CBSE EXAMINATION PAPER-2024

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 90

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **45 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 3** are case based questions

iv. **Section B** – questions number **4 to 23** are multiple choice questions

v. **Section C** – questions number **24 to 31** are very short answer

vi. **Section D** – questions number **32 to 39** are short answer

vii. **Section E** – questions number **40 to 45** are long answer

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. The metals produced by various reduction processes are not very pure. They contain impurities, which must be removed to obtain pure metals. The most widely used method for refining impure metals is electrolytic refining.

(1) What is the cathode and anode made of in the refining of copper by this process?

[1 Marks]

Answer: In the refining of copper through electrolytic refining, the cathode is made of pure copper while the anode consists of impure copper.

Key Points: "Cathode: Pure Copper, Anode: Impure Copper"

(2) Name the solution used in the above process and write its formula.

[1 Marks]

Answer: The solution used in the electrolytic refining of copper is copper(II) sulfate solution, which has the formula $CuSO_4$.

Key Points: "Copper(II) sulfate solution, Formula: $CuSO_4$"

(3)

How copper get refined when electric current is passed in the electrolytic cell?

[2 Marks]

Answer: During electrolysis, copper ions in the copper sulfate solution are attracted to the cathode, where they gain electrons and get deposited as pure copper, while impurities settle down at the bottom as anode sludge.

Key Points: "Electrolysis mechanism, Copper ions transported"

(4) You have two beakers 'A' and 'B' containing copper sulfate solution. What would you observe after about 2 hours if you dip a strip of zinc in beaker 'A' and a strip of silver in beaker 'B'? Give reason for your observations in each case.

[2 Marks]

Answer: In beaker 'A', the zinc strip will dissolve as it displaces copper ions, resulting in a deposition of copper. In beaker 'B', the silver strip will not react as silver cannot displace copper ions from the solution, thus observing no change.

Key Points: "Zinc reacts with $CuSO_4$, Silver does not displace copper"

Question 2.

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 F_2 generation. By which method did he obtain F_2 generation? Write the ratio of the parental combinations obtained and what conclusions were drawn from this experiment.

RRYY	×	rryy
(Round Yellow)		(Wrinkled Green)

[2 Marks]

Answer: Mendel obtained the F_2 generation by allowing the F_1 plants, which were hybrids, to self-pollinate. From this self-pollination, he observed four types of seed combinations in the F_2 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: F_2 generation obtained by self-pollination of F_1 plants-The ratio of parental combinations in F_2 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 3. 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.

Case	Mirror	Focal Length (cm)	Object Distance (cm)
1	A	20	45
2	B	15	30
3	C	30	20

(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) => 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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Section B

Question 4.

When 2 mL of sodium hydroxide solution is added to a few pieces of granulated zinc in a test tube and then warmed, the reaction that occurs can be written in the form of a balanced chemical equation as:

[1 Marks]

(A) $NaOH + Zn \rightarrow NaZnO_2 + H_2O$

(B) $2NaOH + Zn \rightarrow Na2ZnO_2 + H_2O$

(C) $2NaOH + Zn \rightarrow NaZnO_2 + H_2$

(D) $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

Explanation:

The reaction between zinc metal and sodium hydroxide solution on warming produces sodium zincate (Na_2ZnO_2) and hydrogen gas (H_2). The balanced chemical equation that represents this reaction is $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$. This is confirmed by the given context, which states that “$2NaOH (aq) + Zn (s) \rightarrow Na_2ZnO_2 (s) + H_2 (g)$” and mentions the formation of hydrogen gas.

Question 5.

Select from the following a decomposition reaction in which the source of energy for decomposition is light:

[1 Marks]

(A) $2AgBr \rightarrow 2Ag + Br_2$

(B) $2H_2O \rightarrow 2H_2 + O_2$

(C) $CaCO_3 \rightarrow CaO + CO_2$

(D) $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_2$

Explanation:

The decomposition of silver bromide (2AgBr) into silver (2Ag) and bromine gas (Br_2) is caused by light energy, as given in the context. This reaction is similar to the decomposition of silver chloride by sunlight, which is used in black and white photography. Other reactions mentioned require heat or electricity, but 2AgBr decomposes specifically due to light energy.

Question 6.

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 7.

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 8.

