

CBSE EXAMINATION PAPER-2024

SCIENCE

(Solved)

Time allowed : 3 hours

Maximum Marks : 36

General Instructions :

Read the following instructions carefully and follow them :

- i. This question paper contains **24 questions**. All questions are **compulsory**.
- ii. This question paper is divided into **4 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 18** are very short answer Each question carries **2 marks**.
- v. **Section C** – questions number **19 to 22** are short answer Each question carries **3 marks**.
- vi. **Section D** – questions number **23 to 24** 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.

A metal and a non-metal that exists in liquid state at the room temperature are respectively:

[1 Marks]

(A) Bromine and Mercury

(B) Mercury and Bromine

(C) Iodine and Mercury

(D) Mercury and Iodine

Explanation: Mercury is the only metal that is liquid at room temperature, and bromine is the non-metal that is liquid at room temperature. Therefore, the correct option is 'Mercury and Bromine'. This is because mercury is unique among metals for its liquid state at room temperature, while bromine is one of the few non-metals present as a liquid under these conditions.

Question 2.

Carbon compounds:

- (i) are good conductors of electricity.
- (ii) are bad conductors of electricity.
- (iii) have strong forces of attraction between their molecules.
- (iv) have weak forces of attraction between their molecules.

The correct statements are:

[1 Marks]

(A) (i) and (ii)

(B) (ii) and (iii)

(C) (i) and (iii)

(D) (ii) and (iv)

Explanation: Most carbon compounds are poor conductors of electricity because the bonding in these compounds does not produce ions. Also, these compounds have low melting and boiling points, indicating that the forces of attraction between their molecules are weak. Therefore, statements (ii) and (iv) are correct.

Question 3.

Consider the following compounds:

FeSO_4 , CuSO_4 , CaSO_4 , Na_2CO_3

The compound having maximum number of waters of crystallization in its crystalline form in one molecule is:

[1 Marks]

(A) Na_2CO_3

(B) CuSO_4

(C) CaSO_4

(D) FeSO_4

Explanation: Among the given compounds, Na_2CO_3 (sodium carbonate) has 10 molecules of water of crystallization in its hydrated form ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$), which is the highest number of water molecules compared to $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (5 water molecules), $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (2 water molecules), and $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ (7 water molecules, though FeSO_4 was not fully described in the provided context, the known common form is $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$). Therefore, Na_2CO_3 has the maximum number of waters of crystallization.

Question 4. Oxides of aluminium and zinc are:

[1 Marks]

(A) basic

(B) acidic

(C) amphoteric

(D) neutral

Explanation: The oxides of aluminium and zinc exhibit both acidic and basic properties as they react with acids and bases to form salts and water. Such oxides are called amphoteric oxides. For example, aluminium oxide reacts with hydrochloric acid to form aluminium chloride and with sodium hydroxide to form sodium aluminate. Therefore, the correct answer is amphoteric.

Question 5.



The reaction given above is a redox reaction because in this case:

[1 Marks]

(A) MnO_2 is reduced and HCl is oxidised.

(B) HCl is oxidised.

(C) MnO_2 is reduced.

(D) MnO_2 is oxidised and HCl is reduced.

Explanation: The correct answer is ' MnO_2 is reduced and HCl is oxidised.' In this reaction, manganese dioxide (MnO_2) gains electrons and is reduced to manganese chloride (MnCl_2), while hydrochloric acid (HCl) loses electrons and is oxidized to chlorine gas (Cl_2). This simultaneous process of reduction and oxidation makes the reaction a redox reaction.

Question 6.

Chromosomes:

(i) carry hereditary information from parents to the next generation.

(ii) are thread-like structures located inside the nucleus of an animal cell.

(iii) always exist in pairs in human reproductive cells.

(iv) are involved in the process of cell division. The correct statements are:

[1 Marks]

(A) (i) and (ii)

(B) (iii) and (iv)

(C) (i), (ii) and (iv)

(D) (i) and (iv)

Explanation: Statements (i), (ii), and (iv) are correct because chromosomes carry hereditary information, are thread-like structures located inside the nucleus, and are involved in cell division. Statement (iii) is incorrect because human reproductive cells (gametes) have only one set of chromosomes, not pairs.

