SCIENCE
CBSE Class-X (2023)

Series-Z1XYW/2	QP Code- 31/2/1	Set-I

Time allowed: 3 hours **Maximum Marks: 80**

General Instructions:

Read the following instructions very carefully and strictly follow them:

(i) This question paper comprises 39 questions. **All** questions are compulsory.

(ii) This question paper is divided into **five** sections **- A, B, C, D and E.**

(iii) **Section A** - Question Nos. 1 to 20 are multiple choice questions. Each question carries 1 mark.

(iv) **Section B** - Question Nos. 21 to 26 are very short answer type questions. Each question carries 2 marks. Answer to these questions should be in the range of 30 to 50 words.

(v) **Section C** - Question Nos. 27 to 33 are short answer type questions. Each question carries 3 marks. Answer to these questions should be in the range of 50 to 80 words.

(vi) **Section D** - Question Nos. 34 to 36 are long answer type questions. Each question carries 5 marks. Answer to these questions should be in the range of 80 to 120 words.

(vii) **Section E** - Question Nos. 37 to 39 are of 3 source-based/case-based units of assessment carrying 4 marks each with sub-parts.

(viii) There is no overall choice. However, an internal choice has been provided in some sections. Only one of the alternatives has to be attempted in such questions.

SECTION-A

This section has 20 multiple choice questions (Q.No. 1 20). All questions are compulsory ***20x1=20***

1. Which of the following is an example of endothermic process?

(a) Formation of slaked lime

(b) Decomposition of vegetable matter into compost

(c) Dissolution of ammonium chloride in water

(d) Digestion of food in our body

Ans: The correct answer is (c) Dissolution of ammonium chloride in water.

Explanation: Endothermic reaction is a chemical reaction in which the reactants absorbs heat from its surroundings, causing a decrease in the temperature of its surroundings.

Key characteristics of Endothermic reactions:

1. **Heat absorption.**
2. **Increased energy -**The products of an endothermic reaction have more energy than the reactants.
3. **Positive enthalpy change (ΔH) -**The enthalpy change for an endothermic reaction is positive, indicating that heat was absorbed.
4. **Temperature decrease -** The surroundings will cool down during an endothermic reaction because heat is being absorbed.

Why other options are incorrect:

(a) Formation of slaked lime: This is an exothermic reaction where heat is released during the formation of slaked lime.

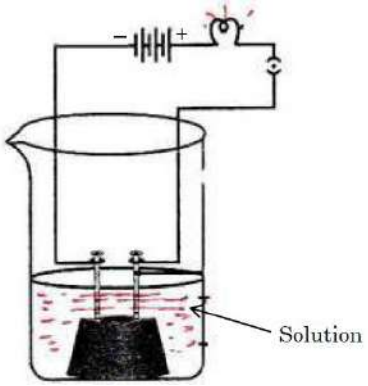
$$\mathbf{CaO\ (quicklime) + H_2O \rightarrow Ca(OH)_2\ (slaked\ lime) + heat}$$

(b) Decomposition of vegetable matter into compost: This is also an exothermic reaction. When **organic waste** like vegetable peels, leaves, and food scraps are decomposed by **microbes (bacteria and fungi)**, the complex organic substances are broken down into simpler compounds such as carbon dioxide, water, and nutrients. This decomposition is a type of **aerobic respiration** (in the presence of oxygen), which releases **energy in the form of heat**.

(d) Digestion of food in our body: Digestion is also an exothermic process. Our bodies generate heat by breaking down food molecules to obtain energy.

$$\mathbf{C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + energy\ (ATP) + heat}$$

2. In the given experimental set-up, if the experiment is carried out separately with each of the following solutions the cases in which the bulb will glow is/are:



(i) Dilute hydrochloric acid
(ii) Dilute sulphuric acid
(iii) Glucose solution
(iv) Alcohol
(a) (i) only
(b) (ii) only

(c) (i) and (ii)
(d) (ii), (iii) and (iv)
Answer – The correct answer is option (C)

Explanation: The experiment shown in the above image is designed to test **electrical conductivity** of four different solutions (i.e. Dilute hydrochloric acid, Dilute sulphuric acid, Glucose solution and Alcohol). The bulb will glow **only if the solution conducts electricity** i.e. allowing current to pass through.

Now, let's analyze each given option:

(i) Dilute Hydrochloric Acid (HCl) - Conducts electricity because HCl dissociates completely in water to give ions (H^+ and Cl^-). Hence the Bulb will glow.

(ii) Dilute Sulphuric Acid (H_2SO_4) – conducts electricity because it dissociates in water into **H^+ and SO_4^{2-} ions**. Hence, the **Bulb will glow**

(iii) **Glucose solution –** Glucose solution is a **covalent compound**, and it **does not ionize** in water. So, it will not conduct electricity and consequently the bulb will not glow.

(iv) **Alcohol -** alcohol is also a **covalent compound** and **does not dissociate** into ions in water. So, it will not conduct electricity and consequently the bulb will not glow.

3. In order to balance the following chemical equation, the values of the coefficients x and y respectively are:

$$x\,Pb(NO_3)_2 \xrightarrow{Heat} 2\,PbO + y\,NO_2 + O_2$$

(a) 2, 4 *(b) 2, 2*

(c) 2, 3 *(d) 4, 2*

Solution: option (a)

$$\boxed{2\,Pb(NO_3)_2 \rightarrow 2\,PbO + 4\,NO_2 + O_2}$$

Hence, to balance the given chemical equation, the value of x = 2 and y = 4.

4. When zinc reacts with sodium hydroxide, the product formed is:

(a) Sodium oxide *(b) Sodium zincate*

(c) Zinc hydroxide *(d) Zinc oxide*

Solution: (b) Sodium zincate

When zinc (Zn) reacts with sodium hydroxide (NaOH), the reaction produces sodium zincate (Na_2ZnO_2) and hydrogen gas (H_2).

$$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$$

5. Among the following, the metal with lowest density is:

(a) Lithium *(b) Lead*
(c) Magnesium *(d) Aluminium*

Solution: (a) Lithium

Explanation: The density of the given metal is:

- **Lithium: Density around 0.53 g/cm³ -------- lowest among the given option.**
- Lead: Density around 11.34 g/cm³
- Magnesium: Density around 1.74 g/cm³
- Aluminum: Density around 2.70 g/cm³

6. The number of electrons in the outermost shell of the atom of a non-metal can be :

(a) 1, 2 or 3 ***(b) 3, 4 or 5***
(c) 5, 6 or 7 ***(d) 5, 6 or 8***

Solution: (c) 5, 6 or 7

Explanation: Let`s analyse why the other options are incorrect:

Option (a) 1, 2, or 3: - These are common valence electrons for metals and metalloids, not non-metals.

Option (b) 3, 4, or 5: - While some non-metals have 4 valence electrons (e.g., carbon), 3 and 5 are not typical values.

