CBSE EXAMINATION PAPER-2023

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 88

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **46 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 32** are very short answer

vi. **Section D** – questions number **33 to 42** are short answer

vii. **Section E** – questions number **43 to 46** 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. Almost all metals combine with oxygen to form metal oxides. Metal oxides are generally basic in nature. But some metal oxides show both basic as well as acidic behaviour. Different metals show different reactivities towards oxygen. Some react vigorously while some do not react at all.

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

[1 Marks]

Answer: When copper is heated in air, it reacts with oxygen present in the air to form copper(II) oxide. This copper oxide is black in color and forms as a layer on the surface of copper. The chemical reaction involved is: $2Cu + O2 \rightarrow 2CuO$. Here, copper (Cu) combines with oxygen ($O2$) to form copper oxide (CuO).

Key Points: Copper reacts with oxygen on heating - copper oxide formed is black in color - chemical reaction: $2Cu + O2 \rightarrow 2CuO$ - copper oxide forms on the surface of copper - copper oxide is an example of a basic metal oxide

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

[1 Marks]

Answer: Some metal oxides are categorized as amphoteric because they can react both with acids and bases to form salts and water. This means they show both acidic and basic properties. For example, aluminium oxide ($Al2O3$) is an amphoteric oxide. It reacts with hydrochloric acid to form aluminium chloride and water, showing basic behaviour. It also reacts with sodium hydroxide to form sodium aluminate and water, showing acidic behaviour.

Key Points: Amphoteric oxides react with both acids and bases-They produce salts and water on reacting with acids and bases-Example of amphoteric oxide is aluminium oxide ($Al2O3$)-Aluminium oxide reacts with acid to give aluminium salt and water-Aluminium oxide reacts with base to give complex salt and water

(3)

Complete the following equations:

(i) $Na_2O_{(s)} + H_2O_{(l)} \rightarrow$

(ii) $Al_2O_3 + 2\ NaOH \rightarrow$?

[2 Marks]

Answer: (i) Sodium oxide reacts with water to form sodium hydroxide: $Na_2O + H_2O \rightarrow 2\ NaOH$ (ii) Aluminium oxide is an amphoteric oxide and reacts with sodium hydroxide to form sodium aluminate and water: $Al_2O_3 + 2\ NaOH \rightarrow 2\ NaAlO_2 + H_2O$

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

(4)

On burning sulphur in oxygen a colourless gas is produced.

(i) Write chemical equation for the reaction.

(ii) Name the gas formed.

(iii) State the nature of the gas.

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

[2 Marks]

Answer: (i) The chemical equation when sulphur burns in oxygen is: S + O2 → SO2 (ii) The gas formed is Sulphur dioxide (SO2). (iii) The nature of the gas sulphur dioxide is acidic. (iv) When sulphur dioxide gas comes in contact with dry litmus paper, there is no change in the color of the dry litmus paper because dry litmus paper only shows change in color in presence of moisture.

Key Points: 1. Sulphur combines with oxygen to form sulphur dioxide. 2. The reaction chemical equation: S + O2 → SO2. 3. Sulphur dioxide is an acidic oxide. 4. Dry litmus paper does not change color when exposed to acidic oxides as moisture is necessary for the gas to affect the litmus paper.

Question 2.

In order to trace the inheritance of traits Mendel crossed pea plants having one contrasting character or a pair of contrasting characters. When he crossed pea plants having round and yellow seeds with pea plants having wrinkled and green seeds, he observed that no plants with wrinkled and green seeds were obtained in the F_1 generation. When the F_1 generation pea plants were cross-bred by self-pollination, the F_2 generation had seeds with different combinations of shape and colour also.

(1) Differentiate between dominant and recessive traits.

[1 Marks]

Answer: Dominant traits are the traits that appear or are expressed in the offspring even if only one allele is present for that trait. In Mendel's experiments, round seed shape (represented by allele R) and yellow seed color (represented by allele Y) were dominant traits. This means if the plant has at least one R allele, the seeds will be round, and if it has at least one Y allele, the seeds will be yellow. Recessive traits, on the other hand, are traits that are hidden or masked in the presence of dominant alleles. They only appear when both alleles are recessive. For example, wrinkled seed shape (r) and green seed color (y) are recessive traits and are visible only when the plant has two recessive alleles (rr or yy). Therefore, dominant traits mask the presence of recessive traits in the heterozygous condition.

Key Points: Dominant traits appear when one or both alleles are dominant - Recessive traits appear only when both alleles are recessive - In Mendel's pea plants, round seed shape and yellow color are dominant - Wrinkled seed shape and green color are recessive - Dominant traits mask recessive traits in heterozygous plants

(2)

State the ratio of the combinations observed in the seeds of F_2 generation in the above case. What do you interpret from this result?

[2 Marks]

Answer:

The ratio of combinations observed in the seeds of the F_2 generation was approximately 9:3:3:1. This means that out of 16 plants, 9 had round yellow seeds, 3 had round green seeds, 3 had wrinkled yellow seeds, and 1 had wrinkled green seeds. This result shows that the traits for seed shape and seed color assort independently of each other during inheritance. It also confirms Mendel's principle of independent assortment, which states that different traits are inherited separately and new combinations of traits can appear in the offspring.

Key Points:

Ratio of combinations in F2 is 9 round yellow : 3 round green : 3 wrinkled yellow : 1 wrinkled green - Traits of seed shape and color assort independently - Mendel's principle of independent assortment - Explanation that new combinations of traits are formed in F_2 generation

(3)

Given below is a cross between a pure violet flowered pea plant (V) and a pure white flowered pea plant (v). Diagrammatically explain what type of progeny is obtained in F_1 generation and F_2 generation:

Pure violet flowered plant × Pure white flowered plant.

(V V) (v v)

[2 Marks]

Answer: In this cross, violet (V) is the dominant allele and white (v) is the recessive allele. Parental generation (P): Pure violet flowered plant has the genotype VV and pure white flowered plant has the genotype vv. F_1 generation: When we cross VV × vv, all offspring will have genotype Vv. Since V is dominant, all F_1 flowers will be violet. F_2 generation: When F_1 plants (Vv) are self-pollinated, the possible genotypes of the F_2 generation are: - VV (homozygous violet) - Vv (heterozygous violet) - vv (homozygous white) Phenotypically, the ratio is 3 violet : 1 white flower. This pattern is explained by Mendel's law of dominance and segregation.

Key Points: Violet color is dominant allele (V) and white is recessive (v)-Pure violet (VV) crossed with pure white (vv) results in all heterozygous violet (Vv) flowers in F_1-When F_1 (Vv) plants self-pollinate, F_2 generation shows genotypic ratio 1 VV : 2 Vv : 1 vv-Phenotypic ratio in F_2 is 3 violet : 1 white-Mendel's laws of dominance and segregation explain these results

(4)

Write any two pairs of contrasting characteristics of pea plant used by Mendel other than those mentioned above.