Question 7. In a nerve cell, the site where the electrical impulse is converted into a chemical signal is known as:

[1 Marks]

(A) Axon

(B) Dendrites

(C) Neuromuscular junction

(D) Cell body

Explanation: The correct answer is 'Neuromuscular junction'. According to the context, the electrical impulse travels along the axon to its end, where it triggers the release of chemicals called neurotransmitters. These chemicals cross the synapse and initiate a new electrical impulse in the next cell. This process of converting an electrical impulse into a chemical signal occurs at the nerve endings at the neuromuscular junction, where the neuron communicates with a muscle fiber.

Question 8. At what distance from a convex lens should an object be placed to get an image of the same size as that of the object on a screen?

[1 Marks]

- (A) Beyond twice the focal length of the lens.
- (B) At twice the focal length of the lens.**
- (C) At the principal focus of the lens
- (D) Between the optical centre of the lens and its principal focus.

Explanation: For a convex lens, when the object is placed at twice the focal length ($2F$) from the lens, the image formed is real, inverted, and of the same size as the object. This is because at this position, the image distance equals the object distance, leading to magnification of 1. Hence, to get an image of the same size on a screen, the object should be placed at twice the focal length.

Question 9. The lens system of human eye forms an image on a light sensitive screen, which is called as:

[1 Marks]

- (A) Cornea
- (B) Ciliary muscles
- (C) Optic nerves
- (D) Retina**

Explanation: The correct answer is 'Retina'. The lens system of the human eye focuses light to form an image on a light-sensitive screen called the retina. The retina contains many light-sensitive cells that capture the image. Other options are incorrect because the optic nerve carries signals from the retina to the brain, the ciliary muscles adjust the lens shape, and the cornea allows light to enter the eye.

Question 10. The pattern of the magnetic field produced inside a current carrying solenoid is:

[1 Marks]

(A)

(B)

(C)

(D)

Explanation: The correct answer is that the magnetic field lines inside a current-carrying solenoid are nearly parallel and close together, indicating a strong and uniform magnetic field. This is similar to the magnetic field pattern inside a bar magnet. The solenoid behaves like a bar magnet with one end acting as a magnetic north pole and the other as a south pole. The field lines inside run straight and uniformly from one end to the other, showing the uniform magnetic field produced.

Question 11. Identify the food chain in which the organisms of the second trophic level are missing:

[1 Marks]

(A) Grass, goat, lion

(B) Zooplankton, Phytoplankton, small fish, large fish

(C) Grasshopper, grass, snake, frog, eagle

(D) Tiger, grass, snake, frog

Explanation: The correct option is 'Tiger, grass, snake, frog.' In a food chain, the second trophic level consists of primary consumers that feed on producers (like grass). In the given options, the chain 'Tiger, grass, snake, frog' is not correctly structured as it misses the primary consumers (herbivores). Tigers are tertiary consumers and cannot directly feed on grass. Therefore, this chain is missing organisms of the second trophic level, which are herbivores that consume producers. Other options show clear presence of the second trophic level such as grasshopper or zooplankton feeding on producers like grass or phytoplankton.

Question 12. In which of the following organisms, multiple fission is a means of asexual reproduction? a) (b) (c) (d)

[1 Marks]

(A) Yeast

(B) Paramecium

(C) Leishmania

(D) Plasmodium

Explanation: The correct answer is Plasmodium. Multiple fission is a process where the nucleus of the cell divides repeatedly without the cell immediately dividing, resulting in many daughter cells formed simultaneously. The context explains that Plasmodium, a parasite, reproduces by multiple fission, producing many daughter cells called merozoites. Yeast reproduces by budding, Leishmania reproduces by binary fission, and Paramoecium reproduces primarily by binary fission or conjugation, but not by multiple fission.

Section B

Question 13. Name the type of chemical reaction in which calcium oxide reacts with water. Justify your answer by giving balanced chemical equation for the chemical reaction.

[2 Marks]

Answer: Type of Reaction: This reaction is a **combination reaction**.

Explanation: When calcium oxide (CaO) reacts with water (H₂O), they combine to form a single product, calcium hydroxide Ca(OH)₂, also known as slaked lime. This type of reaction where two or more reactants combine to form one product is called a combination reaction.