Option (d) 5, 6, or 8: - While 5, 6, and 7 are common, including 8 would be incorrect because noble gases (which have 8 valence electrons) are not considered non-metals.

7. The total number of electrons shared in the formation of an ethyne molecule is:

(a) 6 ***(b) 3***
(c) 10 ***(d) 4***

Solution: (c) 10

Explanation – The chemical formula of ethyne (acetylene) is **C_2H_2**. There is a triple bond between the carbon atoms.

The lewis structure of C_2H_2

i. Sharing of electrons between two carbon atoms = 3 pairs of electrons = 6 electrons.
ii. Sharing of electrons between carbon and hydrogen atoms = 2 pairs (one pair each) = 4 electrons

Total electrons shared = 6 + 4 = 10 electrons.

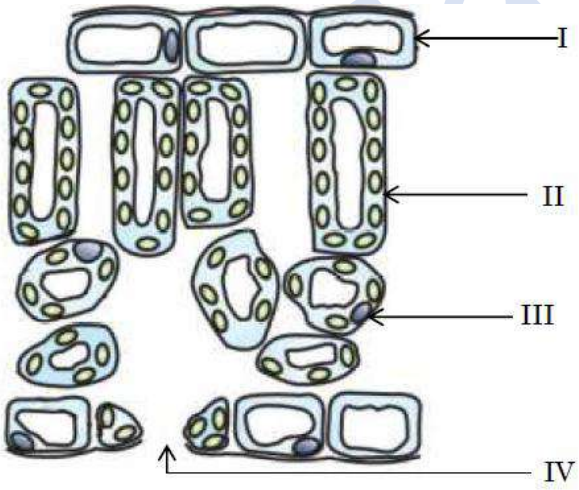
8. Sphincter muscles are present at the exit of:
(a) Stomach and small intestine
(b) Stomach and anus
(c) Small intestine and large intestine
(d) Oesophagus and stomach

Solution: (b) Stomach and anus

Explanation: A sphincter muscle is a circular muscle that works as a valve, regulating the flow of substances in and out of an organ. In the digestive system, two important sphincters are found at the exits of the stomach and anus:

- **Pyloric sphincter:** This muscle regulates the movement of food from the stomach to the small intestine.
- **Anal sphincter:** This muscle controls the release of excrement from the rectum.

9. In the following diagram, identify the cells through which massive amounts of gaseous exchange take place for photosynthesis:



(a) I (b) IV
(c) III (d) II

Solution: (b) IV

Explanation: Massive amounts of gaseous exchange (like intake of CO_2 and release of O_2) take place through the **stomata**.

10. During vigorous exercise, the occurrence of cramps in the outer muscles of an athlete is due to the conversion of pyruvate to:

(a) Glucose *(b) Ethanol*
(c) Lactic acid *(d) Lactose*

Solution: (c) Lactic acid

Explanation: During intense exercise, when the oxygen supply is limited, muscle cells begin to use anaerobic respiration. In this process, pyruvate is transformed into lactic acid, which can build up and lead to muscle cramps.

11. Plants which bear unisexual flowers are:
(a) Mustard and Papaya *(b) Hibiscus and Watermelon*
(c) Mustard and Hibiscus *(d) Watermelon and Papaya*

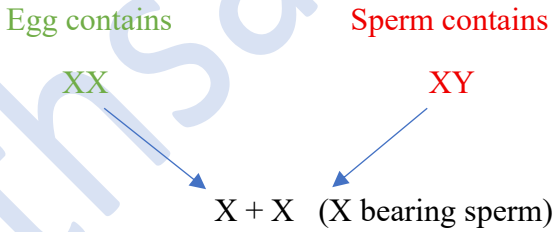
Solution: (d) Watermelon and Papaya

Explanation: Unisexual flowers are flowers that contain either male or female reproductive parts, but not both. The example of unisexual flowers are watermelon and papaya. They have separate male and female flowers on the same plant, making them unisexual.

12. When an 'X' bearing sperm fertilizes the egg, the resulting zygote has the following combination of chromosomes:
(a) 44+XX *(b) 44+XY*
(c) 22+XX *(d) 22+XY*

Solution: (a) 44+XX

Explanation:



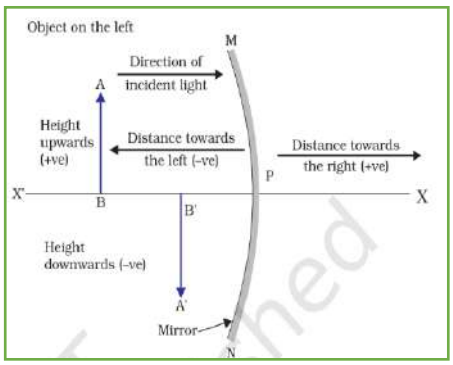
Resulting Zygote = 44 + XX

When an X-bearing sperm fertilizes the egg, the resulting zygote will have the chromosome combination 44+XX. This is because the egg contributes one X chromosome, and the X-bearing sperm contributes another X chromosome, for a total of two X chromosomes and 44 autosomes.

13. An object is placed in front of a convex mirror at infinity. According to the New Cartesian Sign Convention, the sign of the focal length and the sign of the image distance in this case are respectively:
(a) +, - *(b) - , +*
(c) - , - *(d) + , +*

Solution: (d) + , +

Explanation: Sign convention

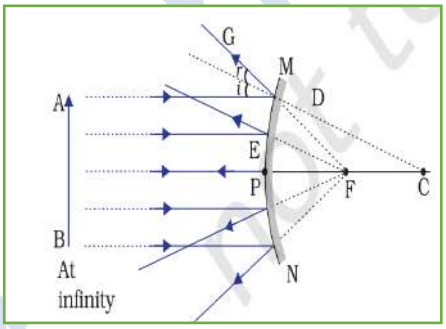


i) All the distances measured to the right of the origin (along + x-axis) are taken as positive while those measured to the left of the origin (along – x-axis) are taken as negative.

(ii) Distances measured perpendicular to and above the principal axis (along + y-axis) are taken as positive.

(iii) Distances measured perpendicular to and below the principal axis (along –y-axis) are taken as negative.

When the object is placed in front of a **convex mirror** at infinity (as shown in the right side), the image will be formed at the focal length on the right side of the mirror.



1. Since, the focal length is present on the right side of the mirror, the sign of the focal length will be **positive.**
2. The sign of the image formed will also be **the positive** as the image has been formed on the focal length.

14. For verifying ohm`s law, we design an electric circuit diagram in which we show the arrangement of different circuit components. We find that with respect to the resistor, the:
(a) ammeter is connected in parallel and the voltmeter in series.
(b) ammeter is connected in series and the voltmeter in parallel.
(c) ammeter and voltmeter are both connected in series.
(d) ammeter and voltmeter are both connected in parallel.

Solution: (b) ammeter is connected in series and the voltmeter in parallel.

