CBSE EXAMINATION PAPER-2024

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 88

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 40** are short answer

vii. **Section E** – questions number **41 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. Salts play a very important role in our daily life. Sodium chloride which is known as common salt is used almost in every kitchen. Baking soda is also a salt used in faster cooking as well as in baking industry. The family of salts is classified on the basis of cations and anions present in them.

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

[1 Marks]

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

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

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

[1 Marks]

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

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

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

[2 Marks]

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

Key Points: Salts with same positive or negative radicals belong to the same family - Sodium chloride contains Na+ and Cl- ions - Washing soda contains Na+ and CO3 2- ions - Both have sodium ion (Na+) as common cation - Hence, both belong to the sodium salt family

(4)

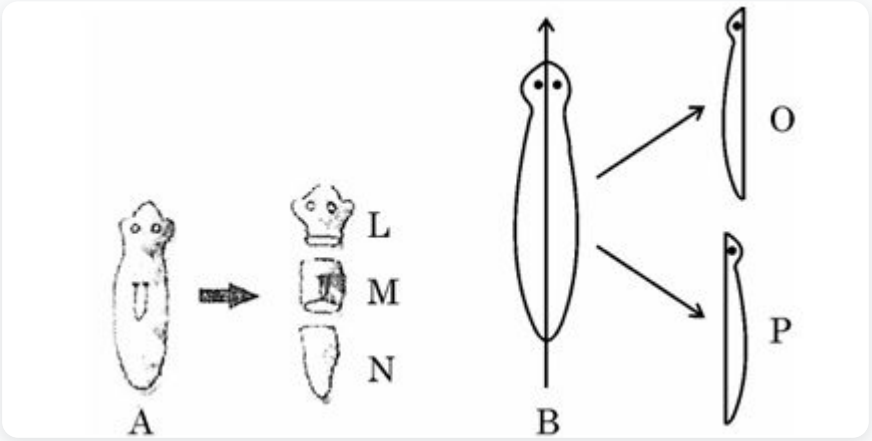
Define the term pH scale. Name the salt obtained by the reaction of Potassium hydroxide and Sulphuric acid and give the pH value of its aqueous solution.

[2 Marks]

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

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

Question 2. Asexual reproduction involves a single parent to produce offsprings without the formation of gametes. It occurs by the following ways: Fission, Budding, Fragmentation, Spore formation and Regeneration. In one of the methods like regeneration, Planaria A is cut horizontally into three pieces — L, M and N and Planaria B is cut vertically into two equal halves — O and P.



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

[1 Marks]

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

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

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

[1 Marks]

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

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

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

[2 Marks]

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

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

(4)

Differentiate between regeneration and fragmentation.

[2 Marks]

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

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

Question 3.

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

(1) List two properties of electric fuse.

[1 Marks]

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

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

(2) List two properties of heating elements.

[1 Marks]

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

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

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

[2 Marks]

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

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

(4)

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

[2 Marks]

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

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

Section B

Question 4. Solid Calcium oxide reacts vigorously with water to form Calcium hydroxide accompanied by the liberation of heat. From the information given above it may be concluded that this reaction is:

[1 Marks]

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

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

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

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

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

Question 5. Juice of tamarind turns blue litmus to red. It is because of the presence of an acid called:

[1 Marks]

(A) methanoic acid

(B) acetic acid

(C) tartaric acid

(D) oxalic acid

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

Question 6.

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

[1 Marks]

(A) Black and White photography

(B) Burning of methane

(C) Burning of coal

(D) Digestion of food

Explanation:

The correct option Burning of coal coal is a combination reaction. Coal is primarily carbon (C). When it burns, it reacts with oxygen (O_2) from the air to form carbon dioxide (CO_2). This is represented by the chemical equation: ($C+O_2 \rightarrow CO_2$). In this reaction, two reactants (C) and (O_2) combine to form a single product (CO_2).

Question 7.

The oxide which can react with HCl as well as KOH to give corresponding salt and water is:

[1 Marks]

(A) Al_2O_3

(B) Na_2O

(C) CuO

(D) K_2O

Explanation: Aluminium oxide (Al_2O_3) is an amphoteric oxide, meaning it reacts with both acids and bases. It reacts with HCl (acid) to form aluminium chloride and water, and with NaOH or KOH (bases) to form sodium aluminate or corresponding aluminate salts and water. Other options like K_2O and Na_2O only react with water to form bases, and CuO mainly reacts as a base reacting with acids only.