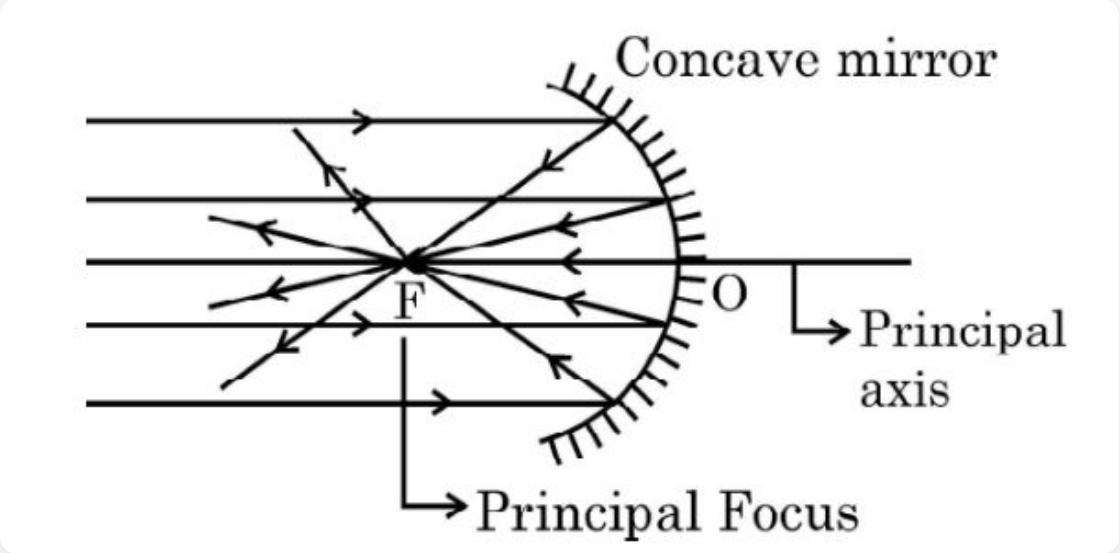
[1 Marks]

Answer: Two pairs of contrasting characteristics used by Mendel other than seed shape and seed colour are: 1. Tall plants and short plants (height of the plant). 2. White flowers and violet flowers (colour of the flowers).

Key Points: Mendel used a number of contrasting characters-Tall/short plants-White/violet flower colour-Other traits observed such as pod shape and pod colour

Question 3.

Hold a concave mirror in your hand and direct its reflecting surface towards the sun. Direct the light reflected by the mirror on to a white card-board hold close to the mirror. Move the card-board bock and forth gradually until you find a bright, sharp spot of light on the board. Thik spot of light is the image of the sun on the sheet of paper, which is also termed as "Principal Focus" of the concave mirror.



(1)

List two applications of concave mirror.

[1 Marks]

Answer: Two applications of concave mirror are: 1. Dentist's Mirror: Concave mirrors are used by dentists to get a magnified and clear view of the teeth for examination and treatment. 2. Solar Furnace: Concave mirrors are used to focus sunlight on a point to generate high temperatures, which can be used in solar furnaces to melt materials or produce energy.

Key Points: Concave mirror forms real and magnified images - Used in dentists' mirrors for magnified view - Used in solar furnaces to focus sunlight and generate heat

(2)

If the distance between the mirror and the principal focus is 15 cm. find the radius of curvature of the mirror,

[1 Marks]

Answer: The distance between the mirror and the principal focus is called the focal length (f) of the concave mirror. Given, focal length (f) = 15 cm. The radius of curvature (R) of a concave mirror is twice the focal length. Therefore, R = 2 × f = 2 × 15 cm = 30 cm. Hence, the radius of curvature of the mirror is 30 cm.

Key Points: Principal focus is the point where parallel rays of light converge after reflection from a concave mirror - Given distance between mirror and principal focus is focal length (f) - Radius of curvature (R) is twice the focal length (R = 2f) - Substitute the given focal length to find radius of curvature

(3)

Draw a ray diagram to show the type of image formed when an object is placed between pole and focus of n concave mirror.

[2 Marks]

Answer: When an object is placed between the pole (P) and the focus (F) of a concave mirror, the image formed is virtual, erect, and magnified. To draw the ray diagram: 1. Draw the principal axis, mark the Pole (P) and Focus (F). 2. Place the object between P and F. 3. Draw a ray from the top of the object parallel to the principal axis. After reflection, this ray passes through the focus (F). 4. Draw a ray from the top of the object passing through the pole (P), reflecting back symmetrically. 5. Since the rays diverge after reflection, extend the reflected rays backward behind the mirror. They appear to meet at a point behind the mirror. 6. The point where the extended rays meet is the position of the image. It is virtual (since rays do not actually meet), erect, and bigger than the object. This is the typical image formed by a concave mirror when the object is between the pole and the focus.

Key Points: Object placed between Pole and Focus-Virtual image formed-Image is erect and magnified-Rays appear to diverge and meet behind the mirror-Use two rays to construct the diagram (parallel ray and ray through pole)

(4)

An object 10 cm in size is placed at 100 cm in front of a concave mirror. If its image is formed at the same point where the object is located, find:

(i) focal length of the mirror, and

(ii) magnification of the image formed with sign as per Cartesian sign convention.

[2 Marks]

Answer: (i) Given that the object is placed at 100 cm in front of the mirror and its image is formed at the same point, so the object distance (u) = image distance (v) = -100 cm (since in mirror formula, distances measured against the direction of incident light are negative). Using mirror formula: 1/f = 1/v + 1/u => 1/f = 1/(-100) + 1/(-100) = -1/100 - 1/100 = -2/100 = -1/50 => focal length, f = -50 cm The negative sign indicates the mirror is concave. (ii) Magnification, m = height of image / height of object = v/u => m = (-100)/(-100) = +1 So, the magnification is +1, which means the image is of the same size as the object and is erect. However, since it is a concave mirror, the image formed at the same position as the object indicates it is a virtual image formed behind the mirror at the same distance. Therefore, focal length of the mirror is -50 cm and magnification of the image is +1.

