

HIGHLY  
RECOMMENDED

TERM-I  
EXAM



# CBSE CHAPTERWISE **QUESTION BANK** CLASS 10 SCIENCE

Strictly as per the Latest CBSE Circular No.  
Acad-53/2021, dated July 22, 2021



Revision Notes

Mind Maps & Mnemonics

- MCQs
- Assertion & Reason
- Case-based MCQs

Strictly as per the Term-wise Syllabus  
for Board Examination 2021-22

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1<sup>st</sup> EDITION

YEAR 2021-22

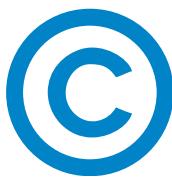


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(CBSE Cir. No. Acad 53/2021)

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# TWIST IN THE TEST



## The Special Assessment Scheme

CBSE's Special Assessment Scheme has radically transformed the evaluation landscape.

This novel decision has unequivocally changed the perception of board examinations in India. This change has made our examination systems compatible with semester-based systems followed in higher education institutions in the country and across the globe.

As per the Special Assessment Scheme, the Academic Session 2021-22 will be divided into two terms with approximately 50% syllabus in each term, thereby helping the students in achieving the learning objectives over a more structured and progressively flexible curriculum.

## How will this special scheme benefit the students?

2020 was a year that has fundamentally changed the world as we knew it. Every sector underwent a transformation, none more so than education. Students and teachers alike adapted to online learning, examinations and new teaching learning methodologies.

This announcement, right at the start of the new academic year, gives teachers and students ample time to prepare and plan for the year. This timely announcement will enable students to have a clear understanding of what they need to study for their Terms – I & II for their board examinations.

## How to prepare for Term – I board?

There is a lot of focus on MCQs in the assessment policy as they are a robust assessment technique for evaluating learning outcomes.

MCQs are an excellent way to test conceptual understanding. They offer the advantages of versatility (can be used to assess application & problem solving), and are a much more reliable test of understanding.

The Term – I examination will be of 90 minutes' duration and the question paper will have Multiple Choice Questions (MCQs) including case-based MCQs and MCQs on assertion-reason type. This focus on MCQs will make students mentally more ready for facing competitive examinations in the future.

Oswaal CBSE Chapter-wise Question Banks for Term – I are strictly based on the new term-wise syllabus for Board examinations to be held in the Academic Session 2021-22.

For extensive practice of MCQs based questions and for deep understanding of core-concepts.

## These Question Banks include:

1. Multiple Choice Questions based on latest typologies introduced by the board like:
  - a. **Stand-alone MCQs**
  - b. **MCQs based on Assertion-Reason**
  - c. **Case-based MCQs**
2. Revision Notes, Mnemonics, Mind Maps, Answers with Explanations & Concept videos, all of which enhance learning experiences and improve learning outcomes.
3. Questions from CBSE official Question Bank (released in April 2021) for exam-oriented preparation.

## Our Heartfelt Gratitude

Finally, we would like to thank our authors, editors, and reviewers. We promise to always strive towards '**Making Learning Simple**' for all of you.

Wish you all Happy Learning!

***Wish you all Happy Learning and a Successful 2021-22!!***

# WISH TO KNOW WHAT WE HAVE FOR YOU UNDER FREE RESOURCES?

## HERE YOU GO:

- ▶ Date Sheet
- ▶ Board Syllabus 2022 Exams
- ▶ Solved Board Paper 2018, 2019, 2020
- ▶ Toppers' Answer 2015 to 2019
- ▶ Latest Sample Question Paper
- ▶ Project Report
- ▶ Lab Activities (Science & Math only)
- ▶ Flowcharts & Mind Maps

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How to decode icons given throughout the book?

- Chapter-wise
- Mnemonics
- Previous Years' Board Papers
- Mind Maps
- Concept Videos
- Highly Expected Questions for the upcoming exam



# 30 DAYS OF ONLY GRATITUDE!

Take it as a challenge; practice gratitude every day.

When you'll look around yourself, you'll find umpteen number of things to be grateful for.

Practicing gratitude everyday will only multiply those things in your life & will ignite positive emotions in you. Here are a few things you could be grateful for. So, get started today!

#1		About your body.	#2		What you find beautiful.	#3		A song you love.	#4		An accomplishment of yours.	#5		A friend.
#6		A Smell you love.	#7		Something that makes you smile.	#8		A happy memory.	#9		Something you like about where you live.	#10		A person in your family.
#11		A food you love.	#12		An ability of yours.	#13		A person.	#14		You're looking forward to.	#15		A life lesson.
#16		A person you look up to.	#17		A personality trait of yours.	#18		An item you use every day.	#19		A freedom you are grateful for.	#20		A holiday you love.
#21		A technology.	#22		Something made you laugh.	#23		Something nice.	#24		A book magazine or podcast.	#25		Another person.
#26		Something in nature.	#27		A gift you received.	#28		Something that brings hope.	#29		A compliment you have received.	#30		Something you are passionate about.

# CBSE CIRCULAR 2021-22



केन्द्रीय माध्यमिक शिक्षा बोर्ड  
CENTRAL BOARD OF SECONDARY EDUCATION



NO.: F1001/CBSE-Acad/Curriculum/2021

Date: July 22, 2021

Circular No: Acad- 53/2021

All the Heads of Schools affiliated to CBSE

**Subject:** Term wise syllabus for Board Examinations to be held in the academic session 2021-22 for Secondary and Senior Secondary classes and guidelines for the conduct of the Internal Assessment/Practicum/Project.