Question 8.

Consider the following cases:

(a) $CaSO_4 + Al \rightarrow$

(b) $CuSO_4 + Ca \rightarrow$

(c) $FeSO_4 + Cu \rightarrow$

(d) $ZnSO_4 + Mg \rightarrow$

The cases in which new products will form are:

[1 Marks]

(A) (a) and (b)

(B) (c) and (d)

(C) (b) and (c)

(D) (b) and (d)

Explanation:

A more reactive metal can displace a less reactive metal from its salt solution. From the reactivity series, Ca is more reactive than Cu, and Mg is more reactive than Zn. Therefore, in (b) $CuSO_4 + Ca$, calcium will displace copper forming $CaSO_4$ and Cu, and in (d) $ZnSO_4 + Mg$, magnesium will displace zinc forming $MgSO_4$ and Zn. In (a), Al cannot displace Ca because calcium is more reactive than aluminum. In (c), Cu cannot displace Fe because copper is less reactive than iron. Hence, new products form only in cases (b) and (d).

Question 9.

Identify the correct statement about the following reaction

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

[1 Marks]

(A) SO_2 is oxidized to sulfur.

(B) H_2S is reduced to sulfur.

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

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

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

Question 10.

Consider the following statements about homologous series of carbon compounds:

All succeeding members differ by a CH_2 unit.

Melting point and boiling point increase with increasing molecular weight.

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

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

[1 Marks]

(A) (a) and (b)

(B) (a) and (c)

(C) (c) and (d)

(D) (b) and (c)

Explanation: The correct option is (a) and (b) because, according to the homologous series, all succeeding members differ by a CH_2 unit, and melting and boiling points increase with molecular weight. The statement (c) is incorrect because the difference in molecular masses between two successive members is due to a CH_2 unit, which is 14 u (12 for carbon + 2 for hydrogen), not 16 u. Statement (d) is correct as well since C_2H_2 (acetylene) and C_3H_4 are not successive alkenes, but given the options, (a) and (b) best fits the given context.

Question 11.

Which of the following statement(s) is (are) true about the human heart?

(a)Right atrium receives oxygenated blood from lungs through pulmonary artery.

(b)Left atrium transfers oxygenated blood to left ventricle which sends it to various parts of the body.

(c)Right atrium receives deoxygenated blood through vena cava from upper and lower body.

(d)Left atrium transfers oxygenated blood to aorta which sends it to different parts of the body.

[1 Marks]

(A) (b) and (d)

(B) (a) and (d)

(C) (b) and (c)

(D) (a)

Explanation:

The correct statements are (b) and (c). Statement (b) is true because the left atrium receives oxygenated blood from the pulmonary vein and transfers it to the left ventricle, which then pumps it to different parts of the body. Statement (c) is true because the right atrium receives deoxygenated blood from the upper and lower parts of the body through the vena cava. Statement (a) is false because the right atrium receives deoxygenated blood, not oxygenated blood, and pulmonary artery carries deoxygenated blood from the right ventricle to the lungs, not to the right atrium. Statement (d) is false because it is the left ventricle, not the left atrium, that pumps oxygenated blood to the body through the aorta.

Question 12. Select out of the following a gland which does NOT occur as a pair in the human body:

[1 Marks]

(A) Pituitary

(B) Ovary

(C) Testis

(D) Adrenal

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

Question 13. In the human respiratory system, when a person breathes in, the position of ribs and diaphragm will be:

[1 Marks]

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

(B) lifted ribs and flattened diaphragm.

(C) relaxed ribs and flattened diaphragm.

(D) relaxed ribs and curved dome shaped diaphragm.

