing through it. The radius of the solenoid does not appear in this formula, indicating that the strength of the magnetic field does not depend on the radius. The direction of the current affects the polarity of the magnetic field but not its strength. Therefore, the correct answer is 'radius of solenoid'.

Section B

Question 12. "No precipitation reaction can occur without exchange of ions between the two reactants." Justify this statement giving a balanced chemical equation for the reaction.

[2 Marks]

Answer: A precipitation reaction involves the formation of an insoluble substance called a precipitate when two solutions are mixed. This reaction can only happen when there is an exchange of ions between the reactants, known as a double displacement reaction. For example, when silver nitrate ($AgNO_3$) solution is mixed with sodium chloride ($NaCl$) solution, silver chloride ($AgCl$), a white precipitate, is formed, while sodium nitrate ($NaNO_3$) remains dissolved in water. The balanced chemical equation is: $AgNO_3 + NaCl \rightarrow AgCl$ (precipitate) $+ NaNO_3$. Hence, ion exchange leads to formation of precipitate.

Question 13. Giving one example of each, differentiate between a displacement reaction and a double displacement reaction.

[2 Marks]

Answer: A displacement reaction occurs when a more reactive metal displaces a less reactive metal from its compound. For example, zinc displaces copper from copper sulphate solution: Zinc + Copper sulphate → Zinc sulphate + Copper. A double displacement reaction involves an exchange of ions between two compounds, forming new products. For example, when barium chloride reacts with sodium sulphate, they exchange ions to form barium sulphate (a white precipitate) and sodium chloride: Barium chloride + Sodium sulphate → Barium sulphate + Sodium chloride. Thus, in displacement

reactions, one element displaces another, while in double displacement reactions, ions are exchanged between two compounds.

Question 14. Photosynthesis takes place in the leaves and the food prepared by it reaches other parts of the plants. Name the process involved and explain it.

[2 Marks]

Answer: The process by which food prepared in the leaves is transported to other parts of the plant is called translocation. During photosynthesis, leaves make food using sunlight, carbon dioxide, and water. This food, mainly glucose, is then dissolved in water and moved through the phloem vessels to different parts of the plant like roots, stems, and fruits where it is used or stored.

Question 15. "Stability of DNA in a species is ensured during sexual reproduction." Justify the statement.

[2 Marks]

Answer: During sexual reproduction, specialized cell division called meiosis ensures that germ cells have half the number of chromosomes. When two germ cells from different individuals combine, they restore the normal chromosome number in the offspring. This careful process ensures the DNA content remains stable across generations, preserving the species' body design and traits essential for survival in their ecological niche. Although slight variations occur due to minor copying errors, these are beneficial for species survival without compromising overall DNA stability.

Question 16. State two laws of refraction of light.

[2 Marks]

Answer: The two laws of refraction of light are: 1) The incident ray, refracted ray, and the normal to the interface of two media all lie in the same plane. 2) The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for light of a given colour and for a given pair of media. This constant ratio is known as Snell's Law.

Question 17.

Define the term absolute refractive index of a medium. A ray of light enters from vacuum to glass of absolute refractive index 1.5. Find the speed of light in glass. The speed of light in vacuum is 3×10^8 m/s.

[2 Marks]

Answer: The absolute refractive index of a medium is the ratio of the speed of light in vacuum to the speed of light in that medium. It indicates how much the medium slows down light compared to vacuum. Given that the absolute refractive index of glass is 1.5 and the speed of light in vacuum is 3×10^8 m/s, the speed of light in glass can be found by dividing the speed in vacuum by the refractive index. Therefore, speed of light in glass = $(3\times10^8) / 1.5 = 2\times10^8$ m/s.

Question 18. Use Ohm's law to determine the potential difference across the 3 Ω resistor in the circuit shown in the following diagram when key is closed.

[2 Marks]

Answer: Ohm's law states that voltage (V) across a resistor is equal to the product of current (I) flowing through it and its resistance (R). When the key is closed, current flows through the series circuit. If the current flowing is I amperes, then the potential difference V across the 3 ohms resistor is given by V = I × 3 volts. By measuring or calculating the current, we can find the voltage across the 3 Ω resistor using this formula.

Question 19. Name the term used for the materials which cannot be broken down by biological processes. Give two ways by which they harm various components of an ecosystem.