This is in continuation to Board's circular number Acad 51/2021 dated July 05, 2021 regarding Special Scheme of Assessment for Board Examination for Classes X and XII for the Session 2021- 22. The syllabus for the two terms mentioned in the scheme in all subjects for classes IX to XII are hereby notified vides this circular. In addition to syllabus for term end board examinations, guidelines for the conduct of Internal Assessment/Practicum/Project are also enclosed.

Schools are requested to share the term wise syllabus and guidelines for the conduct of board examinations and Internal Assessment / Practicum / Project available on CBSE Academic Website <http://www.cbseacademic.nic.in> at the link [http://cbseacademic.nic.in/Term-wise-curriculum\\_2022.html](http://cbseacademic.nic.in/Term-wise-curriculum_2022.html) with all their teachers and students.

(Dr. Joseph Emmanuel)  
Director (Academics)

# SYLLABUS

Latest Syllabus issued by CBSE for Academic Year 2021-22

## SCIENCE

Class - X (Code No. 086)

### COURSE STRUCTURE

3 Hours

Marks 80

EVALUATION SCHEME		
THEORY		
Units	Term - I	Marks
I	Chemical Substances-Nature and Behaviour: Chapter 1,2 and 3	16
II	World of Living: Chapter 6	10
III	Natural Phenomena: Chapter 10 and 11	14
Units	Term - II	Marks
I	Chemical Substances-Nature and Behaviour: Chapter 4 and 5	10
II	World of Living: Chapter 8 and 9	13
III	Effects of Current: Chapter 12 and 13	12
	Natural Resources: Chapter 15	05
<b>Total Theory (Term I+II)</b>		<b>80</b>
<b>Internal Assessment: Term I</b>		<b>10</b>
<b>Internal Assessment: Term II</b>		<b>10</b>
<b>Grand Total</b>		<b>100</b>

### TERM - I

#### Theme : Materials

##### Unit I : Chemical Substances - Nature and Behaviour

###### Chapter -1 Chemical reactions and equations

**Chemical reactions:** Chemical equation, Balanced chemical equation, implications of a balanced chemical equation, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.

###### Chapter – 2 Acids, Bases and Salts

**Acids, bases and salts:** Their definitions in terms of furnishing of  $H^+$  and  $OH^-$  ions, General properties, examples and uses, concept of pH scale (Definition relating to logarithm not required), impor-

# SYLLABUS

tance of pH in everyday life; preparation and uses of Sodium Hydroxide, Bleaching powder, Baking soda, Washing soda and Plaster of Paris.

## Chapter – 3 Metals and non – metals

**Metals and nonmetals:** Properties of metals and non-metals; Reactivity series; Formation and properties of ionic compounds.

## Theme : The World of the Living

### Unit II : World of Living

#### Chapter – 6 Life processes

**Life processes:** ‘Living Being’. Basic concept of nutrition, respiration, transport and excretion in plants and animals.

## Theme : How Things Work

### Unit III : Natural Phenomena

#### Chapter – 10 Light – Reflection and Refraction

Reflection of light by curved surfaces; Images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula (Derivation not required), magnification.

Refraction; Laws of refraction, refractive index.

Refraction of light by spherical lens; Image formed by spherical lenses; Lens formula (Derivation not required); Magnification. Power of a lens.

#### Chapter – 11 Human eye and colourful world

Refraction of light through a prism, dispersion of light, scattering of light, applications in daily life.

## TERM - II

## Theme : Materials

### Unit I : Chemical Substances - Nature and Behaviour

#### Chapter – 4 Carbon and its compounds

**Carbon compounds:** Covalent bonding in carbon compounds. Versatile nature of carbon.Homologous series.

#### Chapter – 5 Periodic classification of elements

Periodic classification of elements: Need for classification, early attempts at classification of elements (Dobereiner’s Triads, Newland’s Law of Octaves, Mendeleev’s Periodic Table), Modern periodic table, gradation in properties, valency, atomic number, metallic and non-metallic properties.

# SYLLABUS

## Theme : The World of the Living

### Unit II : World of Living

#### Chapter – 8 How do organisms reproduce?

**Reproduction:** Reproduction in animals and plants (asexual and sexual) reproductive health-need and methods of family planning. Safe sex vs HIV/AIDS. Child bearing and women's health.

#### Chapter – 9 Heredity and Evolution

**Heredity:** Heredity; Mendel's contribution- Laws for inheritance of traits: Sex determination: brief introduction;

## Theme : Natural Phenomena

### Unit IV : Effects of Current

#### Chapter – 12 Electricity

Ohm's law; Resistance, Resistivity, Factors on which the resistance of a conductor depends. Series combination of resistors, parallel combination of resistors and its applications in daily life. Heating effect of electric current and its applications in daily life. Electric power, Interrelation between P, V, I and R.

#### Chapter – 13 Magnetic effects of current

**Magnetic effects of current:** Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming's Left Hand Rule, Electric Motor, Electromagnetic induction. Induced potential difference, Induced current. Fleming's Right Hand Rule.

## Theme : Natural Resources

### Unit V : Natural Resources

#### Chapter – 15 Our Environment

**Our environment:** Eco-system, Environmental problems, Ozone depletion, waste production and their solutions. Biodegradable and non-biodegradable substances.



### ONLY FOR INTERNAL ASSESSMENT

**Note:** Learners are assigned to read the below listed part of Unit V. They can be encouraged to prepare a brief write up on any one concept of this Unit in their Portfolio. This may be an assessment for Internal Assessment and credit may be given (Periodic assessment/Portfolio). This portion of the Unit is not to be assessed in the year-end examination.