Chemical Equation: $\text{CaO (s)} + \text{H}_2\text{O (l)} \rightarrow \text{Ca(OH)}_2 \text{ (aq)} + \text{Heat}$

This reaction releases heat, which shows it is exothermic. It is also called the slaking of lime.

Question 14. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position of the image formed by the mirror.

[2 Marks]

Answer: Given: Object distance (u) = -10 cm (since the object is in front of the mirror), Focal length (f) = +15 cm (convex mirror has positive focal length). Using the mirror formula: $1/f = 1/v + 1/u$. Substitute the values: $1/15 = 1/v + 1/(-10)$. $\Rightarrow 1/v = 1/15 + 1/10 = (2 + 3)/30 = 5/30 = 1/6$. Therefore, $v = +6$ cm. The positive sign of v indicates that the image is formed behind the convex mirror at 6 cm from it. The image is virtual, erect, and diminished.

Question 15.

How is the movement of leaves of a sensitive plant different from the downward movement of the roots?

[2 Marks]

Answer: The movement of leaves of a sensitive plant is a quick response to touch and does not involve growth. This movement happens due to changes in water pressure inside

the leaf cells caused by electrical signals. In contrast, the downward movement of roots is a slow, directional growth movement. Roots grow downward because of growth processes and if growth is stopped, the roots do not move. So, leaf movement is rapid and reversible without growth, while root movement is slow and due to growth.

Question 16.

There is a hormone which regulates carbohydrate, protein and fat metabolism in our body. Name the hormone and the gland which secretes it. Why is it important for us to have iodised salt in our diet?

[2 Marks]

Answer: The hormone that regulates carbohydrate, protein, and fat metabolism in our body is called thyroxin. It is secreted by the thyroid gland. Thyroxin is essential for maintaining a proper balance of these nutrients to support growth and energy. Iodine, which is found in iodised salt, is necessary for the production of thyroxin. Without sufficient iodine in our diet, the thyroid gland cannot produce adequate thyroxin, leading to health problems like goitre, which causes swelling in the neck. Hence, consuming iodised salt helps prevent iodine deficiency and keeps our thyroid gland healthy.

Question 17.

In the given circuit calculate the power consumed in watts in the resistor of $2\ \Omega$:

[2 Marks]

Answer: To calculate the power consumed by the 2 ohm resistor, first find the current flowing through it using Ohm's law ($I = V / R$). Once the current is known, power (P) can be calculated using the formula $P = I^2 \times R$, where I is the current through the resistor and R is its resistance. This will give the power consumed in watts.

Question 18.

(i) Two magnetic field lines do not intersect each other. Why?

(ii) How is a uniform magnetic field in a given region represented? Draw a diagram in support of your answer.

[2 Marks]

Answer:

(i) Two magnetic field lines do not intersect each other because if they did, it would mean that at the point of intersection, the magnetic field has two different directions, which is not possible. The tangent to the field line at any point shows the direction of the magnetic field, so field lines must not cross.

(ii) A uniform magnetic field is represented by straight, parallel, and equally spaced magnetic field lines. This shows that the magnetic field has the same strength and direction at every point in that region. For example, between two opposite poles of two identical magnets placed close to each other, the magnetic field lines are parallel and evenly spaced.

Section C

Question 19.

(i) The pH of a sample of tomato juice is 4.6. How is this juice likely to be in taste? Give reason to justify your answer.

(ii) How do we differentiate between a strong acid and a weak base in terms of ion-formation in aqueous solutions ?

(iii) The acid rain can make the survival of aquatic animals difficult. How?

[3 Marks]

Answer: (i) Tomato juice with a pH of 4.6 is acidic, as its pH is less than 7. This means the juice will have a slightly sour taste. The sourness is due to the presence of hydrogen ions (H^+) from organic acids in the juice.

(ii) A strong acid ionizes completely in aqueous solution, producing a large number of H^+ ions. For example, hydrochloric acid (HCl) dissociates fully to give H^+ and Cl^- ions. A weak base, on the other hand, does not ionize completely in water and produces fewer OH^- ions. For example, ammonia (NH_3) ionizes partially, forming fewer hydroxide ions. Thus, ion formation helps differentiate between strong acids and weak bases.