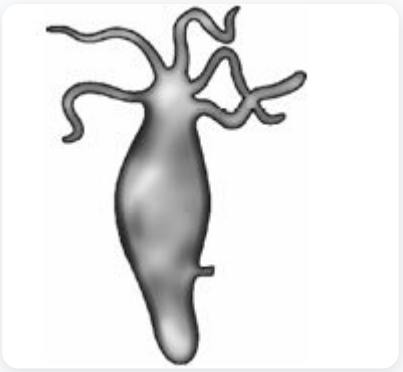
Explanation: During inhalation, the ribs move up and outwards (lifted ribs) and the diaphragm contracts and moves downwards, causing it to flatten. This increases the space in the chest cavity,

allowing the lungs to expand and air to rush in. Therefore, the correct position during inhalation is lifted ribs and flattened diaphragm.

Question 14.

Identify the mode of asexual reproduction in the following organism:

[1 Marks]



(A) Budding

(B) Binary fission

(C) Multiple fission

(D) Fragmentation

Explanation:

The correct option Budding

Question 15.

A cross made between two pea plants produces 50% tall and 50% short pea plants. The gene combination of the parental pea plants must be:

[1 Marks]

(A) Tt and Tt

(B) TT and tt

(C) Tt and tt

(D) TT and Tt

Explanation: The 50% tall and 50% short offspring ratio indicates that one parent is heterozygous tall (Tt) and the other is homozygous short (tt). When a Tt plant is crossed with a tt plant, the offspring genotypes are 50% Tt (tall) and 50% tt (short), producing the observed phenotype ratio.

Question 16.

Consider the following statements in the context of the human eye:

(a)The diameter of the eyeball is about 2.3 cm.

(b)Iris is a dark muscular diaphragm that controls the size of the pupil.

(c)Most of the refraction for the light rays entering the eye occurs at the crystalline lens.

(d)While focusing on the objects at different distances the distance between the crystalline lens and the retina is adjusted by ciliary muscles.

[1 Marks]

(A) (a), (b) and (c)

(B) (b), (c) and (d)

(C) (a), (c) and (d)

(D) (a) and (b)

Explanation: Statement (a) is correct because the eyeball is approximately spherical with a diameter of about 2.3 cm. Statement (b) is correct because the iris is the colored part of the eye that controls the size of the pupil by contracting or relaxing, regulating the amount of light entering the eye. Statement (c) is incorrect because most of the refraction of light rays entering the eye occurs at the outer surface of the cornea, not the crystalline lens. The crystalline lens only provides finer adjustment for focusing. Statement (d) is incorrect because ciliary muscles do not adjust the distance between the crystalline lens and the retina; instead, they change the shape of the crystalline lens to focus on objects at different distances.

Question 17.

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

[1 Marks]

(A) 0.5Ω

(B) 0.25 Ω

(C) 0.1 Ω

(D) 1Ω

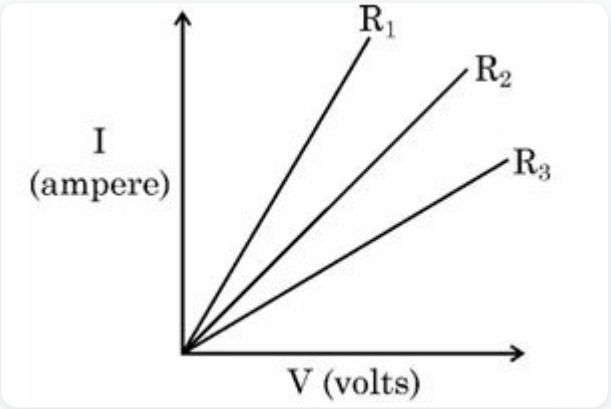
Explanation: The maximum resistance is obtained when all the resistors are connected in series. In series, the total resistance is the sum of the individual resistances. Each resistor has a resistance of

1/5 Ω = 0.2 Ω. Therefore, the maximum resistance = 5 × 0.2 Ω = 1 Ω.

Question 18.

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

[1 Marks]



(A) $R_2 > R_3 > R_1$

(B) $R_3 > R_2 > R_1$

(C) $R_1 = R_2 > R_3$

(D) $R_1 = R_2 = R_3$

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

Question 19. Strength of magnetic field produced by a current carrying solenoid does NOT depend upon:

[1 Marks]

(A) number of turns in the solenoid

(B) radius of solenoid

(C) direction of the current flowing through it

(D) material of the core of the solenoid

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

the polarity of the magnetic field but not its strength. Therefore, the correct answer is 'radius of solenoid'.