[2 Marks]

Answer: The materials which cannot be broken down by biological processes are called non-biodegradable materials. They harm the ecosystem in two main ways: first, they persist in the environment for a long time, causing pollution and harming living organisms. Second, they can disrupt the natural recycling of nutrients and cause physical damage to habitats, for example, plastics can choke animals or block water flow in aquatic systems.

Section C

Question 20. It is observed that Calcium on reaction with water floats on its surface. Explain why it happens. Also write a balanced chemical equation for the reaction that occurs. What happens when the aqueous solution of the product of this reaction reacts with Carbon dioxide gas? Write a balanced chemical equation for the reaction.

[3 Marks]

Answer: (a) Calcium floats on water because during its reaction with water, hydrogen gas is produced as bubbles that stick to the surface of calcium and make it float.

Chemical equation: $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$

(b) The product formed is calcium hydroxide ($Ca(OH)_2$), which is present in aqueous solution called lime water. When carbon dioxide gas is passed through lime water, a white precipitate of calcium carbonate ($CaCO_3$) is formed.

Chemical equation: $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

(c) If excess CO_2 is passed, the calcium carbonate reacts with carbon dioxide and water to form soluble calcium bicarbonate.

Chemical equation: $CaCO_3(s) + CO_2(g) + H_2O(l) \rightarrow Ca(HCO_3)_2(aq)$

This demonstrates the behavior of calcium and lime water with carbon dioxide.

Question 21. Draw a labelled diagram to show electrolytic refining of copper. State what happens when electric current is passed through the electrolyte taken in this case.

[3 Marks]

Answer: In electrolytic refining of copper, an impure copper anode and a thin strip of pure copper cathode are dipped in an electrolyte solution of acidified copper sulphate. When electric current passes through the electrolyte, copper atoms from the impure anode lose electrons and dissolve into the solution as copper ions. These copper ions move towards the cathode, gain electrons, and get deposited as pure copper on the cathode strip. Impurities either remain in the solution or fall off as anode mud. This process results in the purification of copper, where the pure copper deposits on the cathode, ensuring a high-purity copper product.

Question 22. Explain the events that take place once a sperm reaches the oviduct till it becomes a foetus. Write the role of placenta in pregnancy.

[3 Marks]

Answer: Once a sperm reaches the oviduct, it may encounter and fertilize an egg present there. This results in the formation of a fertilized egg called a zygote. The zygote starts dividing repeatedly, forming a ball of cells known as an embryo. The embryo travels to the uterus, where it gets implanted into the thick, muscular lining of the uterus. Here, it grows and develops over time, forming different organs and eventually becoming a foetus. The placenta plays a crucial role during pregnancy. It acts as a connection between the mother and the developing foetus, facilitating the exchange of oxygen, nutrients, and waste products. It also produces hormones that support and maintain pregnancy. Thus, the placenta ensures the proper growth and development of the baby till birth.

Question 23.

(1) Define the term power of accommodation of the human eye. Write the name of the part of the eye which plays a major role in the process of accommodation and explain what happens when the human eye focuses (i) on nearby objects and (ii) distant objects.

[3 Marks]

Answer: Power of Accommodation: The power of accommodation of the human eye is its ability to change the focal length of the crystalline lens to focus on objects at different distances.

Part of the Eye Responsible: The ciliary muscle plays a major role in the accommodation process.

Focusing on Nearby Objects: When focusing on a nearby object, the ciliary muscles contract. This makes the crystalline lens thicker and more curved, increasing its focal length to bend light rays more sharply, allowing the eye to form a clear image on the retina.

Focusing on Distant Objects: When focusing on distant objects, the ciliary muscles relax.

The crystalline lens becomes thinner and less curved, decreasing its focal length, so light rays from distant objects are focused on the retina, producing a clear image.

Thus, accommodation is the process by which the eye adjusts the lens shape to focus images correctly on the retina for clear vision at different distances.

Question 24. Use of pesticides to protect our crops affect organisms at various trophic levels especially human beings. Name the phenomenon involved and explain how this happens.

[3 Marks]

Answer: The phenomenon involved is called biological magnification. Pesticides used on crops do not easily degrade and enter the environment through soil and water. From the soil, plants absorb these chemicals, and from water bodies, aquatic organisms take them in. These pesticides accumulate at each trophic level because organisms at each level consume many from the previous level, thereby increasing the concentration of pesticides. Since humans are at the top of the food chain, they accumulate the highest concentration of these harmful chemicals in their bodies, which can cause serious health problems.