**Chapter – 16 Management of natural resources:** Conservation and judicious use of natural resources. Forest and wild life; Coal and Petroleum conservation. Examples of people's participation for conservation of natural resources. Big dams: advantages and limitations; alternatives, if any. Water harvesting. Sustainability of natural resources.

# SYLLABUS

## PRACTICALS

Practical should be conducted alongside the concepts taught in theory classes.

### TERM - I

#### LIST OF EXPERIMENTS

1. A. Finding the pH of the following samples by using pH paper/universal indicator:
  - (i) Dilute Hydrochloric Acid
  - (ii) Dilute NaOH solution
  - (iii) Dilute Ethanoic Acid solution
  - (iv) Lemon juice
  - (v) Water
  - (vi) Dilute Hydrogen Carbonate solutionB. Studying the properties of acids and bases (HCl & NaOH) on the basis of their reaction with:
  - a) Litmus solution (Blue/Red)
  - b) Zinc metal
  - c) Solid sodium carbonateUnit-I:(Chapter-2)
2. Performing and observing the following reactions and classifying them into:
  - A. Combination reaction
  - B. Decomposition reaction
  - C. Displacement reaction
  - D. Double displacement reaction
    - (i) Action of water on quicklime
    - (ii) Action of heat on ferrous sulphate crystals
    - (iii) Iron nails kept in copper sulphate solution
    - (iv) Reaction between sodium sulphate and barium chloride solutions. Unit-I: (Chapter-1)
  3. A. Observing the action of Zn, Fe, Cu and Al metals on the following salt solutions:
    - (i)  $\text{ZnSO}_4\text{(aq)}$
    - (ii)  $\text{FeSO}_4\text{(aq)}$
    - (iii)  $\text{CuSO}_4\text{(aq)}$
    - (iv)  $\text{Al}_2(\text{SO}_4)_3\text{(aq)}$B. Arranging Zn, Fe, Cu and Al (metals) in the decreasing order of reactivity based on the above result. Unit-I : (Chapter-3)
  4. Experimentally show that carbon dioxide is given out during respiration. Unit-II: (Chapter-6)
  5. Determination of the focal length of (i) Concave mirror and (ii) Convex lens by obtaining the image of a distant object. Unit-III: (Chapter-10)
  6. Tracing the path of a ray of light passing through a rectangular glass slab for different angles of incidence. Measure the angle of incidence, angle of refraction, angle of emergence and interpret the result. Unit-III: (Chapter-10)
  7. Tracing the path of the rays of light through a glass prism. Unit-III: (Chapter-11)

# SYLLABUS

## TERM - II

### LIST OF EXPERIMENTS

1. Studying the dependence of potential difference (V) across a resistor on the current (I) passing through it and determining its resistance. Also plotting a graph between V and I. **Unit-IV: (Chapter-12)**
2. Studying (a) binary fission in Amoeba, and (b) budding in yeast and Hydra with the help of prepared slides. **Unit-II: (Chapter-8)**

### PRESCRIBED BOOKS:

- Science-Textbook for class IX-NCERT Publication
- Science-Text book for class X- NCERT Publication
- Assessment of Practical Skills in Science-Class IX - CBSE Publication
- Assessment of Practical Skills in Science- Class X- CBSE Publication
- Laboratory Manual-Science-Class IX, NCERT Publication
- Laboratory Manual-Science-Class X, NCERT Publication
- Exemplar Problems Class IX – NCERT Publication
- Exemplar Problems Class X – NCERT Publication



## Assessment Areas (Theory) 2021-22 (Class X) Science (086)

### Theory

Total Maximum Marks: 80 Marks

Competencies	Marks
Demonstrate Knowledge and Understanding	46%
Application of Knowledge/Concepts	22%
Analyze, Evaluate and Create	32%

### Note:

- Internal choice would be provided.