Key Points: Use the mirror formula 1/f = 1/v + 1/u-mirror formula application-object and image distances are equal and negative as per sign convention-focal length calculation and its negative value indicating concave mirror-magnification formula m = v/u-magnification value and sign interpretation

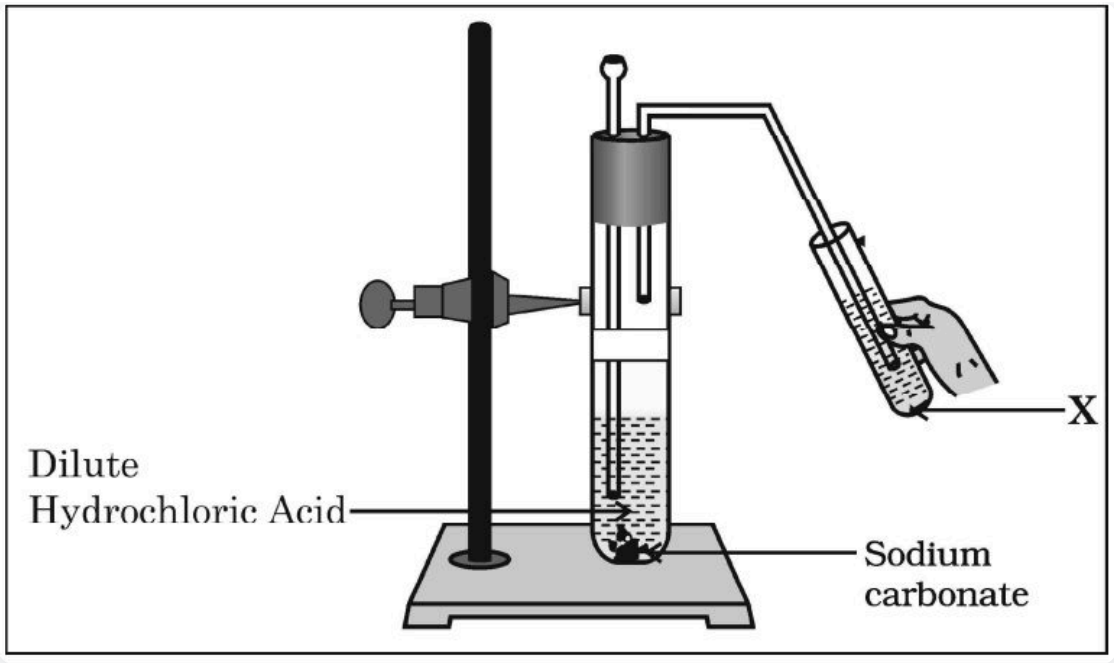
Section B

Question 4.

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

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

[1 Marks]



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

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

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

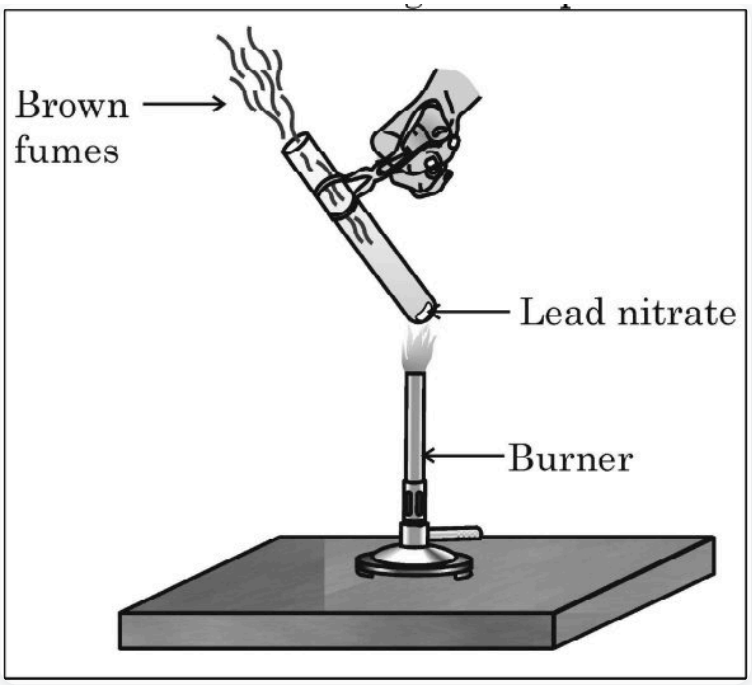
(D) the carbon dioxide liberated during the reaction turns lime water milky due to formation of calcium hydrogen carbonate and after some time it turns colourless due to formation of calcium carbonate which is soluble in water.

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

Question 5.

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

[1 Marks]



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

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

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

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

Explanation: The brown fumes observed during the heating of lead nitrate are due to the thermal decomposition of lead nitrate which produces nitrogen dioxide (NO2) gas. Nitrogen dioxide is a reddish-brown gas, which causes the brown fumes. The chemical reaction involved is the decomposition of lead nitrate into lead oxide (a solid that remains in the tube), nitrogen dioxide (brown fumes), and oxygen gas. Thus, the correct option is that the brown fumes are due to the thermal decomposition of lead nitrate producing brown fumes of nitrogen dioxide.

Question 6.

$MnO_2 + x\ HCl \rightarrow MnCl_2 + y\ H_2O + z\ Cl_2$

In order to balance the above chemical equation, the values of x, y and z respectively are:

[1 Marks]

(A) 2, 2, 1

(B) 6, 2, 2

(C) 4, 2, 1

(D) 4, 1, 2

Explanation: The balanced chemical equation is $MnO_2 + 4\ HCl \rightarrow MnCl_2 + 2\ H_2O + Cl_2$. Here, x = 4, y = 2, and z = 1. This corresponds to the provided balanced equation from the context where manganese dioxide reacts with hydrochloric acid to form manganese chloride, water, and chlorine gas.

Question 7.

The table below has information regarding pH and the nature (acidic/basic) of four different solutions. Which one of the options in the table is correct?

[1 Marks]

Option	Solution	Colour of pH paper	Approximate pH value	Nature of solution
(a)	Lemon juice	Orange	3	Basic
(b)	Milk of magnesia	Blue	10	Basic
(c)	Gastric juice	Red	6	Acidic
(d)	Pure water	Yellow	7	Neutral

(A) B

(B) D

(C) A

(D) C

Explanation:

The correct option corresponds to the one that accurately matches pH values with the nature of the solutions. Acidic solutions have pH less than 7, basic solutions have pH greater than 7, and neutral solutions have pH equal to 7. Since 1M HCl has pH around 1, it is highly acidic. Blue litmus turns red in acidic solution and red litmus turns blue in basic solution. Using these principles, the correct option (C) correctly identifies the pH values and nature (acidic or basic) of the four given solutions in the table.

Question 8.

A metal 'X' is used in thermite process. When X is burnt in air it gives an amphoteric oxide 'Y'. 'X' and 'Y' are respectively:

[1 Marks]

(A) Al and Al_2O_3

(B) Al and Al_2O_4

(C) Fe and Fe_3O_4

(D) Fe and Fe_2O_3

Explanation: In the thermite process, aluminum (Al) is used as the metal 'X'. When aluminum is burnt in air, it forms aluminum oxide (Al_2O_3), which is an amphoteric oxide. The thermite reaction involves iron(III) oxide reacting with aluminum to produce molten iron and aluminum oxide (Al_2O_3). Therefore, 'X' and 'Y' are aluminum and aluminum oxide respectively.