Explanation: Verifying Ohm`s law

In the given figure on the right side, we find that with respect to resistor (R), the ammeter (A) is connected in series whereas the Voltmeter (V) is connected in parallel connection.

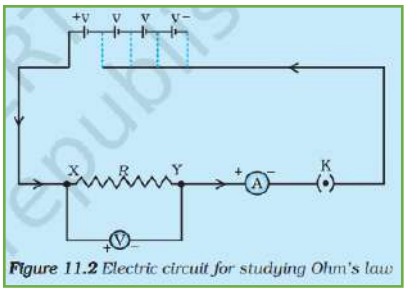


Figure 11.2 *Electric circuit for studying Ohm's law*

15. In a resistive circuit if the current is increased to two times, the percentage change in the amount of heat dissipated in the circuit would be:

(a) 400% *(b) 300%*
(c) 200% *(d) 100%*

Solution: (b) 300%

Explanation:

Heat dissipated in a resistor (H) = I^2RT

where I = original current, R = resistance and T = time of current flow

New Current (I`) = 2I,

New heat dissipated in a resistor (H`) = $(2I)^2RT$

$= 4I^2RT$

$= 4H$

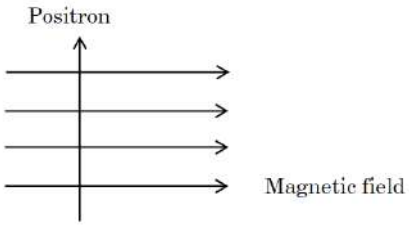
Change in heat = 4H – H = 3H

Percentage change in heat = $\frac{change\ in\ heat}{original\ heat}$ x 100

$= \frac{3H}{H}$ x 100

= 300%

16. A positron enters a uniform magnetic field at right angles to it as shown. The direction of force experienced by the positron will be :



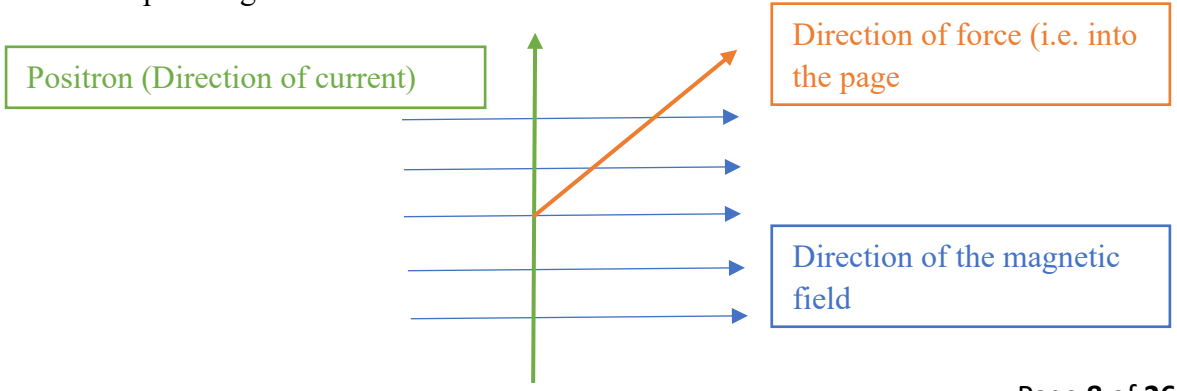
(a) to the right
(b) to the left
(c) into the page
(d) out of the page

Solution: (c) into the page

Explanation: Fleming`s left hand rule will tell the direction of the generated force.

According to fleming`s left hand rule, stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If the forefinger (F) points in the direction of magnetic field and the Centre finger (C) in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

In the given case, the direction of the force experienced by the positron will into the page as shown in the picture given below:



For Questions number 17 to 20, two statements are given one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

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

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

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

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

17. Assertion (A) : Sodium oxide is an amphoteric oxide.
Reason (R) : Metal oxides which react with both acids as well as bases are known as amphoteric oxides.
Solution: (d) Assertion (A) is false, but Reason (R) is true.

Explanation:

Sodium oxide is not an amphoteric oxide. **Sodium oxide (Na_2O)** is a strong base and it will react with acids to form sodium salts and water. For example, **Na_2O** reacts with HCl to produce sodium chloride (NaCl) and water (H_2O). However, it does not react with bases.

Amphoteric oxides- are metal oxides that can react with both acids and bases, forming salts and water. Examples include zinc oxide (ZnO) and aluminum oxide (Al2O3).

18. Assertion (A) : When a bacterium divides into two, and the resultant two bacteria divide again, the four bacteria produced would be almost similar.
Reason (R) : DNA copying involves small inaccuracies in the reproduction process.
Solution: (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

Explanation:

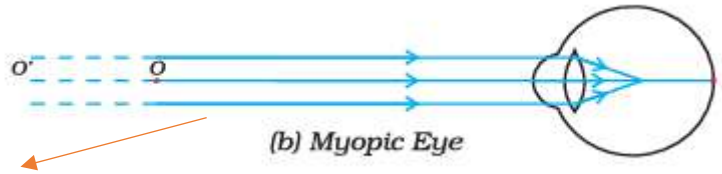
The Assertion (A) is true: Bacteria reproduce asexually (typically by binary fission), and the offspring are genetically very similar to the parent.
The Reason (R) is also true: DNA copying (replication) is not perfectly accurate. It may involve small errors (mutations), which is a natural and important part of evolution and variation.
Hence, both A and R is correct, and R correctly provides the reason why the resultant bacteria are similar and not the exact.

19. Assertion (A): A person suffering from myopia cannot see the distant objects clearly.
Reason (R): A converging lens is used for the correction of myopic eye as it can form real as well as virtual images of the objects placed in front of it.

Solution: ***(c) Assertion (A) is true, but Reason (R) is false.***

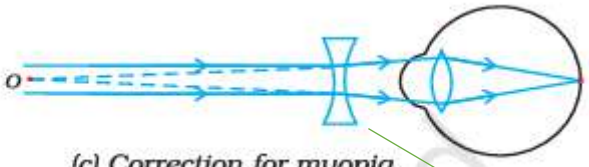
Explanation: Myopia is also known as nearsightedness. A person with myopia can see nearby objects clearly but cannot see distant objects distinctly.

This defect can be corrected by using a concave lens (diverging lens) of suitable power.



(b) Myopic Eye

Ray coming from the distant will not be able to form image on the retina of the eye.



(c) Correction for myopia

Diverging lens (Concave lens)

20. Assertion (A) : Magnetic field lines do not intersect each other.
Reason (R) : Magnetic field lines are imaginary lines, the tangent to which at any point gives the direction of the field at that point.

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

Explanation –

Assertion: The magnetic field lines do not intersect, for if they did, the direction of the magnetic field would not be unique at the point of intersection. Therefore, magnetic field lines do not intersect each other.

Reason: The reason states that the tangent to a magnetic field line at any point gives the direction of the field. This implies that if two lines intersected, the tangent at the intersection would have two different directions, which is not possible.