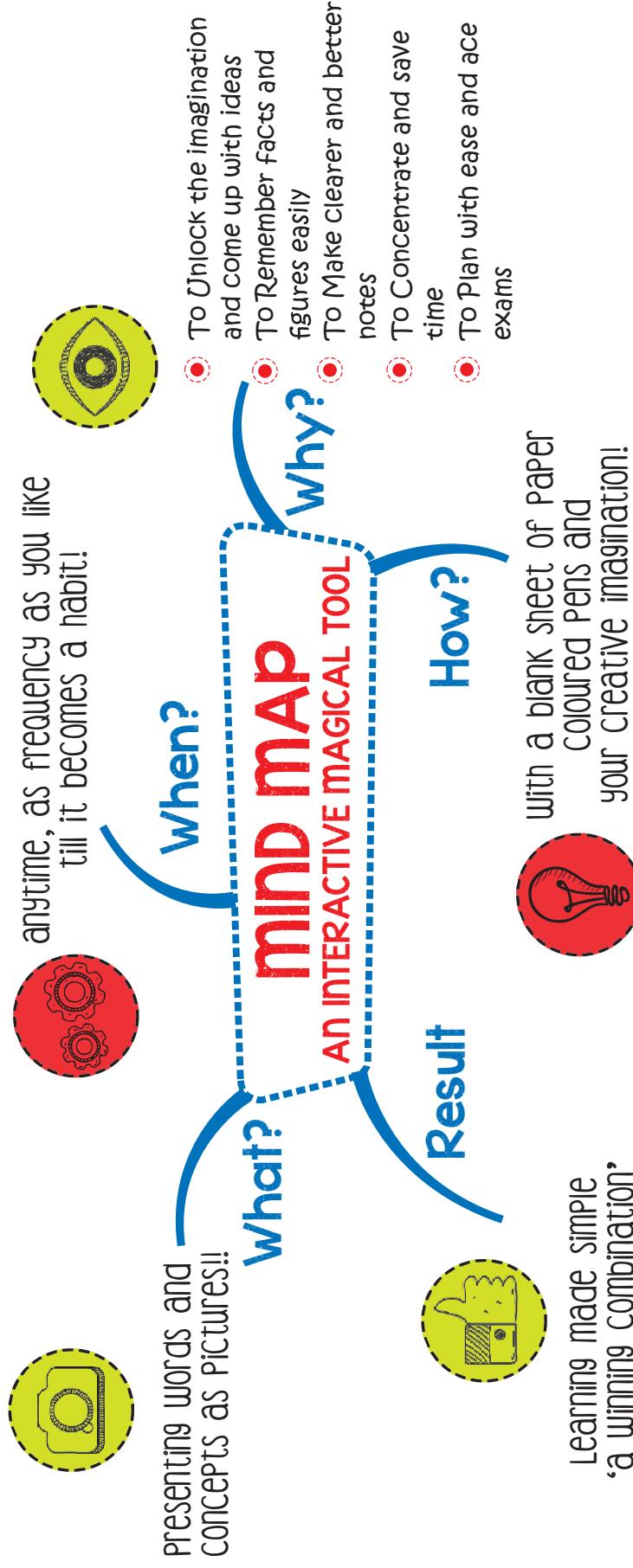
### Internal Assessment – Term I and II (10 Marks each)

- Periodic Assessment - 03 marks
- Multiple Assessment – 02 marks
- Subject Enrichment (Practical Work) - 03 marks
- Portfolio - 02 marks



# MIND mAPS

Learning MADE SIMPLE



## What are Associations?

It's a technique connecting the core concept at the Centre to related concepts or ideas. Associations spreading out straight from the core concept are the First Level of Association. Then we have a Second Level of Association emitting from the first level and the chronology continues. The thickest line is the First Level of Association and the lines keep getting thinner as we move to the subsequent levels of association. This is exactly how the brain functions, therefore these Mind Maps. Associations are one powerful memory aid connecting seemingly unrelated concepts, hence strengthening memory.

# HEAR IT FROM OUR HAPPY READERS!



Daksh Gaba  
Teacher

Good sample paper for preparation after revision. Once I finished my syllabus for boards, I used sample papers for practicing and found it really good and beneficial.

If you are confident after solving 5 solved sample papers you can practice the 5 self-assessment papers which have QR code so you can see answers and they are kind to provide hints and I think this worked for me. Excellent preparation tool for my Boards!!



Ansh  
Teacher



Oswaal Sample Question Papers are great for practice because it contains a variety of questions synchronised with the latest syllabus. Kudos to the Oswaal Editorial Team!

Shalini Mehta  
Student



Rajni  
Student

Very good test papers as per new CBSE pattern. Very good mind maps and chapter wise notes. Also, toppers answer papers for reference are extremely helpful.



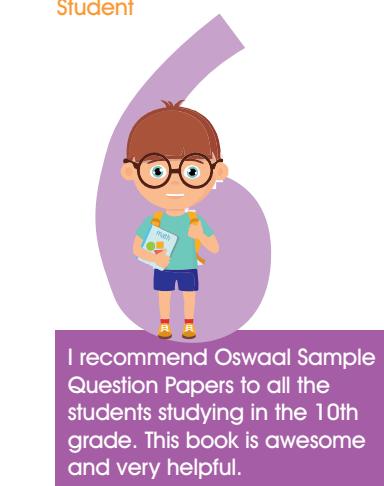
Rohan Mehra  
Teacher

This is the best book of sample papers for 10th. Best material for the board preparation. Highly Recommended!!



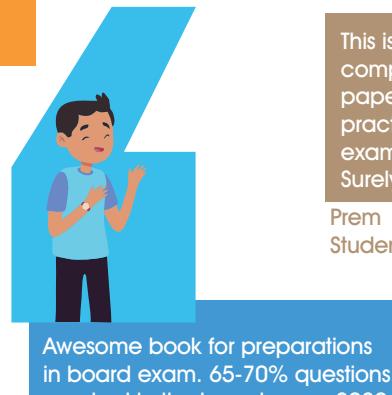
This is the best till date, I completed all the sample papers and got a good practice of writing in examination, just go for it. Surely, it will help you a lot.

Prem  
Student



I recommend Oswaal Sample Question Papers to all the students studying in the 10th grade. This book is awesome and very helpful.

Soham Roshan  
Student



Awesome book for preparations in board exam. 65-70% questions cracked in the board exam 2020 from this book.