Question 9.

Select washing soda from the following:

[1 Marks]

(A) $Na_2CO_3 \cdot 10H_2O$

(B) $NaHCO_3$

(C) NaOH

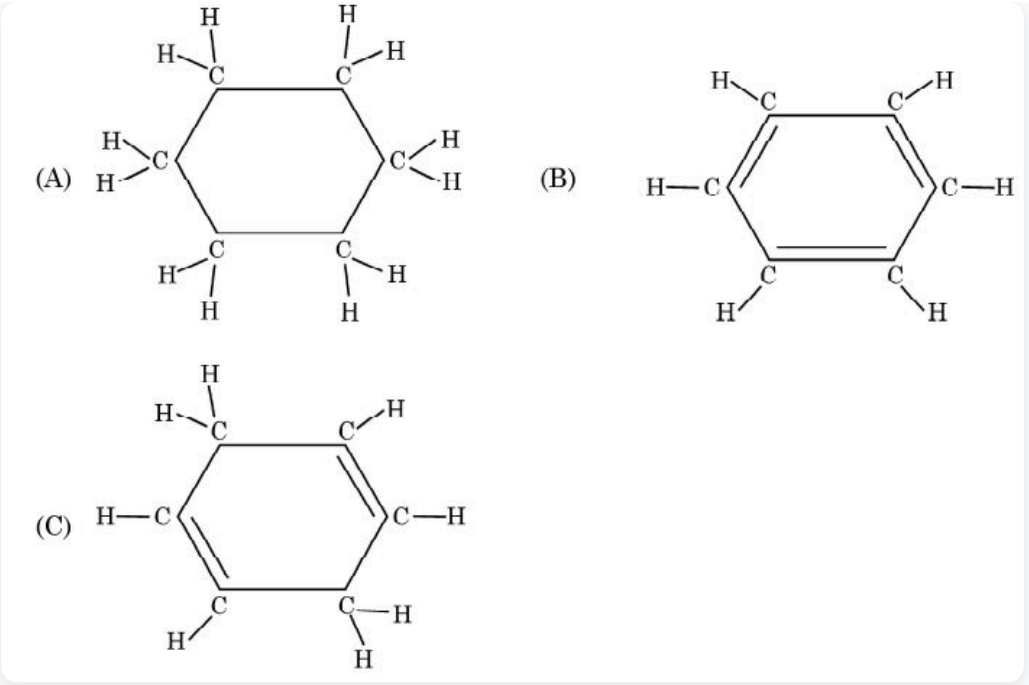
(D) $Na_2CO_3 \cdot 5H_2O$

Explanation: The correct option is $Na_2CO_3 \cdot 10H_2O$ because washing soda is the decahydrate form of sodium carbonate, meaning it contains 10 water molecules of crystallization. This is supported by the context which mentions $Na_2CO_3 \cdot 10H_2O$ as washing soda and explains that recrystallisation of sodium carbonate gives washing soda. Other options such as $NaHCO_3$ (baking soda), NaOH (caustic soda), and $Na_2CO_3 \cdot 5H_2O$ do not represent washing soda.

Question 10.

Consider the structures of the three cyclic carbon compounds A, B and C given below and select the correct option from the following :

[1 Marks]



(A) A is an isomer of hexane, B is benzene and C is an isomer of hexene.

(B) A is a saturated cyclic hydrocarbon and B and C are unsaturated cyclic hydrocarbons.

(C) A is cyclohexane and B and C are the isomers of benzene.

(D) A and C are isomers of hexane and B is benzene.

Explanation:

The correct option is: 'A and C are isomers of hexane and B is benzene.' This is because cyclohexane (A) and compound C both have the molecular formula C6H12 and are cyclic saturated hydrocarbons (cycloalkanes). They are structural isomers of hexane (C6H14) but in cyclic form, meaning they have the same molecular formula but different structures. Benzene (B), with molecular formula C6H6, is an aromatic compound that is unsaturated due to the alternating double bonds. Therefore, A and C are cyclic isomers related to hexane derivatives, and B is benzene.

Question 11.

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

[1 Marks]

(A) a bacteria, Rhizobium

(B) a plant parasite, Cuscuta

(C) a fungi, Rhizopus

(D) an animal parasite, Tapeworm

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

Question 12.

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

[1 Marks]

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

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

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

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

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

Question 13.

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

[1 Marks]

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

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

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

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

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

Question 14.

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

[1 Marks]

(A) It is a growth related movement.

(B) It is due to stimulus of touch and temperature.

(C) It does not depend upon the direction of stimulus received.

(D) It is observed only in roots and not in stems.

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

Question 15.

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

[1 Marks]

(A) Money-plant, stem

(B) Bryophyllum, leaf

(C) Potato, stem

(D) Rose, root

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

Question 16.

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

[1 Marks]

(A) 0.5

(B) 2

(C) 16

(D) 32

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

Question 17.

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

[1 Marks]

(A) lower power ratings such as fan.

(B) non-metallic bodies and low power

(C) higher power ratings such as geyser.

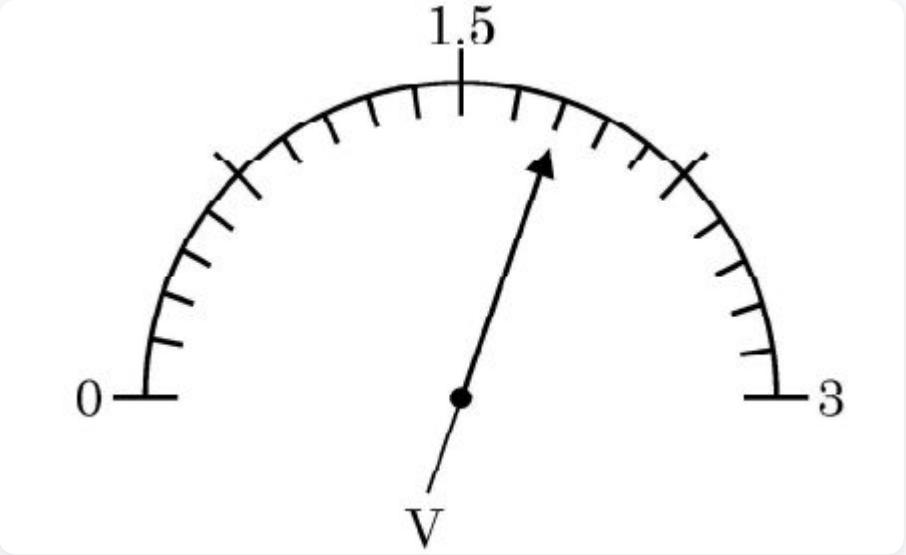
(D) metallic bodies and low power ratings.