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 ($Na_2CO_3 \cdot 10H_2O$), which is the highest number of water molecules compared to $CuSO_4 \cdot 5H_2O$ (5 water molecules), $CaSO_4 \cdot 2H_2O$ (2 water molecules), and $FeSO_4 \cdot 7H_2O$ (7 water molecules, though $FeSO_4$ was not fully described in the provided context, the known common form is $FeSO_4 \cdot 7H_2O$). Therefore, Na_2CO_3 has the maximum number of waters of crystallization.

Question 9. 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 10.

$MnO_2+4HCl \rightarrow MnCl_2+2H_2O+ Cl_2$.

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 11.

Consider the following statements:

(i) The sex of a child is determined by what it inherits from the mother.

(ii) The sex of a child is determined by what it inherits from the father.

(iii) The probability of having a male child is more than that of a female child.

(iv) The sex of a child is determined at the time of fertilization when male and female gametes fuse to form a zygote. The correct statements are:

[1 Marks]

(A) (i) and (iii)

(B) (iii) and (iv)

(C) (ii) and (iv)

(D) (i), (ii), and (iv)

Explanation:

The correct statements are (ii) and (iv). The sex of a child is determined by the chromosome inherited from the father, since the mother always provides an X chromosome while the father can provide either an X or a Y chromosome. The presence of a Y chromosome makes the child male, while XX makes the child female. This determination happens at fertilization when the sperm and egg fuse to form a zygote. Statement (i) is incorrect because the mother's chromosome is always X and does not determine sex. Statement (iii) is incorrect because the probability of having a male or female child is approximately equal.

Question 12.

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 13. 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 14.

A stomata closes when:

(i) it needs carbon dioxide for photosynthesis.

(ii) it does not need carbon dioxide for photosynthesis.

(iii) water flows out of the guard cells.

(iv) water flows into the guard cells.

The correct reason(s) in this process is/are:

[1 Marks]

(A) (ii) and (iv)

(B) (i) only

(C) (i) and (iii)

(D) (ii) and (iii)

Explanation:

The correct options are (ii) and (iii). According to the provided context, stomata close when the plant does not need carbon dioxide for photosynthesis to prevent excessive water loss. This closure happens because the guard cells lose water and shrink, causing the stomatal pore to close. Therefore, stomata close when the plant does not need carbon dioxide (ii), and when water flows out

of the guard cells causing them to shrink (iii). Water flowing into guard cells (iv) causes them to swell and the stomata to open, and needing carbon dioxide (i) leads to stomatal opening, not closing.

Question 15. 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 16. 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

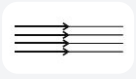
(D) Retina

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.

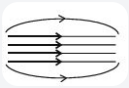
Question 17. The pattern of the magnetic field produced inside a current carrying solenoid is:

[1 Marks]

(A)



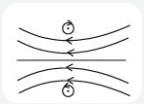
(B)



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

[1 Marks]

(A) Yeast

(B) Paramoecium

(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.

Question 20.

Assertion (A) Hydrogen gas is not evolved when zinc reacts with nitric acid.

Reason (R) Nitric acid oxidises the hydrogen gas produced to water and itself gets reduced.

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false.

(B) Assertion (A) is false, but Reason (R) is true

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

(D) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

Explanation:

Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). When zinc reacts with nitric acid, hydrogen gas is not evolved because nitric acid is a strong oxidising agent. It oxidises any hydrogen gas that would be formed into water, and itself gets reduced. This is different from reactions with dilute sulfuric or hydrochloric acid, where hydrogen gas is evolved.

Question 21.

Assertion (A): Accumulation of harmful chemicals is maximum in the organisms at the highest trophic level of a food chain.

Reason (R): Harmful chemicals are sprayed on the crops to protect them from diseases and pests

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false.

(B) Assertion (A) is false, but Reason (R) is true

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

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

Explanation:

Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). The assertion is true because harmful chemicals, which are not degradable, get accumulated progressively at each trophic level, leading to maximum accumulation in organisms at the highest trophic level (biological magnification). The reason is also true as harmful chemicals like pesticides are sprayed on crops to protect them from diseases and pests. However, the reason does not directly explain the assertion; it only explains the source of harmful chemicals, not the fact that accumulation is maximum at the highest trophic level.

Question 22.

Assertion (A): The rate of breathing in aquatic organisms is much faster than in terrestrial organisms.

Reason (R): The amount of oxygen dissolved in water is very high as compared to the amount of oxygen in air.