Abhay Kumar  
Student

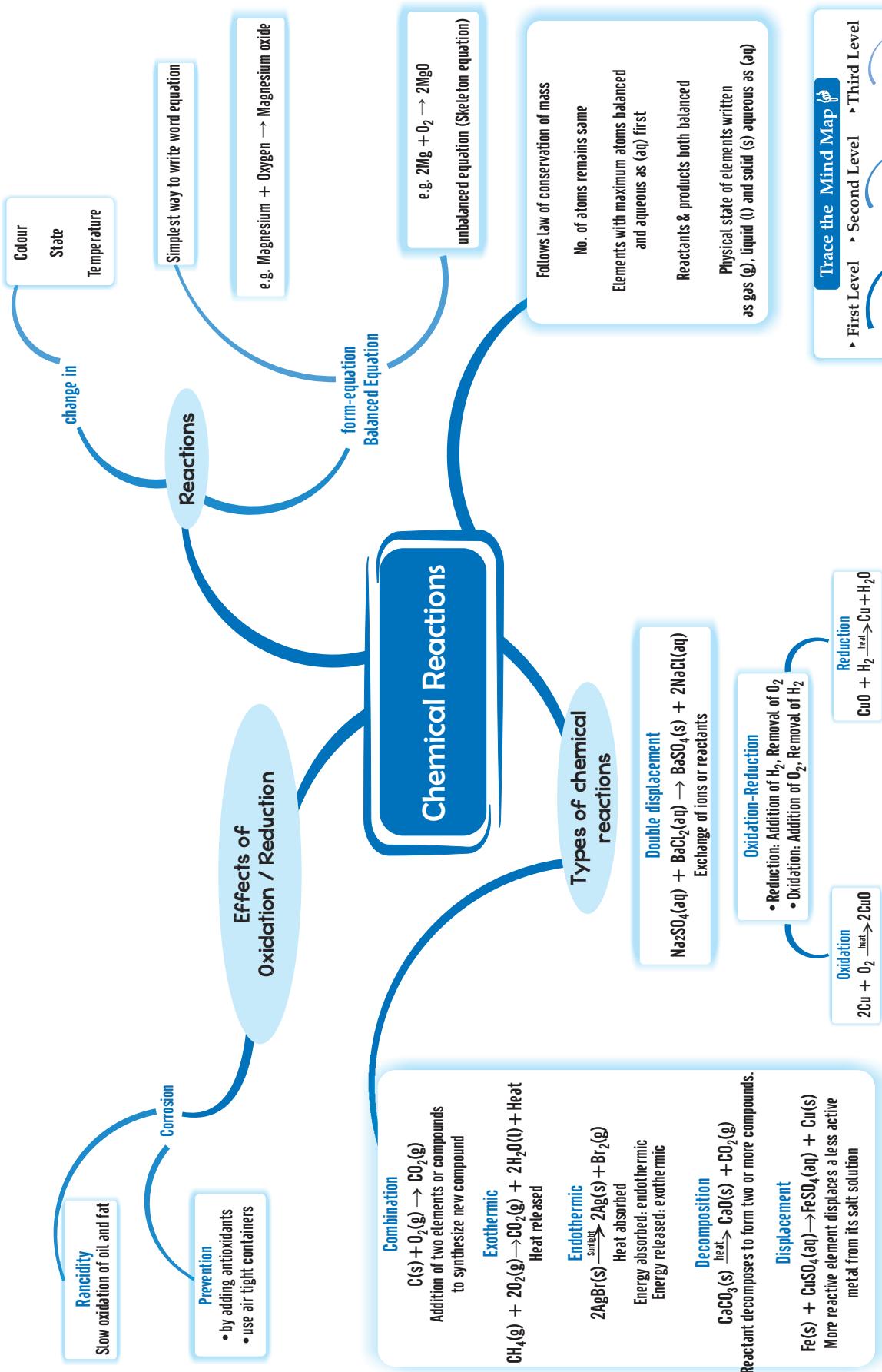


Awesome book! Class 10th students must buy it as soon as possible! Very helpful!

Neel  
Student

# WRITING NOTES

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## UNIT I: CHEMICAL SUBSTANCES: NATURE AND BEHAVIOUR

### CHAPTER

# 1

# CHEMICAL REACTIONS AND EQUATIONS

### Syllabus

*Chemical reactions: Chemical equation, balanced chemical equation, implications of a balanced chemical equation, types of chemical reactions: Combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.*



### Revision Notes

## Chemical Reactions and Equations

#### 1. A chemical reaction

- A chemical reaction is a process in which the original substance(s) loses its nature and identity and forms new substance(s) with different properties.
- Breaking of the chemical bonds and formation of new chemical bonds is responsible for the occurrence of a chemical reaction.
- The substances which take part in a chemical reaction are called **Reactants**.
- The substances which are formed in a chemical reaction are called **Products**.
- **Examples of chemical reaction:**
  - (i) Digestion of food
  - (ii) Respiration
  - (iii) Rusting of iron
  - (iv) Burning of magnesium ribbon
  - (v) Formation of curd
- A chemical reaction can be identified by either of the following observations:
  - (i) Change in state
  - (ii) Change in colour
  - (iii) Evolution of gas
  - (iv) Change in temperature
  - (v) Formation of a precipitate

#### 2. More about chemical equations:

- A chemical equation is written in the following way:
  - (i) The symbols of elements and the formulae of reacting substances (reactants) are written on the left hand side of the equation, with a plus (+) sign between them.
  - (ii) The symbols and formulae of the substances formed (products) are written on the right hand side of the equation, with a plus sign (+) between them.