Question 20.

Assertion (A): Different metals have different reactivities with water and dilute acids.

Reason (R): Extraction of a metal from its ore depends on its position in the reactivity series.

[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 (A) and (R) are true and (R) is the correct explanation of (A). Different metals react differently with water and dilute acids because they have varying reactivities. The reactivity series ranks metals based on their reactivity, and this ranking determines the method used for extracting a metal from its ore. For example, highly reactive metals are extracted by electrolysis, while less reactive metals can be extracted by reduction with carbon. Thus, the position of a metal in the reactivity series directly influences both its reactivity and the extraction process.

Question 21.

Assertion (A): Human females have a perfect pair of sex chromosomes.

Reason (R): The sex chromosome contributed by the human male in the zygote decides the sex of a child.

[1 Marks]

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

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

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

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

Explanation:

(A) is true, but (R) is false. Assertion (A) is correct because a human female has a pair of identical sex chromosomes, XX. Reason (R) is incorrect. The sex of a child is determined by the sex chromosome

contributed by the male, which can be either an X or a Y chromosome. The female always contributes an X chromosome.

Question 22.

Assertion (A): Myopic eyes cannot see distant objects distinctly.

Reason (R): For the correction of myopia, converging lenses of appropriate power are prescribed by eye surgeons.

[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:

The correct option is: (A) is true, but (R) is false. Myopic eyes cannot see distant objects clearly because the image forms in front of the retina. However, myopia is corrected using concave (diverging) lenses, not converging lenses. Concave lenses diverge the light rays so that the image forms correctly on the retina, allowing clear vision of distant objects.

Question 23.

Assertion (A): The deflection of a compass needle placed near a current carrying wire decreases when the magnitude of an electric current in the wire is increased.

Reason (R): The strength of the magnetic field at a point due to a current carrying conductor increases on increasing the current in the conductor.

[1 Marks]

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

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

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

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

Explanation:

The assertion (A) is false because when the current in the wire increases, the magnetic field produced around the wire also increases. This causes the compass needle to deflect more, not less. Therefore,

the deflection of the compass needle increases with an increase in current. The reason (R) is true; the magnetic field strength at a given point due to a current-carrying conductor increases as the current increases. Hence, the correct answer is: (A) is false, but (R) is true.

Section C

Question 24. "No precipitation reaction can occur without exchange of ions between the two reactants." Justify this statement giving a balanced chemical equation for the reaction.

[2 Marks]

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

Key Points: Definition of precipitation reaction-Precipitation requires ion exchange between reactants-Double displacement reaction explanation-Example with silver nitrate and sodium chloride-Formation of silver chloride precipitate-Balanced chemical equation-Other product remains dissolved

Question 25. Giving one example of each, differentiate between a displacement reaction and a double displacement reaction.

[2 Marks]

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

Key Points: Displacement reaction involves one element displacing another-more reactive metal displaces less reactive metal-Zinc displaces copper example-Double displacement reaction involves exchange of ions-between two compounds-Formation of precipitate or new compounds-Barium chloride reacting with sodium sulphate example

Question 26. Photosynthesis takes place in the leaves and the food prepared by it reaches other parts of the plants. Name the process involved and explain it.

[2 Marks]

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

> **Key Points: Name of the process: Translocation- Definition of translocation as transport of food from leaves to other parts- Food prepared in leaves through photosynthesis- Food transported in dissolved form in phloem- Food reaches roots, stems, fruits for use or storage**

Question 27. “Stability of DNA in a species is ensured during sexual reproduction.” Justify the statement.

[2 Marks]

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

> **Key Points: Meiosis produces germ cells with half chromosomes-Combination of germ cells restores chromosome number-Stability of DNA content across generations-Preservation of species characteristics-Minor DNA variations allow species adaptation**

Question 28. State two laws of refraction of light.

[2 Marks]

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

> **Key Points: First law: Incident ray, refracted ray and normal lie in the same plane-Second law: Sine of angle of incidence divided by sine of angle of refraction is constant-Snell's law describes this constant ratio**

Question 29.