Hence, the Assertion and the Reason both are correct and the reason is the correct explanation of the Assertion.

SECTION B

21. (a) What is observed when aqueous solutions of potassium iodide and lead nitrate are mixed together? Name the type of reaction and write the chemical equation for the reaction that occurs. *(2)*

OR

(b) When copper powder is heated in a watch glass, a black substance is formed. ***(2)***
(i) Why is this black substance formed? Name it.
(ii) How can this black substance be reversed to its original form?

Solution- 21. (a) A yellow precipitate of lead Iodide (PbI_2) is formed when aqueous solutions of potassium iodide (KI) and lead nitrate ($Pb(NO_3)_2$) are mixed together.

Type of reaction – Precipitation reaction/ Double displacement reaction.

Chemical equation of the reaction:

$$2KI(aq) + Pb(NO_3)_2(aq) \longrightarrow PbI_2(s) + 2KNO_3(aq)$$

(Potassium Iodide) (Lead Nitrate) (Lead Iodide) (Potassium Nitrate)

OR

Solution –

21(b) (i) When copper powder is heated in a watch glass, it reacts with oxygen in the air and forms a black substance called copper oxide (CuO).

21(b)(ii) The black copper (II) oxide (CuO) can be reduced back to copper (Cu). This can be achieved by heating the copper oxide either with hydrogen gas or carbon.

The chemical equations for the reactions are:

- $2CuO + C \longrightarrow 2Cu + CO_2$ (with carbon)
- $2CuO + H_2 \longrightarrow 2Cu + H_2O$ (with hydrogen)

22. (a) Why is it important to prevent oxygenated and deoxygenated blood from mixing in birds and mammals?
(b) Which animals can tolerate some mixing of the oxygenated and deoxygenated blood streams? On what factor does the body temperature of these animals depend? (2)

Solution 22(a) Birds and mammals are warm-blooded animals. Their cells require a constant and efficient supply of oxygen to produce energy for maintaining their body temperature. Hence, preventing mixing of oxygenated and deoxygenated blood ensures efficient supply of oxygen to the body cells for enhanced energy production.

Solution 22(b) Animals that can tolerate some mixing of oxygenated and deoxygenated blood:

- Amphibians (e.g., frogs, salamanders etc.)
- Reptiles (e.g., lizards, snakes etc.)

These animals have three-chambered hearts, which allows partial mixing of oxygen-rich and oxygen-poor blood. The body temperature of these animals depend on the external environment rather than being internally regulated.

23. Mendel crossed a pure tall pea plant (TT) with a pure short pea plant (tt) and obtained all tall plants in F1 generation.
(a) What is the gene combination present in the plants of F1 generation?
(b) Give reason why only tall plants are observed in F1 progeny.
(c) What will be the ratio of the plants obtained in the F2 generation when F1 plants are self-pollinated? ***(2)***

Solution 23(a) The gene combination in the F1 generation is Tt (heterozygous tall).

Solution 23(b) Only tall plants are observed in the F1 progeny because the tall trait (T) is dominant over the short trait (t). In the heterozygous condition (Tt), the dominant allele masks the effect of the recessive allele.

Solution 23(c) When F1 plants (Tt) are self-pollinated:

F2 genotypes: TT, Tt, Tt, tt

Phenotypes:

- Tall (TT and Tt) = 3 parts
- Short (tt) = 1 part

Phenotypic ratio = 3 Tall : 1 Short

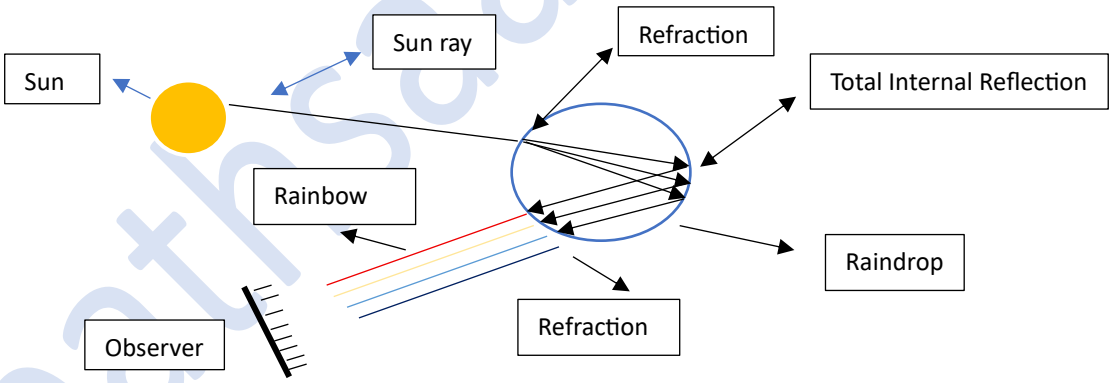
24. (a) When and where does a rainbow appear in the sky? Draw a labelled ray diagram to show its formation. (2)

OR

(b) What is scattering of light? Why does the clear sky appear blue? (2)

Solution:24(a) A **rainbow** appears in the sky:

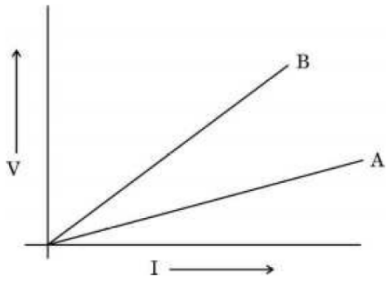
- **When**: Just after a rain shower, while the sun is shining.
- **Where**: In the opposite direction of the Sun, i.e., the Sun is behind the observer, and rain droplets are in the direction the observer is facing.



Solution 24(b) Scattering of light is the phenomenon where light rays are deflected in different directions when they strike tiny particles (like dust, gas molecules, or water droplets) in the atmosphere.

when sunlight enters the Earth's atmosphere, it interacts with air molecules. Shorter wavelengths of light (blue and violet) are scattered more than longer wavelengths (red and yellow). Although violet light is scattered even more than blue, our eyes are more sensitive to blue light and some of the violet is absorbed by ozone. This is why the clear sky appears blue during the day.

25. V I graph for two conducting wires A and B are as shown. If both wires are of the same length and same diameter, which of the two is made of a material of high resistivity? Give reasons to justify your answer. (2)



Solution: 25

The slope of the V-I graph represents the resistance R of the wire.

From the picture, it is clear that

$$\text{Slope of B} > \text{Slope of A}$$

$$V_B/I_B > V_A/I_A \quad \textit{(by Ohm's law } R = V/I\textit{)}$$

$$R_B > R_A \quad \textit{(Resistance of wire B is greater than wire A)}$$

$$\rho \frac{L}{A} > \rho \frac{L}{A}$$

Since length and diameter (hence, area) are the same for both wires, the only variable affecting resistance is the resistivity ρ.

Hence, the resistivity of material B is greater than material A.