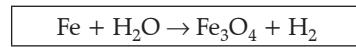
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this topic



Chemical  
Reactions

- (iii) An arrow sign ( $\rightarrow$ ) is put between the reactants and the products.
- (iv) The physical states of the reactants and products are also mentioned in a chemical equation.
- **Balanced Equation:** The equation in which atoms of various elements on both sides of a chemical equation are equal in accordance with the law of conservation of mass.
- The process of equalizing the atoms of various elements both on either sides of an equation is called the balancing of chemical equation. This is known as hit and trial method. We can balance a chemical equation by following the steps given below:

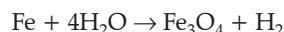
**Step 1.** Write the chemical equation and draw boxes around each formula:



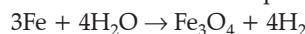
**Step 2.** Count the number of atoms of each element on both the sides of the arrow :

Element	No. of atoms at reactant side	No. of atoms at product side
1. Fe	1	3
2. H	2	2
3. O	1	4

**Step 3.** Equalize the number of the atoms of element which has the maximum number of atoms (oxygen).

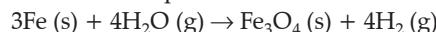


**Step 4.** Try to equalize all the atoms of elements on reactant and product side by adding coefficient in front of it.



Now, all the atoms of elements are equal on both sides.

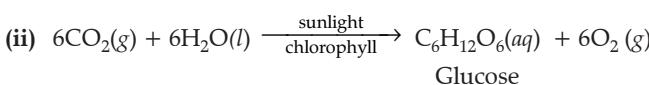
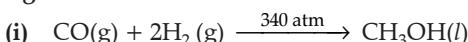
**Step 5.** Write the physical states of reactants and products.



Solid state = (s), Liquid state = (l), Gaseous state = (g), Aqueous state = (aq)

**Step 6.** Write necessary conditions of temperature, pressure or catalyst at above or below the arrow.

e.g.

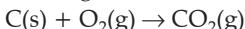


## Types of Chemical Reactions

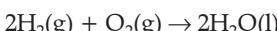
### ➤ Types of Chemical Reactions

I. **Combination Reaction:** The reaction in which two or more reactants combine to form a single product.

e.g., (i) Burning of coal



(ii) Formation of water

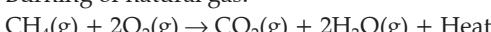


(iii)  $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{Heat}$

(Quick lime) (Slaked lime)

**Exothermic Reactions:** Reaction in which heat is released along with formation of products.

e.g., (i) Burning of natural gas.



(ii) Respiration is also an exothermic reaction.

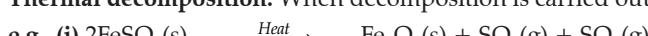


II. **Decomposition Reaction:**

The reaction in which a compound splits into two or more simpler substances is called decomposition reaction.

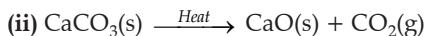


(a) **Thermal decomposition:** When decomposition is carried out by heating.



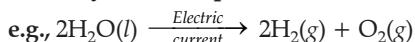
(Ferrous sulphate) (Ferric oxide)

Green colour Red-brown colour

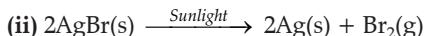
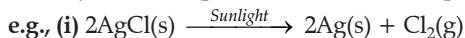


(Lime stone) (Quick lime)

(b) **Electrolytic Decomposition:** When decomposition is carried out by passing electricity.



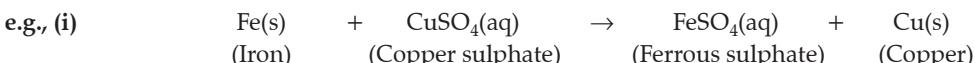
(c) **Photolytic Decomposition:** When decomposition is carried out in presence of sunlight.



This reaction is used in black and white photography.

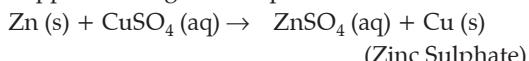
**Endothermic Reaction:** The reactions which require energy in the form of heat, light or electricity to break reactants are called endothermic reactions.

**III. Displacement Reaction:** The chemical reactions in which more reactive element displaces less reactive element from its salt solution.



The iron nail becomes brownish in colour by deposition of Cu and blue colour of  $\text{CuSO}_4$  changes into dirty green colour due to formation of  $\text{FeSO}_4$ .

(ii) Zinc displaces copper forming zinc sulphate. Zn is more reactive than copper.



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this topic



Displacement  
Reaction

**IV. Double Displacement Reaction:** A reaction in which new compounds are formed by mutual exchange of ions between two compounds.



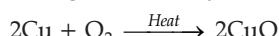
White precipitate of  $\text{BaSO}_4$  is formed, so it is also called precipitation reaction.

**V. Oxidation and Reduction:**

**Oxidation:** Loss of electrons

**Reduction:** Gain of electrons

**Oxidation:** It is a process of gaining oxygen during a reaction by an atom, molecule or ion.



**Reduction:** It is the gain of electrons or a decrease in the oxidation state of an atom by another atom, an ion or a molecule.



In this reaction,  $\text{CuO}$  is reduced to  $\text{Cu}$  and  $\text{H}_2$  is oxidised to  $\text{H}_2\text{O}$ . In other words, one reactant gets oxidised while the other gets reduced. Such reactions are called oxidation-reduction reactions or redox reactions.