(iii) Acid rain contains dissolved acidic components like sulfuric and nitric acids which lower the pH of water bodies. This acidic environment harms aquatic animals by disrupting their physiological balance, damaging gills, causing skin irritation, and affecting reproduction. Low pH can also dissolve toxic metals from the soil which further pollute the water and make survival difficult for aquatic life.

Question 20. Define reflex action. With the help of a flow chart, show the path of a reflex action such as sneezing.

[3 Marks]

Answer: A reflex action is a rapid and automatic response to a stimulus that does not involve conscious thought. It helps protect the body from harm by producing quick reactions. For example, sneezing is a reflex action that clears the nasal passage when irritants are detected. The reflex arc involved in sneezing follows this pathway: first, the stimulus such as dust or smoke irritates the receptors in the nose. Then, sensory neurons

carry the message to the spinal cord where relay neurons process it. Immediately, motor neurons send impulses to the effector muscles (like those in the chest and diaphragm) causing sneezing. Meanwhile, a message is also sent to the brain, making us aware of the stimulus. This whole process happens very quickly to protect the body from harmful substances.

Question 21.

A gas 'X' which is a deadly poison is found at the higher levels of the atmosphere and performs an essential function.

Name the gas and write the function performed by this gas in the atmosphere. Which chemical is linked to the decrease in the level of this gas? What measures have been taken by an international organization to check the depletion of the layer containing this gas?

[3 Marks]

Answer:

The gas 'X' referred to in the question is ozone (O_3). Although ozone is a deadly poison at ground level, it plays a crucial role in the higher levels of the atmosphere, specifically in the ozone layer. It absorbs and shields the Earth's surface from harmful ultraviolet (UV) radiation from the Sun, which can cause serious health problems such as skin cancer and damage to living organisms.

The depletion of the ozone layer is mainly caused by chemicals called chlorofluorocarbons (CFCs). These chemicals release chlorine atoms when they break down in the stratosphere, which then destroy ozone molecules, leading to thinning of the ozone layer.

To address this serious environmental problem, the international community adopted the Montreal Protocol, an agreement to phase out the production and use of ozone-depleting substances like CFCs. Due to these measures, the ozone layer's depletion has slowed down, and there are signs of recovery, although continuous efforts are needed to protect it fully.

Question 22.

Name and state the rule to determine the direction of a:

- (i) magnetic field produced around a current carrying straight conductor.
- (ii) force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it.

[3 Marks]

Answer:

(i) The rule to determine the direction of the magnetic field around a current-carrying straight conductor is called the **Right-Hand Rule**. According to this rule, if you point the thumb of your right hand in the direction of the current, then the way your fingers curl around the conductor shows the direction of the magnetic field. This magnetic field forms concentric circles around the wire.

(ii) The rule to find the direction of the force on a current-carrying conductor placed in a magnetic field perpendicular to it is called **Fleming's Left-Hand Rule**. According to this rule, stretch your thumb, first finger, and second finger of the left hand so that they are mutually perpendicular. 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, and the thumb will then point in the direction of the force (motion) experienced by the conductor.

Section D

Question 23.

Mendel worked out the rules of heredity by working on garden pea using a number of visible contrasting characters. He conducted several experiments by making a cross with one or two pairs of contrasting characters of pea plant. On the basis of his observations he gave some interpretations which helped to study the mechanism of inheritance.

(1)

When Mendel crossed pea plants with pure tall and pure short characteristics to produce F_1 progeny, which two observations were made by him in F_1 plants?

[1 Marks]

Answer: When Mendel crossed pure tall pea plants with pure short pea plants, he observed that all the F_1 progeny plants were tall. Also, there were no plants of intermediate height in the F_1 generation.

Key Points: All F_1 plants were tall—No intermediate (medium) height plants in F_1 generation—Tall trait was dominant over short

(2) Write one difference between dominant and recessive trait.

[1 Marks]

Answer: A dominant trait is the one that appears in the offspring even if only one allele for it is present, whereas a recessive trait appears only when both alleles are recessive.

Key Points: Dominant trait appears when one allele is present–Recessive trait appears only when both alleles are recessive–Mendel's pea plant experiments showed this difference

(3)

In a cross with two pairs of contrasting characters

Mendel observed 4 types of combinations in F₂ generation. By which method did he obtain F₂ generation? Write the ratio of the parental combinations obtained and what conclusions were drawn from this experiment.