26. We do not clean ponds or lakes but an aquarium needs to be cleaned regularly. Why? (2)

Solution: 26

Ponds and lakes are self-sustaining natural ecosystems that have decomposers and natural mechanisms for cleaning, while aquariums are artificial ecosystems that lack these features. Therefore, aquariums require regular cleaning to maintain water quality and prevent the accumulation of waste and harmful substances.

SECTION C

27. Silver chloride kept in a china dish turns grey in sunlight. (3)
(a) Write the colour of silver chloride when it was kept in the china dish.
(b) Name the type of chemical reaction taking place and write the chemical equation for the reaction.
(c) State one use of the reaction. Name one more chemical which can be used for the same purpose.

Solution:

27(a) The colour of Silver Chloride is white when it was kept in china dish.

27(b) Photochemical decomposition reaction takes place when Silver Chloride is kept in sunlight.

$$2AgCl\ (s) \xrightarrow{\text{Sunlight}} 2Ag\ (s) + Cl_2\ (g)$$

27(c) This reaction is used in black and white photography. When photographic film coated with silver chloride is exposed to light, a similar reaction occurs, forming an image. **Silver bromide (AgBr)** is also used in photography for the same purpose.

28. With the help of suitable chemical equations, list the two main differences between roasting and calcination. How is metal reduced from the product obtained after roasting/calcination of the ore? Write the chemical equation for the reaction involved. (3)

Solution: 28

The main differences between roasting and calcination are given below:

Roasting	**Calcination**
1. Roasting involves heating the ores in presence of excess air or oxygen.	1. Calcination involves heating the ores in absence or limited supply of air or oxygen.
2. Roasting is used for sulphide ores to convert it into oxide.	2. Calcination is used for carbonate ores to remove carbon dioxide.
3. $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$	3. $ZnCO3 \rightarrow ZnO + CO_2$

29. (a) (i) What is the first step in the breakdown of glucose during aerobic and anaerobic respiration? Where does it take place?
(ii) ATP is called the energy currency of the cell. Why?
(iii) What is meant by residual volume of air in a breathing cycle? (3)

OR

(b) Write in sequence the steps for experimental verification of the fact that sunlight is essential for photosynthesis . (3)

Solution:

29(a) (i) The first step in the breakdown of glucose in both aerobic and anaerobic respiration is Glycolysis. Glycolysis is the process in which one molecule of glucose is broken down into two molecules of pyruvate, producing a small amount of energy (ATP). It takes place in the cytoplasm of the cell.

29(a)(ii) ATP (Adenosine Triphosphate) is called the energy currency of the cell because:

- It stores and transports energy needed for all cellular activities.
- When the cell needs energy, ATP breaks down and releases energy.

29(a)(iii) The residual volume of air is the amount of air that remains in the lungs even after a forceful exhalation. This volume prevents the lungs from collapsing and ensures that gas exchange continues between breaths.

29(b) Photosynthesis is the process by which green plants use sunlight to synthesize foods with the help of chlorophyll. To verify that sunlight is essential for photosynthesis, we can perform an experiment using a potted plant, black paper, and iodine solution.

Steps 1: Choose a healthy green potted plant and keep it in a dark place for 2–3 days. This ensures the plant uses up all its stored starch.

Steps 2: After 2–3 days, cover part of one of the leaves with black paper, by using paper clips. This blocks sunlight from reaching that portion of the leaf.

Steps 3: Place the plant in sunlight for 4–6 hours so that photosynthesis can occur in the exposed parts.

Steps 4: After exposure, pluck the covered leaf and boil it in water for a few minutes to kill the leaf and stop all chemical processes.

Steps 5: Place the boiled leaf in a test tube containing alcohol (ethanol) and then place the test tube in a hot water bath until the leaf becomes decolorized (removes chlorophyll).

Steps 6: Rinse the decolorized leaf in warm water to soften it.

Steps 7: Place the leaf in a petri dish and add iodine solution. The part of the leaf that was exposed to sunlight will turn blue-black (indicating the presence of starch), while the covered part remains brown/yellow (no starch).

This experiment demonstrates that sunlight is essential for photosynthesis, as starch is only produced in the parts of the leaf that are exposed to sunlight.

30. Name the hormone released and the gland which secretes it in human beings during scary situations. How does the body respond to enable it to deal with the situation? (3)

Solution: 30

In scary or emergency situations, the adrenaline hormone (also called epinephrine) is released in human beings. Adrenal gland (specifically, the adrenal medulla) secretes adrenal hormone into the body. When adrenaline is released into the bloodstream, it triggers several immediate changes in the body to help it deal with danger:

- **Increased Heart Rate:** Pumps more blood to muscles and vital organs quickly.
- **Increased Breathing Rate:** Supplies more oxygen to the muscles.
- **Dilation of Pupils:** Enhances vision and awareness.
- **Conversion of Glycogen to Glucose:** Increases blood sugar level for quick energy.
- **Redirection of Blood Flow:** Blood is directed away from the digestive system and towards muscles.
- **Muscles Become More Responsive:** Readies the body for quick action (either to fight or flee).

The release of adrenaline prepares the body to respond quickly and effectively in frightening or stressful situations — this is known as the **"fight-or-flight" response**.

31. (a) A student has focussed the image of an object of height 3 cm on a white screen using a concave mirror of focal length 12 cm. If the distance of the object from the mirror is 18 cm, find the values of the following: (3)
(i) Distance of the image from the mirror
(ii) Height of the image

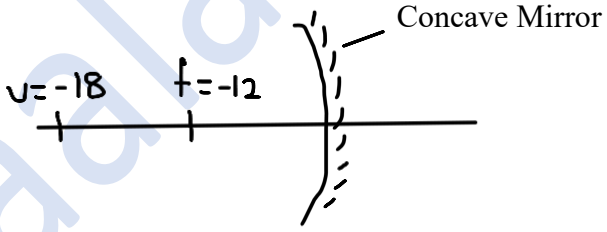
OR

(b) Define power of a lens. The focal length of a lens is 10 cm. Write the nature of the lens and find its power. If an object is placed at a distance of 20 cm from the optical centre of this lens, according to the New Cartesian Sign Convention, what will be the sign of magnification in this case? (3)

Solution:

31. (a) (i) Given:

- Height of object, *ho* = 3 cm
- Focal length of concave mirror, f = −12 cm (concave mirror has negative focal length)
- Object distance, u = −18 cm (object is always placed in front of mirror, so distance is negative)



By using the mirror formula,

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\frac{1}{-12} = \frac{1}{-18} + \frac{1}{v} \quad \textit{(substituting with values)}$$

$$\frac{1}{v} = \frac{1}{-12} + \frac{1}{18}$$

$$\frac{1}{v} = \frac{-3+2}{36}$$

$$\frac{1}{v} = \frac{-1}{36}$$

v = -36 cm

Distance of the image from the mirror = -36 cm

31 (a)(ii) Magnification = $\frac{hi}{ho} = \frac{-v}{u}$

$$\frac{hi}{3} = \frac{-(-36)}{(-18)}$$

hi = -6 cm

Height of the image = -6 cm (the image is real and inverted).