## Mnemonics

Concept: Types of chemical reactions	Concept: Types of decomposition reaction
Mnemonics: ROC. D <sup>3</sup>	Mnemonics: PET
<b>Interpretation:</b> Reduction Oxidation Combination Decomposition Displacement Double Displacement	<b>Interpretation:</b> Photolytic reaction, Electrolytic reaction, Thermal reaction

<b>Concept: Oxidation and reduction reaction</b>	<b>Concept: Preventive ways of rusting</b>
Mnemonics: <b>OIL RIG</b>	Mnemonics: <b>POGG</b>
<b>Interpretation:</b> <b>Oxidation:</b> Loss of electrons <b>Reduction:</b> Gain of electrons	<b>Interpretation:</b> <b>Painting Oil Greasing Galvanising</b>

## Know the Terms

- **Chemical equation:** It is a complete symbolic representation of a chemical reaction involving reactants and products.
- **Electrolysis:** When a decomposition reaction is carried out with the help of electric current, the process is called electrolysis.
- **Redox reaction:** Those reactions in which oxidation and reduction take place simultaneously are called **redox reactions**.
- **Oxidising agent:** It is a substance which can add oxygen or an electronegative element to other materials. It can also remove hydrogen or an electropositive element from other materials.
- **Reducing agent:** It is a substance which can add hydrogen or an electropositive element to other materials. It can also remove oxygen or an electronegative element from other materials.



## STAND ALONE MCQs

(1 Mark each)

- Q. 1.** Which of the following is not a physical change?  
 (A) Boiling of water to give water vapour  
 (B) Melting of ice to give water  
 (C) Dissolution of salt in water  
 (D) Combustion of liquified petroleum gas (LPG)

**Ans. Option (D) is correct.**

**Explanation:** During combustion of liquified petroleum gas (LPG), it forms CO<sub>2</sub> and H<sub>2</sub>O.

- Q. 2.** Which one of the following processes involve chemical reactions?  
 (A) Storing of oxygen gas under pressure in a gas cylinder  
 (B) Liquification of air  
 (C) Keeping petrol in a china dish in the open  
 (D) Heating copper wire in presence of air at high temperature

**Ans. Option (D) is correct.**

**Explanation:** Chemical changes involve formation of new compounds from one or more substances. On heating copper wire in presence of air at high temperature copper (II) oxide is formed.

- Q. 3.** In which of the following chemical equations, the abbreviations represent the correct states of the reactants and products involved at reaction temperature?  
 (A) 2H<sub>2</sub>(l) + O<sub>2</sub>(l) → 2H<sub>2</sub>O(g)  
 (B) 2H<sub>2</sub>(g) + O<sub>2</sub>(l) → 2H<sub>2</sub>O(l)

(C) 2H<sub>2</sub>(g) + O<sub>2</sub>(g) → 2H<sub>2</sub>O(l)

(D) 2H<sub>2</sub>(g) + O<sub>2</sub>(g) → 2H<sub>2</sub>O(g)

**Ans. Option (C) is correct.**

**Explanation:** It is because, the standard state for hydrogen and oxygen is gas and for water is liquid at reaction temperature.

- Q. 4.** The reaction in which a substance or substances undergo change to produce new substances with new properties is called  
 (A) A biochemical reaction  
 (B) A nuclear reaction  
 (C) A physical reaction  
 (D) A chemical reaction

**Ans. Option (D) is correct.**

**Explanation:** A reaction in which a substance is changed to one or more new substances is called a chemical reaction.

- Q. 5.** Which of the following conditions is necessary for a chemical reaction?  
 (A) It must be accompanied with change in temperature and pressure.  
 (B) At least one of the reactants must be in a fixed quantity.  
 (C) It must follow the law of conservation of mass.  
 (D) All of the above.

**Ans. Option (C) is correct.**

**Explanation:** A chemical reaction must follow the law of conservation of mass.

**Q. 6.** There is an equation 'X', which contains equal number of atoms of each element on both the sides. What is 'X'?

- (A) A balanced equation
- (B) An unbalanced equation
- (C) A chemical equation
- (D) All of the above

**Ans. Option (A) is correct.**

**Explanation:** A balanced equation is the one in which the atoms of every element will be the same on both the sides of the equation.

**Q. 7.** Which among the following is not a physical change?

- (A) Evaporation of petrol
- (B) Burning of liquified petroleum gas (LPG)
- (C) Heating of an iron rod to red hot.
- (D) Sublimation of solid ammonium chloride

**Ans. Option (B) is correct.**

**Explanation:** Changes which are temporary with no new substance being formed, are known as physical changes.

Change in which one or more new substances are formed is known as chemical change.

**Q. 8.** In the given equation, what does 'X' stand for?

- $$(2)\text{Al} + (\text{X})\text{H}_2\text{SO}_4 \longrightarrow \text{Al}_2(\text{SO}_4)_3 + (3)\text{H}_2$$
- (A) 2
  - (B) 3
  - (C) 1
  - (D) 5

**Ans. Option (B) is correct.**

**Explanation:** The X value is 3 because, to balance the given equation, the number of atoms of each element should be same on both the sides.



**Q. 9.** Which of the following reactions is an endothermic reaction?

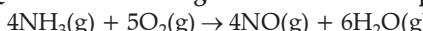
- (A) Burning of coal.
- (B) Decomposition of vegetable matter into compost.
- (C) Process of respiration.
- (D) Decomposition of calcium carbonate to form quick lime and carbon dioxide.

**[Board SQP, 2020]**

**Ans. Option (D) is correct.**

**Explanation:** The reactions which require energy in the form of heat, light or electricity to break reactants are called endothermic reactions.

**Q. 10.** The following reaction is an example of a



- (i) Displacement reaction
  - (ii) Combination reaction
  - (iii) Redox reaction
  - (iv) Neutralisation reaction
- (A) (i) and (iv)
  - (B) (ii) and (iii)
  - (C) (i) and (iii)
  - (D) (iii) and (iv)

**Ans. Option (B) is correct.**

**Explanation :** The given reaction is a redox reaction because oxidation and reduction both take place simultaneously. Also, it is a displacement reaction because hydrogen of  $\text{NH}_3$  has been displaced by oxygen.