[1 Marks]

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

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

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Explanation:

Assertion (A) is true because aquatic organisms generally have a faster breathing rate to meet their oxygen needs. However, Reason (R) is false because the amount of oxygen dissolved in water is actually much lower compared to oxygen in the air. The low availability of oxygen in water forces aquatic organisms to breathe faster to intake sufficient oxygen. Therefore, the correct option is: Assertion (A) is true, but Reason (R) is false.

Question 23.

Assertion (A): The rainbow is a natural spectrum of sunlight in the sky.

Reason (R): Rainbow is formed in the sky when the sun is overhead and water droplets are also present in air.

[1 Marks]

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

(B) Assertion (A) is true, but Reason (R) is false.

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

(D) Assertion (A) is false, but Reason (R) is true

Explanation:

correct option: Assertion (A) is true, but Reason (R) is false.

Section C

Question 24. 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 (H_2O), 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: $CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (aq) + Heat$
This reaction releases heat, which shows it is exothermic. It is also called the slaking of lime.

> **Key Points: combination reaction - calcium oxide reacts with water to form calcium hydroxide - reaction releases heat**

Question 25.

State one role of each of the following in human digestive system:

(i) Hydrochloric acid

(ii) Vill

(iii) Anal Sphincter

(iv) Lipase.

[2 Marks]

Answer: (i) Hydrochloric acid creates an acidic medium in the stomach which helps in killing bacteria and activating the enzyme pepsin for protein digestion.
(ii) Villi are tiny finger-like projections in the small intestine that increase the surface area for absorption of nutrients.
(iii) Anal sphincter controls the opening and closing of the anus and helps in the controlled elimination of feces.
(iv) Lipase is an enzyme that breaks down fats into glycerol and fatty acids in the digestive system.

Key Points: Hydrochloric acid kills bacteria and activates pepsin - Villi increase surface area for absorption - Anal sphincter controls feces release - Lipase breaks down fats

Question 26. 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). => 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.

Key Points: Use mirror formula-Convex mirror focal length is positive-Object distance is negative in mirror formula-Calculate image distance-Interpret positive image distance as virtual image behind mirror-Result: image at 6 cm behind mirror

Question 27.

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.

Key Points: Sensitive plant leaves move quickly in response to touch - Movement involves changes in water pressure, not growth - No nervous or muscle tissue in plants - Root movement is directional and caused by growth - Roots move downward as the seedling grows - Root movement stops if growth is prevented

Question 28.

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.

Key Points: Thyroxin hormone regulates carbohydrate, protein, and fat metabolism - Thyroxin is secreted by the thyroid gland - Iodine is essential for thyroxin synthesis - Iodised salt provides necessary iodine - Lack of iodine causes thyroid problems like goitre - Importance of iodised salt in preventing iodine deficiency

Question 29.

Show how you would connect three resistors each of resistance 6 Ω, so that the combination has a resistance of 9 Ω. Also justify your answer.

[2 Marks]

Answer:

To get a combination resistance of 9 ohms using three 6 ohm resistors, connect two resistors in series and then connect the third resistor in parallel to this series combination.
Step 1: Connect two resistors in series. Their combined resistance R_{series} = 6 Ω + 6 Ω = 12 Ω.
Step 2: Connect this series combination in parallel with the third resistor (6 Ω).
Step 3: Equivalent resistance R_eq = 1 / (1 / 12 + 1 / 6) = 1 / (1 / 12 + 2 / 12) = 1 / (3 / 12) = 4 Ω, but since we want 9 Ω, reverse the process.
Actually, connect two resistors in parallel and then connect the third in series.
Step 1: Two resistors in parallel, $R_{parallel}$ = 1 / (1 / 6 + 1 / 6) = 3 Ω.

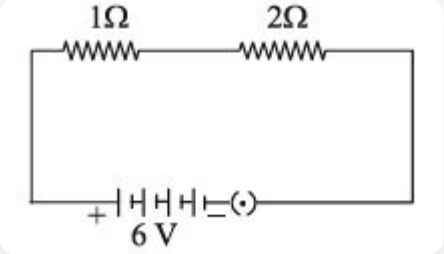
Step 2: Connect the third resistor (6 Ω) in series: R_eq = 3 Ω + 6 Ω = 9 Ω.
Therefore, connect two resistors in parallel and then connect the third resistor in series with this parallel combination to get an equivalent resistance of 9 ohms.
This works because the total resistance decreases in parallel and increases in series, allowing us to get the required resistance.