31(b) Power of a lens is the measure of its ability to converge or diverge light. It is defined as the reciprocal of the focal length of the lens (in meters).

$$P = \frac{1}{f}$$

Given,

Focal length of the lens = + 10 cm = 0.10 m
Since the focal length is positive, it is a convex lens.
Power of the lens = $\frac{1}{0.10} = \frac{100}{10} = +10$ D

Sign of Magnification:

Given,

Object distance, u = −20 cm (according to New Cartesian Sign Convention: object is on the left, so negative)
Focal length, f = +10 cm

Let's calculate the image distance v using the lens formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{10} = \frac{1}{v} - \frac{1}{-20}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{20}$$

$$\frac{1}{v} = \frac{2-1}{20}$$

v = 20 cm

Magnification = v/u = 20/-20 = -1

Since sign of magnification is negative, the image is inverted and real.

32. Explain the meaning of overloading of an electrical circuit. List two possible causes due to which overloading may occur in household circuits. Write one preventive measure that should be taken to avoid overloading of domestic circuits. (3)

Solution: 32

Overloading of an electrical circuit occurs when the total current drawn by the devices connected to the circuit exceeds the circuit's capacity.

The two possible causes of overloading in household circuits are:

1. Connecting too many appliances to a single circuit
2. Using high-power appliances beyond the circuit's capacity

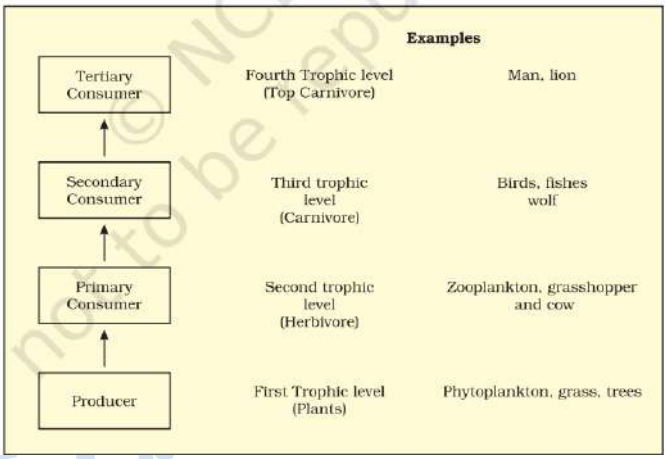
The preventive measures that one should be taken is the installation of circuit breakers or fuses in the electrical system to avoid circuit being damaged from overloading.

33. Explain how some harmful chemicals enter our bodies through the food chain. Why is the concentration of these harmful chemicals found to be maximum in human beings? (3)

Solution:

We often use pesticides and other chemicals to protect our crops from diseases and pests. These chemicals are either washed down into the soil or into the water bodies. From the soil, these are absorbed by the plants along with water and minerals, and from the water bodies these are taken up by aquatic plants and animals. In this way it passes from one trophic level to another as each organism is consumed by the next in the food chain.

As these chemicals are not degradable, these get accumulated progressively at each trophic level. As human beings occupy the top level in any food chain, the maximum concentration of these chemicals get accumulated in human bodies.



SECTION D

34 (a) An acid 'X' and an alcohol 'Y' react with each other in the presence of an acid catalyst to form a sweet smelling substance 'Z'. Identify 'X', 'Y' and 'Z'. Write the chemical equation for the reaction involved and name it. The substance 'Z' on treatment with sodium hydroxide produces back the alcohol 'Y' and sodium ethanoate. Write the chemical equation for the reaction involved and name it, giving justification for the name. (5)

OR

(b) (i) Name the simplest saturated hydrocarbon. Draw its electron dot structure. Which type of bonds exist in this compound?
(ii) Name any two mixtures of the carbon compound used as a fuel in daily life, of which the above mentioned compound is an important component.
(iii) In which homologous series of carbon compounds can this compound be placed? Write the general formula of the series.
(iv) Which type of flame is produced on burning it? (5)

Solution: 34(a)

In the given reaction,

1. Acid 'X' is acetic acid i.e. ethanoic acid (CH_3COOH).
2. Alcohol 'Y' is ethanol (C_2H_5OH).
3. Substance 'Z' is Ethyl ethanoate ($CH_3COOC_2H_5$).

$$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$$

(In the presence of Catalyst: concentrated H_2SO_4)

This reaction is called esterification and produces ethyl ethanoate, which has a fruity smell.

When the substance 'Z' is treated with NaOH (Sodium Hydroxide), it undergoes alkaline hydrolysis (saponification), producing sodium ethanoate and ethanol (Y).

The reaction can be represented as follows:

$$CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$$

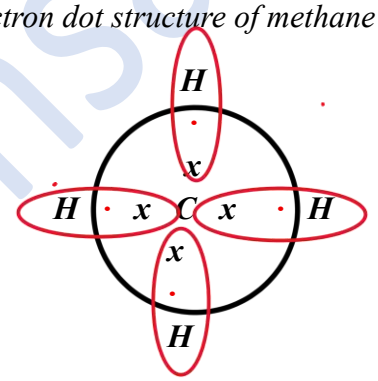
(Ethyl ethanoate + Sodium hydroxide → Sodium ethanoate + Ethanol)

This reaction is called saponification (alkaline hydrolysis of ester). The term "saponification" is derived from soap-making, where esters (fats/oils) react with NaOH to produce soap (sodium salts of fatty acids) and alcohol.

Solution:34

(b)(i) The simplest saturated hydrocarbon is methane (CH_4).

In the electron dot structure, each hydrogen (H) shares one electron with carbon (C), forming four single covalent bonds. Electron dot structure of methane (CH_4) is shown below:



Type of bonds – Covalent bonds (sigma bonds)

(ii) Two mixtures of the carbon compound used as a fuel in daily life that contain methane are:

- Natural Gas
- Bio Gas

(iii) Methane belongs to the **alkane** homologous series.

General formula of alkanes - C_nH_{2n+2}

(iv) On burning methane, it produces a blue flame (non-sooty flame) due to complete combustion.

35. (a) (i) List three points of difference between nervous and hormonal mechanisms for control and coordination in animals.
(ii) How are auxins related with the bending of plant shoot towards unidirectional light? Explain. ***(5)***

OR

(b) (i) Name the disorder which a person is likely to suffer from due to the following :
(I) Over-secretion of growth hormone
(II) Deficiency of oestrogen in females
(III) Less secretion of thyroxine
Also name the gland that secretes each of the hormones mentioned above.
(ii) How is the timing and amount of hormone released regulated? Explain with the help of an example. ***(5)***

Solution:

35(a)(i) The three points of difference between nervous and hormonal mechanisms for control and coordination in animals:

Nervous Mechanism	Harmonal Mechanism
1. The nervous system uses electrical impulses to send signals through neurons.	1. The hormonal system relies on chemical messengers (hormones) that travel through the bloodstream.
2. The nervous system are very fast.	2. Since the hormones travels via blood, the response time is slower as compared to the nervous system.
3. The nervous responses are short lived.	3. The harmonal responses are long lasting.