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

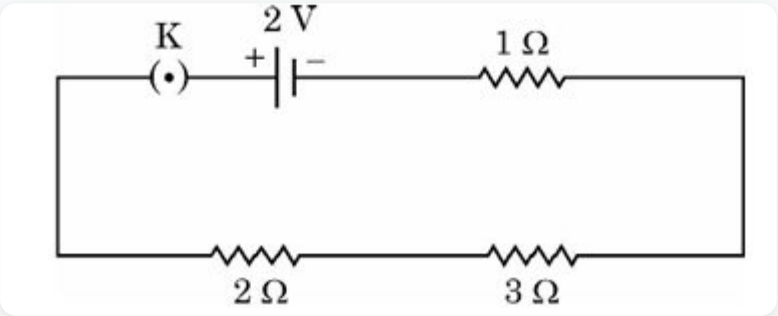
[2 Marks]

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

Key Points: Definition of absolute refractive index-It is the ratio of speed of light in vacuum to speed of light in the medium-Formula: refractive index = speed of light in vacuum / speed of light in medium-Given refractive index of glass = 1.5-Speed of light in vacuum = 3×10^8 m/s-Calculation of speed of light in glass by dividing speed in vacuum by refractive index-Result: speed of light in glass = 2×10^8 m/s

Question 30. Use Ohm's law to determine the potential difference across the 3 Ω resistor in the circuit shown in the following diagram when key is closed.

[2 Marks]



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

Key Points: Ohm's law formula V = I × R - Current flows when key is closed - The resistor is 3 ohms - Voltage across resistor depends on current - Apply V = I × 3 to find potential difference

Question 31. Name the term used for the materials which cannot be broken down by biological processes. Give two ways by which they harm various components of an ecosystem.

[2 Marks]

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

Key Points: Definition of non-biodegradable materials- Persistence in the environment- Harm caused by pollution- Disruption of nutrient recycling- Physical harm to animals and habitats

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Section D

Question 32. It is observed that Calcium on reaction with water floats on its surface. Explain why it happens. Also write a balanced chemical equation for the reaction that occurs. What happens when the aqueous solution of the product of this reaction reacts with Carbon dioxide gas? Write a balanced chemical equation for the reaction.

[3 Marks]

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

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

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

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

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

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

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

Key Points: Calcium reacts with water producing hydrogen gas bubbles that make it float - Reaction forms calcium hydroxide and hydrogen gas - Lime water reacts with carbon dioxide to form insoluble calcium carbonate - Excess CO2 forms soluble calcium bicarbonate

Question 33. Draw a labelled diagram to show electrolytic refining of copper. State what happens when electric current is passed through the electrolyte taken in this case.

[3 Marks]

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

Key Points: Electrolytic refining involves an impure copper anode and pure copper cathode-Acidified copper sulphate is the electrolyte-Electric current causes copper atoms at anode to lose electrons and dissolve as copper ions-Copper ions migrate to cathode and gain electrons to deposit as pure copper-Impurities settle as anode mud or remain in solution-The process purifies copper by transferring it from impure anode to pure cathode

Question 34.

(a) Give reasons for the following:

(i) Alveoli in lungs are richly supplied with blood capillaries.

(ii) Respiratory pigment in blood takes up oxygen and not carbon dioxide.

(iii) During anaerobic respiration, a 3-carbon molecule is formed as an end product instead of CO_2 in human beings.

[3 Marks]

Answer:

(a)(i) Alveoli in lungs are richly supplied with blood capillaries to provide a large surface area for efficient exchange of gases. The close proximity of blood capillaries allows oxygen to move from alveoli into the blood and carbon dioxide to move from blood into alveoli easily and quickly.
(ii) Respiratory pigment in blood, haemoglobin, takes up oxygen and not carbon dioxide because it has a strong affinity for oxygen. Oxygen binds reversibly to haemoglobin for transport, while carbon dioxide is mostly transported as bicarbonate ions in plasma.
(iii) During anaerobic respiration in human beings, a 3-carbon molecule called lactic acid is formed instead of CO_2 because oxygen is not available to completely break down glucose. Hence, glucose is partially broken down into lactic acid to release energy without producing carbon dioxide.

Key Points: Alveoli have many blood capillaries for gas exchange - Haemoglobin binds oxygen, not carbon dioxide - Anaerobic respiration produces lactic acid (3-carbon compound) instead of CO2

Question 35. Explain the events that take place once a sperm reaches the oviduct till it becomes a foetus. Write the role of placenta in pregnancy.