Key Points: Connect two resistors in parallel - Connect the third resistor in series - Equivalent resistance is 9 ohms

Question 30.

In the given circuit calculate the power consumed in watts in the resistor of 2 Ω:

[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.

Key Points: Use Ohm's law to find current (I = V / R)-Calculate power using P = I squared times R-Power is measured in watts (W)

Question 31.

(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.

Key Points: Magnetic field lines never cross because the magnetic field has only one direction at a point- Magnetic field direction is shown by tangent to field line at that point- Uniform magnetic field has parallel and equally spaced straight lines- Parallel lines represent equal strength and uniform direction of the magnetic field- Diagram should show parallel straight lines between two poles

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Section D

Question 32.

Write one chemical equation each for the chemical reaction in which the following have taken place:

(i) Change in colour

(ii) Change in temperature

(iii) Formation of precipitate.

Mention colour change/temperature change (rise/fall)/compound precipitated along with equation.

[3 Marks]

Answer: (a) Change in colour:
Example: Copper sulphate solution is blue. When iron is added, the solution turns greenish due to formation of iron sulphate.
Equation: $CuSO_4$ (blue) + Fe $\rightarrow$ $FeSO_4$ (green) + Cu

(b) Change in temperature:
Example: When quicklime (CaO) is mixed with water, heat is released (temperature rise).
Equation: $CaO + H_2O \rightarrow Ca(OH)_2$ + heat

(c) Formation of precipitate:
Example: When silver nitrate reacts with sodium chloride, a white precipitate of silver chloride is formed.
Equation: $AgNO_3 + NaCl \rightarrow AgCl$ (white precipitate) + $NaNO_3$

Key Points: Change in colour reaction example - Change in temperature reaction example - Formation of precipitate reaction example

Question 33.

(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 (NH3) 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.

Key Points: Tomato juice is acidic with pH 4.6 and tastes sour-Due to presence of H+ ions in acidic solutions-Strong acid ionize completely releasing many H+ ions-Weak base ionize partially releasing fewer OH- ions-Acid rain lowers water pH harming aquatic animals-Acidic water disrupts physiology and reproduction of aquatic life-Acid rain may release toxic metals into water making it harmful

Question 34.

(i) Why is respiratory pigment needed in multicellular organisms with large body size?

(ii) Give reasons for the following:

(a) Rings of cartilage are present in the throat,

(b) Lungs always contain a residual volume of air,

(c) The diaphragm flattens and ribs are lifted up when we breathe,

(d) Walls of alveoli contain an extensive network of blood vessels.

[3 Marks]

Answer:

(i) Need for respiratory pigment in multicellular organisms with large body size:
In large multicellular organisms, simple diffusion is not sufficient to supply oxygen to all cells because the body size is large and cells are far from the external environment. Respiratory pigments like haemoglobin bind oxygen from the lungs and transport it through the blood to the tissues that need oxygen. This ensures efficient oxygen delivery and maintains the body's metabolic needs.

(ii) Reasons for the following:
(a) Rings of cartilage are present in the throat: These cartilage rings keep the trachea or windpipe open and prevent its collapse when we breathe, ensuring continuous airflow.
(b) Lungs always contain a residual volume of air: This residual air prevents the lungs from collapsing and ensures that gas exchange can continue even between breaths.
(c) The diaphragm flattens and ribs are lifted up when we breathe: This increases the chest cavity volume, causing air to be sucked into the lungs for inhalation.
(d) Walls of alveoli contain an extensive network of blood vessels: This rich blood supply helps in the efficient exchange of gases—oxygen moves from alveoli into blood, and carbon dioxide moves from blood into alveoli for exhalation.

> **Key Points: Respiratory pigments carry oxygen in large organisms-Rings of cartilage keep airway open-Lungs retain residual air to prevent collapse-Diaphragm movement increases chest volume for inhalation-Alveolar walls have many blood vessels for gas exchange**

Question 35. 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.

Key Points: Definition of reflex action-Importance of reflex action as a rapid, automatic response-Flow of reflex arc pathway: stimulus, receptors, sensory neuron, relay neuron, motor neuron, effector, response-Example of sneezing as a reflex action-Message sent to brain simultaneously

Question 36.