35(a)(ii) Auxins are plant hormones that help plant shoots bend towards unidirectional light, a phenomenon known as phototropism.

When light falls on one side of a plant shoot, auxins produced at the shoot tip moves towards the shaded side of the shoot. This unequal distribution causes more auxins to accumulate on the shaded side (darker side). Auxins promote cell elongation in shoots, so the cells on the darker side grow quickly than those on the side exposed to light. As a result, the shoot bends towards the light source.

This bending allows the plant to maximize its exposure to sunlight, increasing the process of photosynthesis and overall growth.

Light

↓

[Illuminated Side] → Less auxin → Slower growth

[Shaded Side] → More auxin → Faster growth → Bending towards light

OR

(b)(i)(I) The disorder which a person likely to suffer from Over-secretion of growth hormone is Gigantism (in children) or Acromegaly (in adults). The pituitary gland secretes the hormone responsible for Gigantism or Acromegaly.

(b)(i)(II) The disorders due to deficiency of oestrogen in females are menopause and Osteoporosis. Ovary secretes oestrogen.

(b)(i)(III) The disorder due to less secretion of thyroxine is Hypothyroidism (Goitre). Thyroid Gland secretes thyroxine.

(b)(ii) The time and amount of hormone release in the body are controlled by a feedback mechanism. This ensures that hormone levels remain balanced and are only released when necessary.

For example, the thyroid gland produces thyroxine, which regulates metabolism. When the level of thyroxine in the blood falls below normal, the pituitary gland detects this and secretes thyroid-stimulating hormone. TSH stimulates the thyroid gland into producing and releasing more thyroxine. Once a suitable quantity of thyroxine is obtained, the pituitary gland lowers TSH output to maintain balance.

This negative feedback loop prevents overproduction or underproduction of hormones, helping maintain homeostasis in the body.

36. (a) An object is placed in front of a convex lens of focal length f. If the distance of the object from the lens is 2f, draw a ray diagram to show the formation of the image. Write the value of magnification in this case.

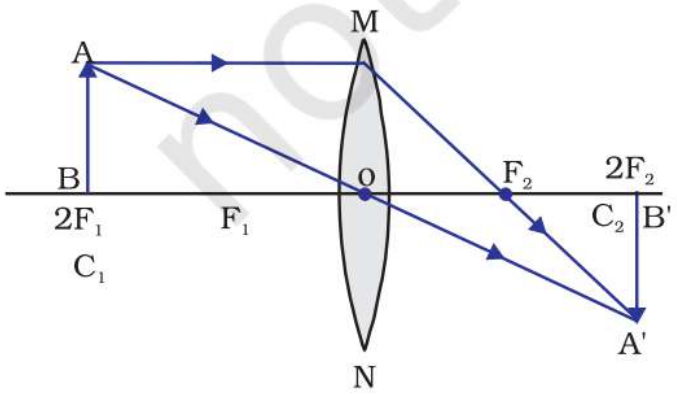
(b) A student has focussed the image of a candle flame on a white screen using a convex lens. The situation is as given below:

Length of the flame = 2 cm
Focal length of the lens = 12 cm
Distance of the flame from the lens = 16 cm

If the flame is perpendicular to the principal axis of the lens, calculate the values of the following:

(i) Distance of the image from the lens
(ii) Length of the image formed

Solution 36(a)



Note- In the image shown above, AB is the object placed at a distance 2f from the convex lens MN. The image A`B` will be formed at $2F_2$ (Centre of Curvature) which will be real and inverted.

1. **Magnification (m):**
   Magnification is given by:

$$M = \frac{v}{u}$$ (where v = distance of the image and u = distance of the object)

Substituting, $v = 2f$ and $u = -2f$ *in the above formula, we will have,*

$$M = \frac{2f}{-2f} = -1$$

The negative sign indicates that the image is inverted.

Solution: 36 (b)

Given:

- Length of the flame (object height, *ho*): 2 cm
- Focal length of the convex lens (*f*): 12 cm (positive for convex lens)
- Object distance (*u*): −16 cm (negative as per sign convention)

Using the Lens Formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Substitute u =−16 cm and f =12 cm we will have,

$$\frac{1}{12} = \frac{1}{v} - \frac{1}{-16}$$

$$\frac{1}{v} = \frac{1}{12} - \frac{1}{16}$$

$$\frac{1}{v} = \frac{4-3}{48} = \frac{1}{48}$$

$v = 48$ cm (distance of the image from the lens).

Using the magnification formula,

$$m = \frac{hi}{ho} = \frac{v}{u}$$

Substitute v =48 cm, u= −16 cm, and *ho* = 2cm we will have,

$$\frac{hi}{2} = \frac{48}{-16}$$

$$\frac{hi}{2} = -3$$

hi = -6 cm (length of the image formed)

SECTION-E

The following questions are source-based/case-based questions. Read the case carefully and answer the questions that follow.

37. The teacher while conducting practicals in the laboratory divided the students into three groups and gave them various solutions to find out their pH and classify them into acidic, basic and neutral solutions.
Group A Lemon juice, vinegar, colourless aerated drink
Group B Tomato juice, coffee, ginger juice
Group C Sodium hydroxide, sodium chloride, lime water
(a) For the solutions provided, which group is/are likely to have pH value (i) less than 7, and (ii) greater than 7? (1)
(b) List two ways of determining pH of a solution (1)
(c) Explain, why the sour substances such as lemon juice are effective in cleaning the tarnished copper vessels. (2)

OR

(c) "pH has great importance in our daily life." Justify this statement by giving two examples. (2)

Solution: 37(a)

Solutions having pH value less than 7 is acidic and more than 7 is basic.

The pH value of Group A - Lemon juice, vinegar, colourless aerated drink are less than 7, hence this group falls under acidic solution.

The pH value of Group B - Tomato juice, coffee, ginger juice are also less than 7, hence this group also falls under the acidic solution.

The pH value of Group C - Sodium hydroxide, sodium chloride, lime water is more than 7, hence this group will fall under the basic solution.

Solution: 37(b) The two ways of determining pH of a solution are:

i. Using pH Paper (Universal Indicator Paper)
ii. Using a pH Meter

Solution: 37 (c) Copper vessels tarnish over time due to the formation of copper carbonate ($CuCO_3$) layer on their surface, which appears as a dull, dark coating. Sour substances like lemon juice contain citric acid that react with copper carbonate, dissolving the tarnish and restore the shiny copper surface.