[2 Marks]

Answer: Mendel obtained the F₂ generation by allowing the F₁ plants, which were hybrids, to self-pollinate. From this self-pollination, he observed four types of seed combinations in the F₂ generation. The ratio of parental combinations obtained was approximately 9:3:3:1. This ratio indicates that the traits segregate independently and combine in different ways, supporting Mendel's Law of Independent Assortment. This experiment concluded that genes for different traits are inherited independently of each other.

Key Points: F₂ generation obtained by self-pollination of F₁ plants–The ratio of parental combinations in F₂ is 9:3:3:1–This shows independent assortment of traits–Genes for different traits segregate independently–Mendel's Law of Independent Assortment

(4)

Justify the statement:

"It is possible that a trait is inherited but may not be expressed."

[2 Marks]

Answer: A trait might be inherited but not expressed because of the presence of dominant and recessive alleles. According to Mendel's principles, a dominant allele

expresses the trait even if only one copy is present, while a recessive allele expresses the trait only when both alleles are recessive. Therefore, if an individual inherits one dominant and one recessive allele, the dominant trait is expressed, but the recessive trait is still inherited and can be passed on to the next generation without being visible.

Key Points: Mendel's experiments on garden pea- Dominant and recessive alleles- Presence of a recessive allele may not show the trait- Trait can be inherited but not expressed- Trait expression depends on allele combination

Question 24. Study the data showing the focal length of three concave mirrors A, B, and C and the respective distances of objects placed in front of the mirrors.

(1) List two properties of the image formed in case 2.

[1 Marks]

Answer: In case 2, where the object is placed at the center of curvature (C) of a concave mirror, the image formed is inverted and of the same size as the object.

Key Points: Object at center of curvature - Image is inverted - Image is same size as object

(2) In which one of the above cases will the mirror form a diminished image of the object? Justify your answer.

[1 Marks]

Answer: The mirror will form a diminished image of the object when the object is placed beyond the center of curvature (C) of the concave mirror. This is because when the object is beyond C, the image formed is real, inverted, and smaller in size compared to the object.

Key Points: For a concave mirror, if the object is beyond the center of curvature, the image is diminished - Image is real and inverted - Image position is between focus (F) and center of curvature (C) - Size of image is smaller than the object

(3) What is the nature and size of the image formed by mirror C? Draw a ray diagram to justify your answer.

[2 Marks]

Answer: The nature and size of the image formed by mirror C depends on the position of the object with respect to the center of curvature (C) and the focus (F) of the mirror. If the object in front of mirror C is placed beyond the center of curvature, the image formed is real, inverted, and smaller than the object. If the object is placed between the center of curvature and the focus, the image is real, inverted, and larger than the object. Assuming the object is beyond C in this case, the image will be real, inverted, and smaller. The image is formed between the focus and the center of curvature. (At the student's level, a simple ray diagram should be drawn showing two rays: one parallel to the principal axis reflected through the focus, and one passing through the center of curvature reflected back on itself. The intersection of the reflected rays gives the image position.)

Key Points: Nature of image depends on object position with respect to C and F- For object beyond C, image is real, inverted and smaller- For object between C and F, image is real, inverted and larger- Ray diagram should show at least two rays to locate image- Rays: parallel ray through focus, ray through center of curvature- Image position and size justified based on ray diagram

(4)

An object is placed at a distance of 18 cm from the pole of a concave mirror of focal length 12 cm. Find the position of the image formed in this case.

[2 Marks]

Answer: Given: Object distance, $u = -18$ cm (negative as per sign convention); Focal length, $f = -12$ cm (for concave mirror, focal length is negative). Using the mirror formula: $1/f = 1/v + 1/u$ Substituting the values, $1/(-12) = 1/v + 1/(-18) \Rightarrow 1/v = 1/(-12) + 1/18 = (-1/12) + (1/18) = (-3/36) + (2/36) = -1/36$ So, $v = -36$ cm The negative sign of v shows that the image is formed on the same side as the object, which means the image is real and inverted. Therefore, the image is formed at 36 cm from the pole on the same side as the object.

Key Points: Use of focal length and object distance with correct sign convention- Mirror formula application to find image distance- Negative image distance

indicates real and inverted image formed on same side as object

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