[3 Marks]

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

Key Points: Sperm reaches oviduct and fertilizes egg-Formation of zygote and repeated cell division-Embryo implantation in uterus lining-Development of embryo into foetus-Role of placenta as an exchange organ for oxygen and nutrients-Production of pregnancy-supporting hormones by placenta

Question 36.

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

[3 Marks]

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

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

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

Focusing on Distant Objects: When focusing on distant objects, the ciliary muscles relax. The crystalline lens becomes thinner and less curved, decreasing its focal length, so light rays from distant objects are focused on the retina, producing a clear image.

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

Key Points: Definition of power of accommodation-The role of ciliary muscles in controlling lens shape-Changes in lens curvature when focusing on nearby objects

(muscles contract, lens thickens)-Changes in lens curvature when focusing on distant objects (muscles relax, lens thins)

Question 37.

Draw a diagram to show the pattern of magnetic field lines on a horizontal sheet of paper due to a straight conductor passing through its center and carrying current vertically upwards. Mark on it

(i) the direction of current in the conductor and

(ii) the corresponding magnetic field lines. State the right-hand thumb rule and check whether the directions marked by you are in accordance with this rule or not.

[3 Marks]

Answer: To draw the magnetic field pattern, first draw a straight vertical line through the center of a horizontal sheet of paper representing the conductor carrying current upwards. Mark an arrow on the conductor pointing upwards to show the direction of current. Around the conductor, draw concentric circles to represent magnetic field lines. Mark arrows on these circles in the direction of the magnetic field. According to the right-hand thumb rule, if you hold the conductor with your right hand such that your thumb points upwards (direction of current), your fingers curl around the conductor showing the direction of magnetic field lines. Therefore, the magnetic field lines will be in a counterclockwise direction around the conductor when viewed from above. The directions of current and magnetic field lines in the diagram match the right-hand thumb rule, confirming the accuracy of the drawing.

Key Points: Diagram showing a vertical conductor through the center with upward current arrow-Magnetic field lines as concentric circles around conductor-Arrows on magnetic field lines showing direction of field-Statement of right-hand thumb rule: Thumb in current direction, fingers curl show magnetic field direction-Magnetic field lines direction matches right-hand thumb rule indicating counterclockwise direction when current is upwards

Question 38. Use of pesticides to protect our crops affect organisms at various trophic levels especially human beings. Name the phenomenon involved and explain how this happens.

[3 Marks]

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

Key Points: Name of the phenomenon: Biological magnification- Pesticides are non-degradable and accumulate in environment- Entry into food chain through soil and water- Accumulate progressively at higher trophic levels- Humans at the top of food chain accumulate maximum pesticides- Health hazards due to accumulation

Question 39.

(i)Name the movements that occur all along the gut in the human digestive system. How do they help in digestion?

(ii) Where is bile juice stored in the human body? List two roles of bile juice.

[3 Marks]

Answer: (i) The movements that occur all along the gut in the human digestive system are called **peristaltic movements**. Peristalsis is a wave-like contraction and relaxation of the muscles in the walls of the alimentary canal. These movements help in pushing the food forward through the digestive tract and mix the food with digestive juices, aiding digestion and absorption.
(ii) Bile juice is stored in the **gall bladder** in the human body. Two roles of bile juice are: (1) It emulsifies fats, breaking large fat globules into smaller droplets to increase the surface area for digestion by enzymes. (2) It helps in the absorption of fat-soluble vitamins like A, D, E, and K.

Key Points: Peristaltic movements push and mix food - Bile juice stored in gall bladder - Bile emulsifies fats and aids absorption of fat-soluble vitamins

Question 40.

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

[3 Marks]

Answer:

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

Necessary conditions to observe a rainbow:

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

Key Points: Explain that dispersion, internal reflection, and refraction occur inside raindrops- Label points A (dispersion), B (internal reflection), and C (refraction) on the ray diagram- Describe the path of sunlight entering, reflecting inside, and exiting raindrops- List conditions: presence of sunlight and raindrops, observer's position between sun and rain

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Section E

Question 41.