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

Question 18.

In the following diagram, the position of the needle is shown on the scale of a voltmeter. The least count of the voltmeter and the reading shown by it respectively are:

[1 Marks]



(A) 0.05 V and 1.6 V

(B) 0.05 V and 1.8 V

(C) 0.15 V and 1.8 V

(D) 0.15 V and 1.6 V

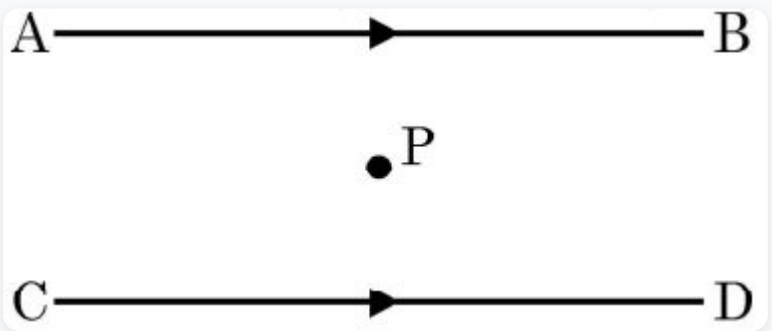
Explanation:

The least count of a voltmeter is the smallest division value on its scale. By observing the scale divisions in the diagram, the least count is 0.05 V. The needle points to a value between 1.75 V and 1.8 V, precisely at 1.8 V. Therefore, the correct option is '0.05 V and 1.8 V'. This means the instrument can read voltages in increments of 0.05 V, and the current reading shown is 1.8 V. Voltmeter readings measure the potential difference between two points and the needle position indicates the measured voltage.

Question 19.

The resultant magnetic field at point 'P' situated midway between two parallel wires (placed horizontally) each carrying a steady current I is

[1 Marks]



(A) in the vertically upward direction.

(B) in the same direction as the current in the wires.

(C) in the vertically downward direction.

(D) zero

Explanation:

The correct answer is 'zero'. According to the right-hand rule, the magnetic field produced by each wire at the midpoint 'P' between them will be equal in magnitude but opposite in direction (one wire produces a field directed upward while the other produces a field directed downward at point 'P'). Since the two wires carry currents in the same direction and are placed parallel horizontally, their magnetic fields at the midpoint cancel each other out, resulting in a net magnetic field of zero at point 'P'.

Question 20.

Assertion (A): The colour of aqueous solution of copper sulphate turns colourless when a piece of lead is added to it.

Reason (R): Lead is more reactive than copper, and hence displaces copper from its salt solution.

[1 Marks]

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

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

(C) A is true but R is false.

(D) A is false but R is true.

Explanation:

Both A and R are true and R is the correct explanation of A. When lead is added to copper sulfate solution, the lead being more reactive than copper, displaces copper from the solution forming lead sulfate, which is colorless. This causes the blue color of the copper sulfate solution (due to Cu2+ ions) to fade and become colorless.

Question 21.

Assertion (A): Genes inherited from the parents decide the sex of a child.

Reason (R): X chromosome in a male child is inherited from his father.

[1 Marks]

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

(B) A is true but R is false.

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

(D) A is false but R is true.

Explanation:

Both statements A and R are true, but R is not the correct explanation of A. The sex of a child is determined by the chromosomes inherited from the parents. While it is true that the genes inherited from the parents influence the child's sex, the sex depends specifically on whether the sperm from the father carries an X or a Y chromosome. The X chromosome in a male child is actually inherited from the mother, not the father. The father contributes either an X chromosome (leading to a female child) or a Y chromosome (leading to a male child). Therefore, the reason given is incorrect.

Question 22.

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

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

[1 Marks]

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

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

(C) A is true but R is false.

(D) A is false but R is true.

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

Question 23.

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

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

[1 Marks]

(A) A is false but R is true.

(B) A is true but R is false.

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

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

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

Section C

Question 24.

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

Identify 'X' and write its chemical formula.

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

[2 Marks]

Answer: (i) Compound 'X' is Plaster of Paris, which is prepared by heating gypsum ($CaSO_4 \cdot 2H_2O$). Its chemical formula is $CaSO_4 \cdot 1/2H_2O$. When mixed with water, it hardens due to formation of gypsum.
(ii) Baking soda is sodium hydrogencarbonate with the formula $NaHCO_3$. Baking powder is a mixture of baking soda ($NaHCO_3$) and a mild edible acid like tartaric acid. Baking powder releases CO_2 gas on heating or mixing with water, helping dough rise.

Key Points: Compound X is Plaster of Paris - Chemical formula of Plaster of Paris is CaSO4 · 1/2H2O - Baking soda is NaHCO3 whereas baking powder is a mixture of NaHCO3 and a mild acid

Question 25.

Write balanced chemical equation for the reaction that occurs when:

(i) blue coloured copper sulphate crystals are heated and

(ii) Sodium hydrogen carbonate is heated during cooking.

[2 Marks]

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

Copper sulphate pentahydrate ($CuSO_4 . 5H_2O$) $\xrightarrow{HEAT}$ Anhydrous copper sulphate ($CuSO_4$) + $5H_2O$ (water vapour)

Balanced equation:

$CuSO_4 . 5H_2O \rightarrow CuSO_4 + 5H_2O$

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

Balanced equation:

$2NaHCO_3 \xrightarrow{HEAT} Na_2CO_3 + H_2O + CO_2$

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

Key Points: Blue copper sulphate crystals lose water to form white anhydrous copper sulphate - Sodium hydrogen carbonate decomposes on heating - Balanced equations CuSO4 . 5H2O → CuSO4 + 5H2O and 2NaHCO3 → Na2CO3 + H2O + CO2

Question 26.

(a) Write the role of insulin in regulating blood sugar levels in human body. Mention the disease caused due to it.

(b) How is the timing and the amount of release of insulin in the blood regulated?

[2 Marks]

Answer:

(a) Insulin is a hormone produced by the pancreas that helps regulate blood sugar levels in the human body. It allows cells to absorb glucose from the blood to use as energy or store for later use, thereby lowering the sugar level in the blood. If insulin is not secreted properly, blood sugar levels rise, leading to a disease called diabetes.

(b) The timing and amount of insulin released into the blood are controlled by a feedback mechanism. When blood sugar levels rise, pancreas cells detect this increase and produce more insulin. As blood sugar levels fall, insulin secretion decreases. This ensures that the blood sugar level is maintained within a normal range.