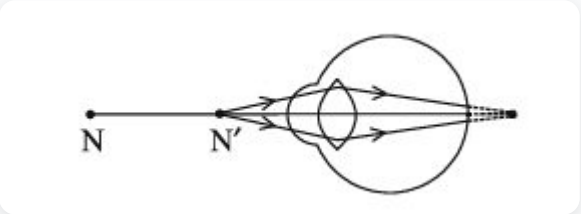
Study the diagram given below and answer the questions that follow:

(i) Name the defect of vision represented in the diagram. Give reason for your answer.

(ii) List two causes of this defect.

(iii) With the help of a diagram, show how this defect of vision is corrected.

[3 Marks]



Answer: (i) Name and Reason: The defect of vision shown in the diagram is myopia, also known as near-sightedness. This is because the image of a distant object is formed in front of the retina instead of on it, leading to blurred distant vision.

(ii) Causes: Two causes of myopia are: (1) Excessive curvature of the eye lens, (2) Elongation of the eyeball.

(iii) Correction: Myopia can be corrected by using a concave lens of suitable power. The concave lens diverges the light rays before they enter the eye, which moves the focal point backward so that the image is formed exactly on the retina, resulting in clear distant vision.

Below is a simple diagram illustrating the correction of myopia:
Concave lens → |>>>>(Eye) → Image on retina.

This correction helps the eye focus distant objects properly.

Key Points: Defect name: Myopia (near-sightedness)-Reason: Image formed in front of retina-Causes: Excessive curvature of eye lens, Elongation of eyeball-Correction: Using concave lens to diverge light rays and form image on retina

Question 37.

Plants → Deer → Lion.

In the given food chain, what will be the impact of removing all the organisms of the second trophic level on the first and third trophic levels? Will the impact be the same for the organisms of the third trophic level in the above food chain if they were present in a food web? Justify.

[3 Marks]

Answer: In the given food chain, Plants → Deer → Lion, the second trophic level consists of deer, which are herbivores feeding on plants. Removing all deer will cause a significant impact on both the first and third trophic levels. Without deer, plants will grow excessively because their primary consumer is missing, leading to an increase in plant biomass. On the other hand, lions, which are carnivores and depend on deer for food, will face starvation, causing a decline in their population. However, if these organisms were part of a food web, the impact on the lions might not be as severe because food webs have multiple feeding relationships. Lions could rely on other prey animals present in the web, reducing the chance of starvation. Thus, the interconnectedness of food webs offers more stability to ecosystems compared to linear food chains.

> **Key Points: Removing deer affects plants and lions-The plants will increase in number due to lack of herbivory-Lions will face scarcity of food leading to population decline-In a food web, lions have alternative prey-This reduces the impact of removal of one species-Food webs provide ecosystem stability and balance**

Question 38.

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.

Key Points: Name of gas - Ozone (O_3)-Function of ozone - Absorbs harmful UV radiation protecting life on Earth-Depleting chemicals - Chlorofluorocarbons (CFCs)-International measure - Montreal Protocol to phase out CFCs and protect ozone layer-Significance - Prevention of skin cancer and environmental damage

Question 39.

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.

Key Points: (i) Right-Hand Rule - Thumb in current direction - Fingers curl shows magnetic field direction - Magnetic field circles around conductor-(ii) Fleming's Left-Hand Rule - First finger: magnetic field direction - Second finger: current direction - Thumb: force direction on conductor - Force is perpendicular to both current and magnetic field

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Section E

Question 40.

(i) Define a homologous series of carbon compounds.

(ii) Why is the melting and boiling points of C_4H_8 higher than that of C_3H_6 or C_2H_4?

(iii) Why do we NOT see any gradation in chemical properties of a homologous series compound?

(iv) Write the name and structures of (i) aldehyde and (ii) ketone with molecular form C_3H_6O.

[5 Marks]

Answer: (i) A homologous series is a series of carbon compounds having the same functional group and similar chemical properties, in which each successive member differs by a CH_2 unit in their molecular formula.

(ii) The melting and boiling points of C_4H_8 are higher than C_3H_6 and C_2H_4 because it has a larger molecular size and greater surface area leading to stronger intermolecular forces (like van der Waals forces), which require more energy to overcome.

(iii) We do not see gradation in chemical properties in a homologous series because the chemical properties depend mainly on the functional group which remains the same in all members of the series, so the reaction behaviour is similar.