(a) Upper half of a convex lens is covered with black paper. Draw a ray diagram to show the formation of the image of an object placed at a distance of 2F from such a lens. Mention the position and nature of the image formed. State the observable difference in the image obtained if the lens is uncovered. Give reason to justify your answer.

(a) An object is placed at a distance of 30 cm from the optical centre of a concave lens of focal length 15 cm. Use lens formula to determine the distance of the image from the optical centre of the lens.

[5 Marks]

Answer: (a) When the upper half of a convex lens is covered with black paper and an object is placed at 2F from the lens, the image is formed at 2F on the other side of the lens. The image formed is real, inverted and of the same size as the object.
In the ray diagram, two rays are drawn from the top of the object: one parallel to the principal axis which passes through the focal point after refraction, and the other passing through the optical centre which goes straight without deviation. Both rays meet at 2F on the other side to form the image.
If the lens is uncovered, the full lens refracts light and more rays pass through. The image remains at the same position (2F), real, and inverted, but the brightness of the image increases because more light rays contribute to image formation.
The reason is that the entire lens area participates in refraction when uncovered, allowing more light to form a brighter image.

(b) Given: Object distance, u = -30 cm (negative as per sign convention: object on the left side of lens)
Focal length, f = -15 cm (negative for concave lens)
Using lens formula: 1/f = 1/v - 1/u
=> 1/v = 1/f + 1/u = 1/(-15) + 1/(-30) = -1/15 - 1/30 = -2/30 - 1/30 = -3/30 = -1/10
=> v = -10 cm

Therefore, the image is formed at 10 cm on the same side of the lens as the object (because v is negative). The image formed by a concave lens is virtual, erect and diminished in size.

Key Points: Covering half of convex lens reduces brightness but image position and nature remain same - Image formed by convex lens at 2F is real, inverted and same size - Lens formula application for concave lens with negative focal length and object distance to find image distance

Question 42.

(i)Give reason why carbon can neither form C^{4+}cations nor C^{4-}anions but form covalent compounds.
(ii)What is homologous series of carbon compound? Write the molecular formula of any two consecutive members of the homologous series of aldehydes.

(iii) Draw the structure of the molecule of cyclohexane (C_6H_{12}).

[5 Marks]

Answer: (i) Carbon cannot form C^{4+} cations or C^{4-} anions because it has four valence electrons and a moderate electronegativity. Losing four electrons to form C^{4+} would require very high energy, and gaining four electrons to form C^{4-} is also unlikely due to strong repulsion and instability. Instead, carbon shares its four valence electrons with other atoms forming covalent bonds to achieve stable octet configuration.

(ii) A homologous series is a group of organic compounds having the same functional group, similar chemical properties, and each member differing from the next by a CH_2 unit. For aldehydes, two consecutive members are methanal (CH_2O) and ethanal (C_2H_4O).

(iii) The structure of cyclohexane (C_6H_{12}) is a six-carbon ring with single bonds between the carbons. Each carbon atom is bonded to two hydrogen atoms. It can be represented as a hexagon where each vertex represents a carbon atom and hydrogens are attached accordingly to satisfy valency. Cyclohexane is a saturated cycloalkane with all single bonds.

Key Points: Carbon forms covalent bonds due to moderate electronegativity - Homologous series have similar properties and differ by CH2 units - Cyclohexane is a six-membered carbon ring with formula C6H12

Question 43.

(i) Name a commercially important carbon compound having functional group -OH and write its molecular formula.
(ii) Write chemical equation to show its reaction with

(1) Sodium metal
(2) Excess conc. sulphuric acid
(3) Ethanoic acid in the presence of an acid catalyst
(4) Acidified potassium dichromate
Also write the name of the product formed in each case.

[5 Marks]

Answer: (i) A commercially important carbon compound having the functional group -OH is **ethanol**. Its molecular formula is C_2H_5OH.

(ii) Reactions of ethanol:

(1) **Reaction with sodium metal:**
$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2\uparrow$
Product formed: Sodium ethoxide (C_2H_5ONa) and hydrogen gas.

(2) **Reaction with excess concentrated sulphuric acid (dehydration):**
$C_2H_5OH \rightarrow$ (Conc. H_2SO_4, heat) $C_2H_4 + H_2O$
Product formed: Ethene (C_2H_4) and water.