Key Points: Insulin lowers blood sugar by helping cells absorb glucose-Diabetes results from improper insulin secretion-Insulin is produced by the pancreas-Release of insulin is regulated by feedback mechanisms-Rise in blood sugar triggers more insulin release-Fall in blood sugar reduces insulin secretion

Question 27.

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

(i) Vena cava

(ii) Pulmonary artery

[2 Marks]

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

Key Points: Vena cava carries deoxygenated blood from body to right atrium of heart-Pulmonary artery carries deoxygenated blood from right ventricle to lungs for oxygenation-Pulmonary artery is unique as it carries deoxygenated blood away from heart

Question 28.

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

(i) in the presence of oxygen

(ii) in lack of oxygen

[2 Marks]

Answer:

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

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

Key Points: Glucose undergoes glycolysis to form pyruvate - In presence of oxygen, pyruvate is broken down into carbon dioxide, water, and energy (aerobic respiration) - In absence of oxygen, pyruvate forms lactic acid (in muscles), releasing less energy (anaerobic respiration) - Aerobic respiration produces a larger amount of energy compared to anaerobic respiration

Question 29.

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

Write the structure and function of nephrons.

[2 Marks]

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

Key Points: Nephrons found in kidneys-Structure includes renal corpuscle (glomerulus) and renal tubule-Glomerulus filters blood by filtration-Tubular part reabsorbs useful substances and secretes wastes-Nephrons produce urine and maintain body's internal balance

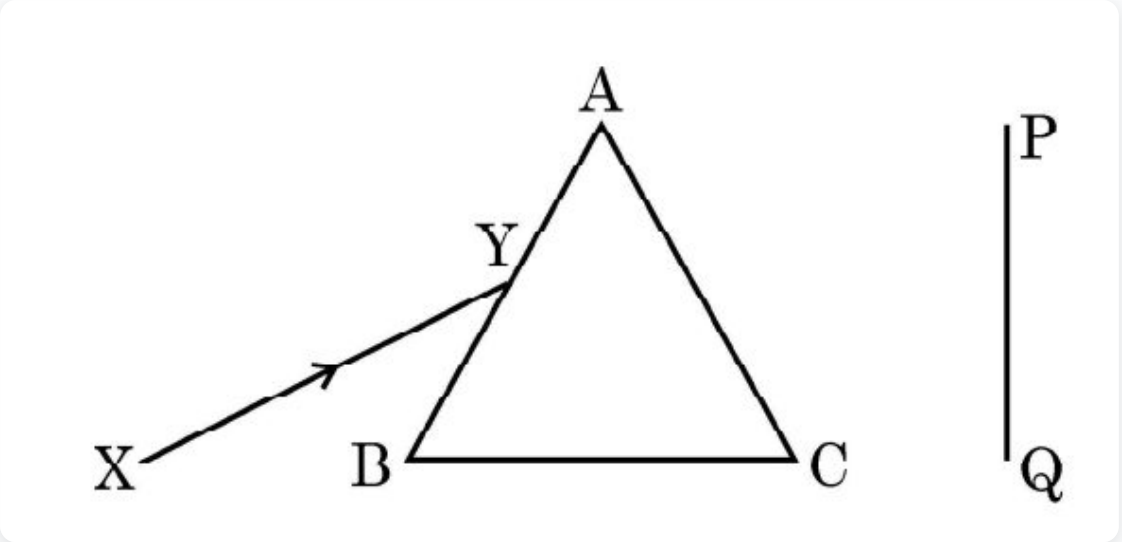
Question 30.

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

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

Name the phenomenon observed and state its cause.

[2 Marks]



Answer: When a narrow beam XY of white light passes through the glass prism ABC, it bends at the surface because light changes speed when it moves from air into glass. Inside the prism, light moves straight but slower. When it comes out of the prism on the other side, it bends again and splits into many colors forming a spectrum on the screen PQ. This splitting of white light into its colors is called dispersion. Dispersion happens because different colors (wavelengths) of light bend by different amounts while refracting through the glass prism.

Key Points: White light is made of many colors-Refraction occurs when light passes from air to glass and bends-Refraction happens again when light exits the prism-White light splits into colors forming a spectrum called dispersion-Dispersion is caused due to different bending of colors inside the prism

Question 31.

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

(i) Give reason for the above statement.

(ii) Name the defect that is likely to arise in the eyes in such a condition.

(iii) Draw a labelled ray diagram to show the type of corrective lens used for restoring the vision of such an eye.

[2 Marks]

Answer:

(i) The power of the eye to see nearby and far off objects diminishes with age because the ciliary muscles weaken and the eye lens loses its flexibility. This reduces the eye's ability to adjust its focal length for clear vision at various distances, a process known as accommodation.

(ii) This condition is called presbyopia.

(iii) To correct presbyopia, convex lenses (converging lenses) are used. They assist the eye lens by converging light rays before they enter the eye, helping to focus the image on the retina clearly.

Key Points: Power of accommodation decreases with age-Weakening of ciliary muscles-Diminished flexibility of eye lens-Defect name: Presbyopia-Corrective lens: Convex lens-Converging lens used to focus image on retina

Question 32.

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

[2 Marks]

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

Key Points: Harmful chemicals enter food chain through soil and water-Plants absorb chemicals and become first trophic level-Chemicals accumulate in herbivores eating plants-Carnivores accumulate more chemicals by eating herbivores-Chemicals are non-degradable-Progressive accumulation called biological magnification-Highest concentration in top-level consumers like humans

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Section D

Question 33.

(a) Identify the reducing agent in the following reactions:
(i) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

(ii) $H_2O + F_2 \rightarrow HF + HOF$

(iii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

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

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

[3 Marks]

Answer: (a) The reducing agents in the given reactions are:
(i) NH_3 as it loses hydrogen and is oxidised to NO.
(ii) H_2O as it loses oxygen and is oxidised when reacting with F_2.
(iii) CO as it loses oxygen and is oxidised to CO_2.
(iv) H_2 as it loses electrons and is oxidised to H_2O.

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

Key Points: Reducing agent is the substance that loses oxygen or electrons - NH3 loses hydrogen and acts as reducing agent in reaction (i) - Redox reaction involves simultaneous oxidation and reduction defined by gain or loss of oxygen

Question 34.

(a) Suggest one remedial measure each to counteract the change in pH in human beings in following cases :
(i) Production of too much acid in stomach during indigestion
(ii) Stung by a honey bee / nettle leaves
(b) Fresh milk has a pH of 6. When it changes into curd will its pH increase or decrease ? Why?

[3 Marks]

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

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

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

Key Points: Use of antacids (like magnesium hydroxide) to neutralize stomach acid-Neutralization of acidic sting by applying a mild base such as baking soda solution-pH of fresh milk is about 6 and is slightly acidic-pH decreases on turning milk to curd due to lactic acid formation during fermentation

Question 35.