(iv) (a) Aldehyde with formula C_3H_6O is Propanal. Structure: CH_3-CH_2-CHO.

(b) Ketone with formula C_3H_6O is Acetone (Propanone). Structure: CH_3-CO-CH_3.

> **Key Points: Definition of homologous series - Melting and boiling points increase with molecular size - Chemical properties depend on functional group - Structures of propanal and acetone**

Question 41.

(i) Write the name and structure of an organic compound 'X' having two carbon atoms in its molecule and its name is suffixed with '-ol'. 5

(ii) What happens when 'X' is heated with excess concentrated sulphuric acid at 443 K? Write chemical equation for the reaction stating the conditions for the reaction. Also state the role played by concentrated sulphuric acid in the reaction.

(iii) Name and draw the electron dot structure of hydrocarbon produced in the above reaction.

[5 Marks]

Answer: (i) The organic compound 'X' is Ethanol which has two carbon atoms and the name ends with '-ol' as it is an alcohol. Its structure is CH_3-CH_2-OH.

(ii) When ethanol (X) is heated with excess concentrated sulphuric acid at 443 K, it undergoes a dehydration reaction where a molecule of water is removed resulting in the formation of ethene (an alkene). The reaction is:

CH_3-CH_2-OH --(hot conc. H_2SO_4, 443 K)--> CH_2=CH_2 + H_2O

Concentrated sulphuric acid acts as a dehydrating agent and catalyst in this reaction. It removes water from ethanol to form ethene and also speeds up the reaction without being consumed.

(iii) The hydrocarbon formed is Ethene (C_2H_4). Its electron dot structure represents the covalent bonds between the two carbon atoms with a double bond and the bonded hydrogen atoms. The structure can be shown as:

C : C

| |

H H H H

Each line corresponds to a pair of shared electrons (a covalent bond) between atoms. Ethene has a double bond between the two carbon atoms indicating the presence of 4 shared electrons between them.

> **Key Points: Ethanol has two carbon atoms and ends with -ol - Ethanol structure is CH3-CH2-OH - Heating ethanol with hot concentrated H2SO4 at 443 K causes dehydration to form ethene and water - Concentrated H2SO4 acts as a dehydrating agent and catalyst - Ethene is the hydrocarbon produced with a double bond between two carbon atoms - Electron dot structure shows shared electron pairs for covalent bonds in ethene**

Question 42.

(i) Name three techniques/devices used by human females to avoid 5pregnancy. Mention the side effects caused by each.

(ii) What will happen if in a human female (a) fertilisation takes place, (b) an egg is not fertilised?

[5 Marks]

Answer: (i) Three contraceptive techniques/devices used by human females to avoid pregnancy are:

1. Barrier method (e.g., condom or diaphragm): This method prevents sperm from reaching the egg.
Side effects: Some people may have allergies or irritation due to latex.
2. Oral contraceptive pills: These pills change the hormonal balance of the body so that eggs are not released from the ovaries.
Side effects: Nausea, weight gain, mood changes, or blood clots in rare cases.
3. Intrauterine device (IUD): A small device inserted in the uterus to prevent fertilization or implantation.
Side effects: May cause abdominal pain, heavy bleeding, or infection in some women.

(ii) (a) If fertilisation takes place in a human female, the fertilised egg (zygote) moves to the uterus and gets implanted in the uterine lining. This leads to pregnancy, and the embryo starts developing.

(b) If an egg is not fertilised, it will not get implanted in the uterus. The egg along with the thickened lining of the uterus breaks down and is shed from the body during menstruation.

Key Points: Barrier methods prevent sperm entry - Hormonal pills prevent ovulation - IUD prevents fertilization or implantation - Fertilisation leads to pregnancy - No fertilisation results in menstruation

Question 43.

(i) Draw a diagram showing spore formation in Rhizopus and label the (a) reproductive and (b) non reproductive parts. Why does Rhizopus not multiply on a dry slice of bread?

(ii) Name and explain the process by which reproduction takes place in Hydra.

[5 Marks]

Answer: (i) In Rhizopus, spore formation occurs on special structures called sporangia which are borne on sporangiophores. The non reproductive parts are the hyphae which support the sporangiophores. The diagram can be drawn as: Hypha (non reproductive) - Sporangiophore (reproductive stalk) - Sporangium (reproductive structure) containing spores. Spores are released when the sporangium bursts and can grow into new Rhizopus individuals. Rhizopus does not multiply on a dry slice of bread because spores require moisture to germinate and grow. Without moisture, the spores cannot develop and the fungus cannot multiply.