(3) **Reaction with ethanoic acid in presence of acid catalyst (esterification):**
$C_2H_5OH + CH_3COOH \rightleftharpoons$ (H_2SO_4, acid catalyst) $CH_3COOC_2H_5 + H_2O$
Product formed: Ethyl ethanoate (an ester) and water.

(4) **Oxidation with acidified potassium dichromate:**
$C_2H_5OH + [O] \rightarrow CH_3CHO + H_2O$ (on mild oxidation, forms ethanal)
Further oxidation:
$CH_3CHO + [O] \rightarrow CH_3COOH$ (ethanoic acid)
Product formed: Ethanal (acetaldehyde) on mild oxidation and ethanoic acid on complete oxidation.

These reactions show the versatile chemistry of ethanol due to its -OH functional group.

Key Points: Ethanol is a commercially important alcohol with formula C2H5OH - It reacts with sodium to form sodium ethoxide and hydrogen gas - Dehydration with conc. H2SO4 produces ethene - Esterification with ethanoic acid produces ethyl ethanoate - Oxidation with acidified potassium dichromate produces ethanal and ethanoic acid

Question 44.

(i)Distinguish between hormonal coordination in plants and animals.

(ii) Which part of the brain is responsible for —

(1) intelligence

(2) riding a bicycle

(3) vomiting

(4) controlling hunger?

(iii) How is brain and spinal-cord protected against mechanical injuries?

[5 Marks]

Answer:

Hormonal coordination in plants and animals plays a crucial role in regulating various physiological activities, but there are significant differences between the two. Plants do not have a nervous system, so they use hormones to control growth, development, and responses to environmental stimuli. Plant hormones, such as auxins, gibberellins, cytokinins, ethylene, and abscisic acid, are synthesized in one part of the plant and transported to other parts where they exert their effects by diffusion or active transport. Hormonal responses in plants are generally slower and tend to influence growth direction, flowering, and seed germination.

On the other hand, animals possess both a nervous system and endocrine system for coordination. Animal hormones are secreted by endocrine glands directly into the bloodstream and transported rapidly to specific target organs. These hormones regulate metabolism, growth, reproduction, and homeostasis. Animal hormonal responses are often faster and more precise, allowing immediate reactions to internal and external changes.

In summary, while both plants and animals use hormones for coordination, plant hormones largely regulate growth and environmental responses slowly through diffusion without a nervous system, whereas animal hormones act quickly via the bloodstream in combination with the nervous system, controlling a wide range of bodily functions.

Key Points: Plants lack nervous system while animals have it-Plant hormones synthesized away from action site and transported by diffusion-Animal hormones secreted by endocrine glands into bloodstream and transported rapidly-Plant hormonal responses affect growth direction and development and are slower-Animal hormonal responses are faster and regulate metabolism, growth, reproduction, and homeostasis

Question 45.

(i) What are tropic movements? Give an example of a plant hormone which (1) inhibits growth and (2) promotes cell division.

(ii) Explain directional movement of a tendril in pea plant in response to touch. Name the hormone responsible for this movement

[5 Marks]

Answer: (i) **Tropic movements** are directional growth movements of plants in response to external stimuli such as light, gravity, water, or touch. The growth occurs either towards the stimulus (positive tropism) or away from it (negative tropism). For example, phototropism is growth towards light.
Plant hormone that (1) inhibits growth is **abscisic acid**, which helps in dormancy and stress response.
Plant hormone that (2) promotes cell division is **cytokinin**, which stimulates cell division and growth.

(ii) In pea plants, tendrils show a directional movement called **thigmotropism**, which is a growth response to touch. When a tendril comes in contact with a support, cells on the opposite side of the contact grow faster than those touching the stimulus. This differential growth causes the tendril to curl around the support, helping the plant climb.
The hormone responsible for this movement is **auxin**. Auxin distribution changes in response to touch, causing the bending and coiling of the tendril around the support.

> **Key Points: Tropic movements are growth responses towards or away from stimuli - Abscisic acid inhibits growth - Cytokinin promotes cell division - Tendril movement towards touch is thigmotropism - Auxin hormone controls tendril coiling**