Question 25.

Draw a ray diagram to show the formation of a rainbow in the sky. On this diagram, mark A – where dispersion of light occurs, B – where internal reflection of light occurs and C – where refraction of light occurs. List two necessary conditions to observe a rainbow.

[3 Marks]

Answer:

A rainbow is formed due to the dispersion, reflection, and refraction of sunlight inside raindrops. When sunlight enters a raindrop, it first refracts (bends) at point C, where the light changes direction as it passes from air into water. Inside the drop, at point A, dispersion occurs which splits the white light into its constituent colors due to different wavelengths bending by different amounts. The light then internally reflects at point B from the inner surface of the raindrop. Finally, the light refracts again while leaving the drop, bending away from the drop and traveling towards the observer's eyes, forming a rainbow.

Necessary conditions to observe a rainbow:

- Sunlight must be present and should fall on raindrops in the atmosphere at a specific angle.
- The observer should be positioned with the sun behind them and rain in front to see the reflected and dispersed light forming a rainbow.

Section D

Question 26. Salts play a very important role in our daily life. Sodium chloride which is known as common salt is used almost in every kitchen. Baking soda is also a salt used in faster cooking as well as in baking industry. The family of salts is classified on the basis of cations and anions present in them.

(1) Find the cation and the anion present in Calcium sulphate.

[1 Marks]

Answer: Calcium sulphate is a salt made up of calcium ions and sulphate ions. The cation in calcium sulphate is calcium ion (Ca^{2+}), and the anion is sulphate ion (SO_4^{2-}).

Key Points: Calcium sulphate is a salt - Cation is calcium ion (Ca^{2+}) - Anion is sulphate ion (SO_4^{2-})

(2) Identify the acid and base from which Sodium chloride is formed.

[1 Marks]

Answer: Sodium chloride is formed by the reaction between hydrochloric acid and sodium hydroxide.

Key Points: Sodium chloride is a salt-common salt-HCl is hydrochloric acid-NaOH is sodium hydroxide-Sodium chloride formed by combining HCl and NaOH

(3) Sodium chloride and washing soda both belong to the same family of salts. Justify this statement.

[2 Marks]

Answer: Sodium chloride (NaCl) and washing soda (Na2CO3·10H2O) both contain the same positive ion, sodium (Na+). Salts that have the same positive ion belong to the same family of salts. Therefore, since both contain the sodium ion, sodium chloride and washing soda belong to the family of sodium salts.

Key Points: Salts with same positive or negative radicals belong to the same family - Sodium chloride contains Na+ and Cl- ions - Washing soda contains

Na+ and CO3 2- ions - Both have sodium ion (Na+) as common cation - Hence, both belong to the sodium salt family

(4)

Define the term pH scale. Name the salt obtained by the reaction of Potassium hydroxide and Sulphuric acid and give the pH value of its aqueous solution.

[2 Marks]

Answer: The pH scale is a scale that measures how acidic or basic a solution is, ranging from 0 to 14. A pH less than 7 indicates an acidic solution, pH equal to 7 is neutral, and pH greater than 7 is basic. When potassium hydroxide (a base) reacts with sulphuric acid (an acid), the salt formed is Potassium sulphate (K2SO4). The aqueous solution of potassium sulphate is neutral and has a pH value of around 7.

Key Points: Definition of pH scale - pH indicates acidity or basicity - Salt from potassium hydroxide and sulphuric acid is potassium sulphate (K2SO4) - pH of potassium sulphate solution is neutral (pH ≈ 7)

Question 27. Asexual reproduction involves a single parent to produce offsprings without the formation of gametes. It occurs by the following ways: Fission, Budding, Fragmentation, Spore formation and Regeneration. In one of the methods like regeneration, Planaria A is cut horizontally into three pieces — L, M and N and Planaria B is cut vertically into two equal halves — O and P.

(1) Which of the cut pieces of the two Planaria could regenerate to form a complete organism?

[1 Marks]

Answer: All cut pieces of both Planaria A and Planaria B, that is pieces L, M, N, O, and P, can regenerate to form complete organisms.