(ii) In Hydra, reproduction takes place by a process called budding. A small bud develops on the body of the parent Hydra due to repeated cell division at one spot. This bud grows into a miniature Hydra and when fully developed, it detaches from the parent and becomes an independent organism. Budding allows Hydra to reproduce asexually and produce offspring genetically identical to the parent.

Key Points: Spore formation in Rhizopus - Hyphae are non reproductive parts - Sporangiophore and sporangium are reproductive parts - Spores need moisture to germinate - Rhizopus does not grow on dry bread - Hydra reproduces by budding - Budding involves growth of a new individual from parent body - Offspring detach as independent organisms

Question 44.

(i) Define electric power. Express it in terms of potential difference (V) and resistance (R).

(ii)An electric oven is designed to work on the mains voltage of 220 V. This oven consumes 11 units of electrical energy in 5 hours. Calculate:
(a) power rating of the oven
(b) current drawn by the oven
(c) resistance of the oven when it is red hot

[5 Marks]

Answer: (i) Definition of electric power: Electric power is the rate at which electrical energy is consumed or converted into some other form of energy in an electric circuit.
It is expressed as the product of potential difference (V) and current (I) in the circuit, i.e., P = V * I.
Using Ohm's law, I = V / R, so power can also be expressed as P = V * (V / R) = V^2 / R.

(ii) Given data: Voltage, V = 220 V
Energy consumed = 11 units = 11 kWh
Time, t = 5 hours

(a) Power rating of the oven:
Energy consumed = Power * time
Power = Energy / time = 11 kWh / 5 h = 2.2 kW = 2200 W

(b) Current drawn by the oven:
Using P = V * I, I = P / V = 2200 W / 220 V = 10 A

(c) Resistance of the oven when red hot:
Using Ohm's law, V = I * R, so R = V / I = 220 V / 10 A = 22 ohms.

Key Points: Definition of electric power - Power formula P = V * I - Power expressed as V squared over resistance - Calculation of power rating from energy and time - Current calculation using P and V - Resistance calculation using V and I

Question 45.

(i) Write the relation between resistance R and electrical 5 resistivity ρ of the material of a conductor in the shape of cylinder of length l and area of cross-section A. Hence derive the SI unit of electrical resistivity.

(ii) The resistance of a metal wire of length 3 m is 60 Ω. If the area of cross-section of the wire is $4\times10-7m^2$, calculate the electrical resistivity of the wire.

(iii) State how would electrical resistivity be affected if the wire (of part 'ii') is stretched so that its length is doubled. Justify your answer.

[5 Marks]

Answer: (i) The resistance R of a conductor is directly proportional to its length l and inversely proportional to its area of cross-section A. Mathematically, R = ρ * (l / A), where ρ is the electrical resistivity of the material. Rearranging, ρ = R * (A / l). Electrical resistivity ρ is a characteristic property of the material which indicates how much it resists the flow of electric current.
The SI unit of resistance R is ohm (Ω), length l is measured in meters (m), and area A in square meters (m^2). Therefore, the SI unit of resistivity ρ is Ω * m, derived as ρ = R * (A / l) = (Ω) * (m^2 / m) =

Ω * m.

(ii) Given: Length l = 3 m, Resistance R = 60 Ω, Area of cross-section A = $4 * 10^{-7}$ m^2.
Using the formula for resistivity: ρ = R * (A / l) = 60 * ($4 * 10^{-7}$ / 3) = 60 * ($1.3333 * 10^{-7}$) = $8 * 10^{-6}$ Ω m.
Therefore, the electrical resistivity of the wire is 8×10^{-6} ohm meter.

(iii) Electrical resistivity ρ depends only on the material and temperature. When the wire is stretched to double its length, its dimensions change but the material remains the same. Therefore, the resistivity ρ remains unchanged.
Justification: Resistivity is an intrinsic property of the material and does not depend on the shape or size of the conductor. Even if the length doubles and area changes, resistivity remains constant as long as the temperature stays the same.

Key Points: Resistance relation R = ρ * l / A - SI unit of resistivity Ω m derived from formula - Resistivity independent of shape or size, depends only on material