(i) State the role of ATP in cellular respiration.

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

(iii) State the conditions on which the direction of diffusion of gases in plant depend upon.

[3 Marks]

Answer:

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

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

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

> **Key Points: ATP stores and provides energy released from glucose breakdown- Stomata and intercellular spaces ensure gas exchange in plants- Direction of gas diffusion depends on environmental conditions and plant's needs**

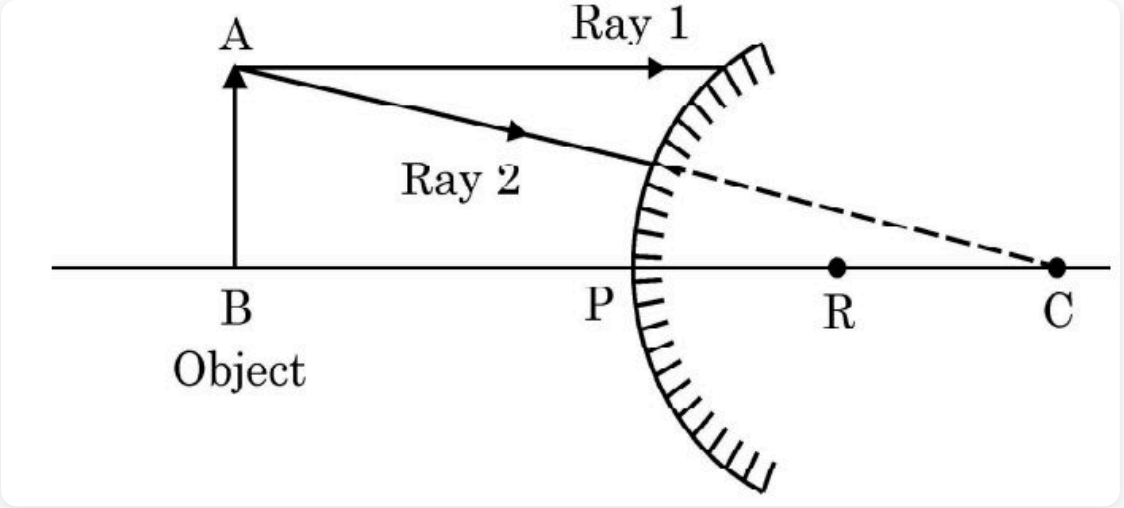
Question 36.

(a) Complete the following ray diagram to show the formation of image

(b) Mention the nature, position and size of the image formed in this case.

(c) State the sign of the image distance in this case using the Cartesian sign convention.

[3 Marks]



Answer: (a) To complete the ray diagram for image formation by a concave mirror when the object is placed between the focal point (F) and the mirror, extend the reflected rays backward behind the mirror. Two rays are usually drawn: one parallel to the principal axis which reflects through the focal point, and another passing through the focal point that reflects parallel to the principal axis. These reflected rays diverge in front of the mirror but their extensions meet behind the mirror, forming a virtual image.

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

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

Key Points: Complete the ray diagram by extending reflected rays backward behind the mirror to find virtual image - The image formed is virtual, erect, and larger than the object - The image is located behind the mirror, between the mirror and focal point - According to Cartesian sign convention, image distance is negative as the image forms behind the mirror

Question 37.

Give reasons for the following :

(a) Danger signals installed at airports and at the top of tall buildings are of red colour.

(b) The sky appears dark to the passengers flying at very high altitudes.

(c) The path of a beam of light passing through a colloidal solution is visible.

[3 Marks]

Answer:

(a) Danger signals at airports and tall buildings are red because red light is least scattered by fog, smoke, or dust. This makes the red signal visible from a long distance and attracts immediate attention, which is crucial for safety.
(b) The sky appears dark to passengers flying at very high altitudes because the atmosphere is very thin there. At such heights, there is not enough air to scatter sunlight, so the sky looks dark instead of blue.
(c) The path of a beam of light is visible when passing through a colloidal solution due to the Tyndall effect. Tiny particles in the colloid scatter the light, making the beam's path visible to our eyes, unlike in pure solutions.

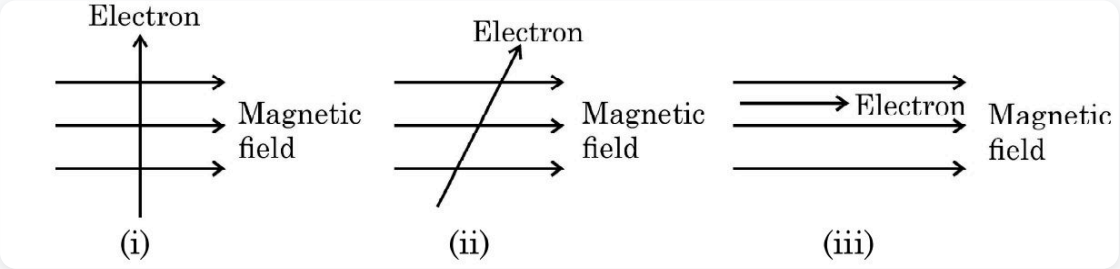
> **Key Points: Red light is least scattered - Red signals are visible from afar - Ensures safety at airports and tall buildings - Atmosphere is thin at high altitudes - Less scattering causes dark sky - Tyndall effect explains visible light path - Colloidal particles scatter light making beam visible**

Question 38.

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

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

[3 Marks]



Answer:

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

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

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

- The force on a charged particle moving in a magnetic field is given by the Lorentz force, which depends on the sine of the angle between velocity of the particle and magnetic field.
- When the velocity is perpendicular to the magnetic field (angle 90°), sin(90°) = 1, so the force is maximum.
- When the velocity is parallel or antiparallel to the magnetic field (angle 0° or 180°), sin(0°) = sin(180°) = 0, so the force is minimum (zero).

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

Key Points: Fleming's Left-Hand Rule-The directions of magnetic field, current, and force are mutually perpendicular-Force direction is given by thumb when first finger is magnetic field and second finger is current-Force on electron in magnetic field depends on angle between velocity and magnetic field-Max force when perpendicular-Force minimum when velocity parallel to magnetic field

Question 39.

(i) Draw the pattern of magnetic field lines of

(1) a current carrying solenoid

(2) a bar magnet

(ii) List two distinguishing features between the two fields.

[3 Marks]

Answer:

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

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

(ii) Two distinguishing features between the magnetic field of a solenoid and a bar magnet are:
1. The magnetic field inside a solenoid is strong and uniform, whereas inside a bar magnet it may not be perfectly uniform.

2. The polarity of the solenoid's magnetic field can be changed by reversing the direction of the current, but the poles of a bar magnet are fixed and cannot be reversed easily.