Key Points: Planaria can regenerate from any piece-Each piece grows into a complete organism-Regeneration is a form of asexual reproduction-Specialized cells help in regeneration

(2) Give an example of another organism which follows the same mode of reproduction as Planaria.

[1 Marks]

Answer: Hydra is another organism that reproduces by regeneration, similar to Planaria.

Key Points: Regeneration mode of reproduction - Planaria and Hydra reproduce by regeneration - In Hydra, regeneration happens through budding which is a form of asexual reproduction

(3) What is the meaning of 'development' in regeneration?

[2 Marks]

Answer: In regeneration, 'development' refers to the organized sequence of changes that cells undergo to form different types of tissues and complete new organisms from a mass of cells produced by specialized cells. These changes help the organism to regrow the missing parts or form a complete organism from the pieces.

Key Points: Development means an organized sequence of changes-Cells undergo changes to become different types of cells and tissues-These changes result in formation of complete organism or body part during regeneration

(4)

Differentiate between regeneration and fragmentation.

[2 Marks]

Answer: Regeneration is a process where an organism is cut into pieces, and each piece grows into a complete new individual, as seen in Planaria. Specialized cells divide and develop into different tissues to form a new organism. Fragmentation is a method where an organism's body breaks into several fragments, and each fragment develops into a new organism independently. In regeneration, the focus is on the growth of lost parts to form a whole organism, whereas in fragmentation, each fragment itself forms a new individual.

Key Points: Regeneration involves growth of new organism from cut pieces-Regeneration uses specialized regenerative cells-Fragmentation involves breaking body into fragments-Each fragment forms a new organism-Regeneration is recovery and growth-Fragmentation is body breaking into multiple parts

Question 28.

When electric current flows in a purely resistive circuit, electrical energy gets fully converted into heat energy. The amount of heat produced (H) in the circuit is found to be directly proportional to (i) the square of current (I^2), (ii) the resistance (R) of the conductor, and (iii) the time (t) for which current flows. In other words, $H = I^2Rt$. Electrical devices such as an electric fuse, electric heater, electric iron, etc. are all based on this effect called heating effect of electric current.

(1) List two properties of electric fuse.

[1 Marks]

Answer: Two properties of an electric fuse are: (1) It has a low melting point, so it melts easily when excessive current flows. (2) It has a high resistance so that it generates enough heat to melt quickly when there is a high current.

Key Points: Low melting point-High resistance-Used to protect circuits by melting when current is too high

(2) List two properties of heating elements.

[1 Marks]

Answer: Two important properties of heating elements are: (1) They have high electrical resistance to produce the required heat when current passes through them. (2) They have a high melting point so that they do not melt or get damaged easily when heated.

Key Points: High electrical resistance-High melting point-Durability under heat

(3) Name the principle on which an electric fuse works and explain how a fuse wire is capable of saving electrical appliances from getting damaged due to accidentally produced high currents.

[2 Marks]

Answer: An electric fuse works on the heating effect of electric current. When an electric current passes through the fuse wire, heat is produced due to the resistance of the wire. The heat generated is proportional to the square of the current, the resistance of the wire, and the time for which the current flows. If the current exceeds a safe limit (called rated current), the heat generated melts the fuse wire, which breaks the circuit. This stops the flow of excessive current and protects electrical appliances from damage caused by high currents.

Key Points: Principle of heating effect of electric current - Heat produced is proportional to square of current, resistance and time - When current is high, fuse wire melts due to heat - Circuit breaks stopping current flow - Protects appliances from damage

(4)

The power of an electric heater is 1100 W. If the potential difference between the two terminals of the heater is 220 V, find the current flowing in the circuit. What will happen to an electric fuse of rating 5 A connected in this circuit?

[2 Marks]

Answer: Given the power of the electric heater, P = 1100 W, and the potential difference, V = 220 V, we can find the current I using the formula P = V × I. Rearranging, I = P / V = 1100 / 220 = 5 A. Therefore, the current flowing in the circuit is 5 amperes. Since the fuse connected in the circuit has a rating of 5 A, it will allow the current to pass through without melting as the current is at its rated capacity. Thus, the fuse will not blow under normal operation in this case.

Key Points: Use power formula P = V × I-Calculate current I = P / V-Current equals fuse rating (5 A)-Fuse will not blow at rated current