Lets discuss in detail

Copper reacts with carbon dioxide and moisture in the air to form **basic copper carbonate**:

$$2Cu + H_2O + CO_2 + O_2 \rightarrow CuCO_3 \cdot Cu(OH)_2 \quad \text{(green layer)}$$

When lemon juice (acid) is applied:

The **citric acid** (represented here as a generic acid, H^+) reacts with the **basic copper carbonate**:

$$CuCO_3 \cdot Cu(OH)_2 + 4H^+ \rightarrow 2Cu^{2+} + CO_2\uparrow + 3H_2O$$

OR

Solution: 37(c) pH is important in daily life because:

1. Our stomach needs the right pH for digestion; antacids are used to neutralize excess acidity.
2. Soil pH affects plant growth; it is adjusted to ensure proper nutrient availability.

38. All the reproductive methods of living organisms are broadly categorized into two types: 1. Asexual reproduction, and 2. Sexual reproduction.
Asexual reproduction involves the participation of a single parent without the formation of gametes, fertilisation and transfer of genetic material. This method is a common means of rapidly increasing offsprings under favourable conditions.
(a) Name the type of fission that occurs in Leishmania and Plasmodium. (1)
(b) Write one advantage of sexual mode of reproduction over asexual reproduction. (1)
(c) Give reasons why: (2)
(i) Colonies of yeast fail to multiply in water but multiply in sugar solution.
(ii) Rhizopus individuals do not grow on a dry slice of bread.

OR

(c) Name the filamentous structures a student could identify when he collected water from a pond that appeared dark green. How do these organisms multiply? Explain. (2)

Solution: 38(a)

In Leishmania (which cause kala-azar), longitudinal binary fission occurs in a definite orientation in relation to these structures i.e. the organism splits along its length.

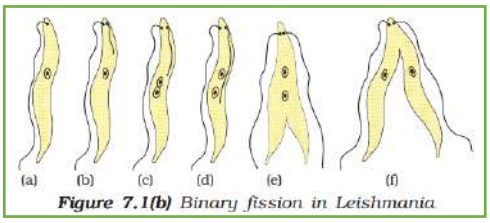


Figure 7.1(b) Binary fission in Leishmania

In Plasmodium multiple fission takes place i.e. one cell divides into many daughter cells simultaneously.

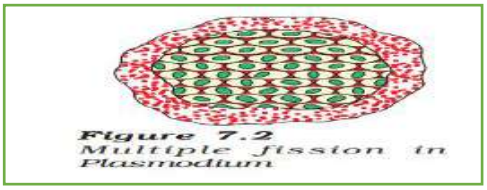


Figure 7.2 Multiple fission in Plasmodium

Solution: 38 (b) Sexual reproduction introduces genetic variation among offspring, which increases adaptability and survival chances in changing environments.

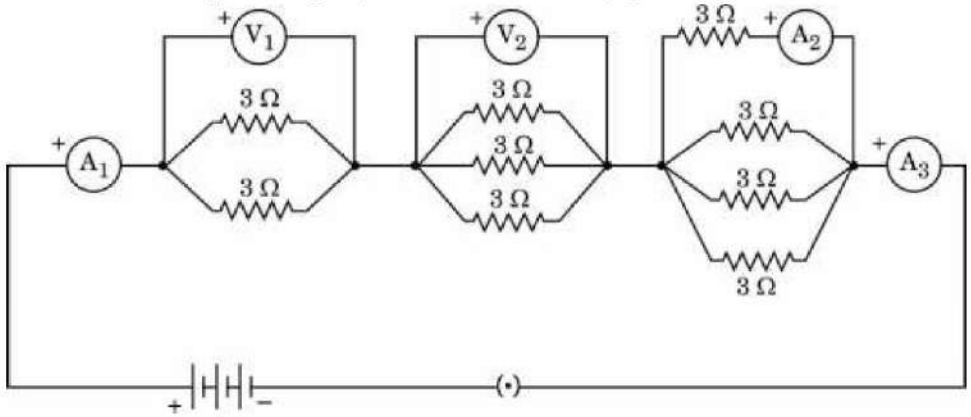
Solution: 38 (c)(i) Colonies of yeast fail to multiply in water because water lacks nutrients, consequentally, yeast cannot grow or reproduce in it. However, in sugar solution Yeast obtains energy for growth and reproduction by fermenting the sugar.

Solution: 38 (c)(ii) Rhizopus individuals do not grow on a dry slice of bread because Rhizopus needs moisture to grow. A dry bread slice lacks the moisture required for spore germination and mycelial growth. Hence, Rhizopus do not grow on a dry slice of bread.

OR

Solution: 38(c) The filamentous structures a student could identify when he collected water from a pond that appeared dark green are likely **algae (spirogyra)**. These organisms multiply through fragmentation, where the filaments break off into smaller pieces, each of which then grows into a new individual.

39. Consider the following electrical circuit diagram in which nine identical resistors of 3 Ω each are connected as shown. If the reading of the ammeter A_1 is 1 ampere, answer the following questions :



(a) What is the relationship between the readings of A1 and A3? Give reasons for your answer. ***(1)***
(b) What is the relationship between the readings of A2 and A3? ***(1)***
(c) Determine the reading of the voltmeter V1. ***(2)***

OR

(c) Find the total resistance of the circuit. ***(2)***

Solution 39(a):

Relationship between the readings of A1 and A3.

Readings of A1 = Reading of A3
Because the total current flowing into the circuit through A1 must be equal to the current coming out of A3 as no current is lost in the circuit (conservation of charge/Kirchhoff's current law).
Hence, $I_1 = I_3 = 1A$
39 (b) Relationship between the readings of A2 and A3.
From the picture, it is clear that the third block (rightmost part) is a parallel combination of four resistors, each of 3Ω. Hence, the 1A current will be split into four equal parts. Thereby, the current at A2 will be 1/4A.

Hence, reading at A2 = ¼ of reading at A3.

39(c) **Voltmeter V_1** measures the voltage drop across two 3Ω resistors in **parallel**, as shown in the left-most combination.

Total resistance (R_1) of left block part = $\frac{1}{R1} = \frac{1}{3} + \frac{1}{3} = \frac{2}{3}\Omega$.

$$R1 = \frac{3}{2}\Omega$$

Reading at V1 = I_1 x R1 = 1 x $\frac{3}{2}$ = 1.5 V.

OR

39(c) Total Resistance of the Circuit

The first block contains two 3Ω resistors in parallel.

$$\frac{1}{R1} = \frac{1}{3} + \frac{1}{3} = \frac{2}{3}\Omega.$$

$$R1 = \frac{3}{2}\Omega$$

The second block contains three **3Ω** resistors in parallel.

$$\frac{1}{R2} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3} = 1\Omega$$

$$R2 = 1\ \Omega$$

The third block contains four **3Ω** resistors in parallel.

$$\frac{1}{R3} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 4/3\Omega$$

$$R3 = 3/4\Omega$$

Total resistance of the circuit (R_{total}) = R1 + R2 + R3

= 3/2 + 1 + 3/4

$= \frac{13}{4} = 3.25\Omega$