Key Points: Magnetic field lines inside solenoid are parallel and indicate a strong uniform field-Magnetic field lines outside both solenoid and bar magnet form closed loops-Direction of magnetic field lines: inside solenoid from south to north pole; outside from north to south-Distinguishing feature 1: solenoid field is uniform inside; bar magnet may not be-Distinguishing feature 2: solenoid polarity reversible by changing current direction; bar magnet poles fixed

Question 40.

(i) Why does a kitchen garden called an artificial ecosystem while a forest is considered to be a natural ecosystem?

(ii) While designing an artificial ecosystem at home, write any two things to be kept in mind to convert it into a self-sustaining system. Give reason to justify your answer.

[3 Marks]

Answer:

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

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

Key Points: Kitchen garden is human-made ecosystem-Forest is natural ecosystem because it develops naturally-Maintain balance between producers and consumers in artificial ecosystem-Adequate decomposers to recycle nutrients-Creates a self-sustaining system

Question 41.

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

Hawk, snake, plants, rat.

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

[3 Marks]

Answer: (i) Food Chain Construction:
Plants → Rat → Snake → Hawk
Here, plants are producers and form the first trophic level. Rats, which eat plants, represent the second trophic level (primary consumers). Snakes, which eat rats, form the third trophic level (secondary consumers). Hawks, which feed on snakes, are the fourth trophic level (tertiary consumers).

(ii) Energy Transfer Calculation:
The energy transferred from producers (plants) to the second trophic level (rat) is given as 20,000 joules. According to the 10% energy transfer rule, only 10% of the energy is passed to the next trophic level at each step.
Energy transferred from the second trophic level (rat) to the third trophic level (snake) = 10% of 20,000 J = 2,000 J.
Energy transferred from the third trophic level (snake) to the fourth trophic level (hawk) = 10% of 2,000 J = 200 J.
Therefore, 200 joules of energy will be transferred from the third trophic level to the fourth trophic level.

Key Points: Food chain levels with plants as producers - Rat as primary consumer - Snake as secondary consumer - Hawk as tertiary consumer - 10% energy transfer between trophic levels - Stepwise calculation of energy transfer from producers to tertiary consumers

Question 42.

(i) State the role of ATP in cellular respiration.

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

(iii) State the conditions on which the direction of diffusion of gases in plant depend upon.

[3 Marks]

Answer: (i) ATP acts as the main energy currency of the cell during cellular respiration. It stores and supplies energy needed for various cellular activities by breaking down its high-energy phosphate bonds.
(ii) Sufficient exchange of gases in plants is ensured by stomata, which are tiny pores on the surface

of leaves. Large intercellular spaces in the leaf allow gases like oxygen and carbon dioxide to diffuse efficiently to all cells.
(iii) The direction of diffusion of gases in plants depends on the concentration gradient of gases between the inside of the leaf and the surrounding air, as well as the requirements of the plant. Gases move from higher to lower concentration areas by diffusion.

Key Points: ATP stores and supplies energy - Stomata and intercellular spaces ensure gas exchange - Direction of diffusion depends on concentration gradient and plant needs

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Section E

Question 43.

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

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

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

(i) Identify A, B and C.

(ii) Write the chemical equations showing the conversion of A into B.

(iii) What happens when compound C undergoes combustion?

(iv) State one industrial application of hydrogenation reaction.

(v) Name the products formed when compound A reacts with sodium.

[5 Marks]

Answer: (i) Identification of compounds:
Compound A is ethanol (C_2H_5OH), a saturated alcohol.
Compound B is ethene (C_2H_4), an unsaturated hydrocarbon with molecular mass 28 u formed by dehydration of ethanol.
Compound C is ethane (C_2H_6), a saturated hydrocarbon formed by hydrogenation of ethene.

(ii) Chemical equation for conversion of A into B:
C_2H_5OH (ethanol) --(conc. H_2SO_4, 443 K)--> C_2H_4 (ethene) + H_2O
Explanation: Ethanol on heating with concentrated sulphuric acid undergoes dehydration to form ethene and water.

(iii) Combustion of compound C:

$C_2H_6 + 3.5\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$ + energy

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

(iv) Industrial application of hydrogenation reaction:

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

(v) Products formed when A reacts with sodium:

$2\ C_2H_5OH + 2\ Na \rightarrow 2\ C_2H_5ONa + H_2$

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

> **Key Points: Ethanol undergoes dehydration to form ethene - Ethene hydrogenated to form ethane - Combustion of ethane produces CO2 and H2O with energy - Hydrogenation used in food industry for making margarine - Ethanol reacts with sodium to form sodium ethoxide and hydrogen**

Question 44.

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

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

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

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

[5 Marks]

Answer:

(i) Formation of Micelles:

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

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

(ii) Testing Soap and Detergent in Hard Water:

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

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

> **Key Points: Soap molecules have hydrophobic tails and hydrophilic heads - Micelles are formed when soap traps oily dirt inside with tails and heads facing outwards - Soap reacts with calcium and magnesium salts in hard water forming insoluble curdy solid called scum - Detergents do not form scum as they do not react with hard water salts - Foam formation is more with detergent in hard water - Soap's cleaning action decreases in hard water due to scum formation**

Question 45.

(a) Name the parts of a bisexual flower that are not directly involved in reproduction.

(b) Differentiate between self pollination and cross pollination. List any two significance of pollination.

(c) What is the fate of ovules and ovary after fertilization in a flower?

[5 Marks]

Answer:

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

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

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

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

dispersal.

Key Points: Parts not directly involved in reproduction - sepals, petals-Difference between self and cross pollination - self: pollen from same flower to stigma; cross: pollen transferred between different flowers-Significance of pollination - ensures fertilization and seed formation, helps in fruit production-Fate after fertilization - ovules develop into seeds, ovary develops into fruit

Question 46.

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

[5 Marks]

Answer: (a)
Given power P and voltage V, the current I can be calculated using the formula I = P / V. For the maximum heating:
Power P = 880 W, Voltage V = 220 V
Current I = 880 / 220 = 4 A
Resistance R = V / I = 220 / 4 = 55 ohms

For the minimum heating:
Power P = 330 W, Voltage V = 220 V
Current I = 330 / 220 = 1.5 A
Resistance R = 220 / 1.5 ≈ 146.67 ohms

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

(c)
The amount of heat produced (H) when a current (I) passes through a resistor (R) for some time (t) is given by the formula:
$H = I^2 \times R \times t$

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

Key Points: Calculate current using I = P/V for both cases - Calculate resistance using R = V/I for both cases - Define heating effect of electric current as heat produced due to electron collisions - Explain practical applications like electric iron and heaters - State formula for heat produced H = I squared times R times t - Explain the meaning of each symbol in the formula

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