**AT Q. 11.** Three beakers labelled as A, B and C each containing 25 mL of water were taken. A small amount of NaOH, anhydrous  $\text{CuSO}_4$  and  $\text{NaCl}$  were added to the beakers A, B and C respectively. It was observed that there was an increase in the temperature of the solutions contained in beakers A and B, whereas in case of beaker C, the temperature of the solution falls. Which one of the following statement(s) is (are) correct?

- (i) In beakers A and B, exothermic process has occurred.
  - (ii) In beakers A and B, endothermic process has occurred.
  - (iii) In beaker C, exothermic process has occurred.
  - (iv) In beaker C, endothermic process has occurred.
- (A) (i) only
  - (B) (ii) only
  - (C) (i) and (iv)
  - (D) (ii) and (iii)

**Ans. Option (C) is correct.**

**Explanation:** In beakers A and B, heat is given out, so the temperature of the solution increases, hence it is an exothermic reaction while in beaker C, heat is absorbed from water, so temperature falls, hence it is an endothermic process.

**Q. 12.** A dilute ferrous sulphate solution was gradually added to the beaker containing acidified permanganate solution. The light purple colour of the solution fades and finally disappears. Which of the following is the correct explanation for the observation?

- (A)  $\text{KMnO}_4$  is an oxidising agent, it oxidises  $\text{FeSO}_4$ .
- (B)  $\text{FeSO}_4$  acts as an oxidising agent and oxidises  $\text{KMnO}_4$ .
- (C) The colour disappears due to dilution; no reaction is involved.
- (D)  $\text{KMnO}_4$  is an unstable compound and decomposes in presence of  $\text{FeSO}_4$  to a colourless compound.

**Ans. Option (A) is correct.**

**Explanation:** A dilute ferrous sulphate solution was gradually added to the beaker containing acidified permanganate solution. A permanganate solution is usually purple in colour. The light purple colour of the solution fades and finally disappears. This is because potassium permanganate ( $\text{KMnO}_4$ ) is relatively an unstable compound, it tends to decompose in the presence of ferrous sulphate ( $\text{FeSO}_4$ ). This changes the colour of the solution from purple to colourless.  $\text{FeSO}_4$  gets oxidised to  $\text{Fe}_2(\text{SO}_4)_3$  as  $\text{KMnO}_4$  acts as a good oxidising agent in an acidic medium.

**Q. 13.** Which among the following is (are) double displacement reaction(s)?

- (i)  $\text{Pb} + \text{CuCl}_2 \rightarrow \text{PbCl}_2 + \text{Cu}$
- (ii)  $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$
- (iii)  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- (iv)  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

- (A) (i) and (iv)
- (B) (ii) only
- (C) (i) and (ii)
- (D) (iii) and (iv)

[U]

**Ans. Option (B) is correct.**

**Explanation:** Double displacement reaction is the reaction in which two different atoms or group of atoms are mutually exchanged. In this reaction ( $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$ ), sodium and barium were mutually exchanged.

**AI Q. 14.** Barium chloride on reacting with ammonium sulphate forms barium sulphate and ammonium chloride. Which of the following correctly represents the type of the reaction involved?

- (i) Displacement reaction
- (ii) Precipitation reaction
- (iii) Combination reaction
- (iv) Double displacement reaction

- (A) (i) only
- (B) (ii) only
- (C) (iv) only
- (D) (ii) and (iv)

**Ans. Option (D) is correct.**

**Explanation:** The reaction is a double displacement reaction as :



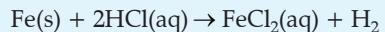
It is also called precipitation reaction due to the formation of white precipitate of barium sulphate.

**Q. 15.** What happens when dilute hydrochloric acid is added to iron filings? Choose the correct answer.

- (A) Hydrogen gas and iron chloride are produced.
- (B) Chlorine gas and iron hydroxide are produced.
- (C) No reaction takes place.
- (D) Iron salt and water are produced.

**Ans. Option (A) is correct.**

**Explanation:** When dilute hydrochloric acid is added to iron filings, hydrogen gas and iron chloride are produced. The reaction is as follows :



**Q. 16.** Which among the following statement(s) is (are) true? Exposure of silver chloride to sunlight for a long duration turns grey due to

- (i) The formation of silver by decomposition of silver chloride
- (ii) Sublimation of silver chloride
- (iii) Decomposition of chlorine gas from silver chloride
- (iv) Oxidation of silver chloride

- (A) (i) only
- (B) (i) and (iii)
- (C) (ii) and (iii)
- (D) (iv) only

**Ans. Option (A) is correct.**

**Explanation:** In the presence of sunlight, the heavy amount of energy of light decomposes  $\text{AgCl}$  to silver ( $\text{Ag}^+$ ) and chloride ( $\text{Cl}^-$ ) ions. The silver flakes are truly black which when fully spread over white silver chloride looks grey.



## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

- (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 true but R is false.
- (D) A is false and R is true.

**Q. 1. Assertion (A):** Carbon dioxide turns lime water milky.

**Reason (R):** Carbon dioxide sullies the water.

**Ans. Option (C) is correct.**

**Explanation:** Carbon dioxide reacts with lime water (calcium hydroxide) to form milky precipitate of calcium carbonate.

**Q. 2. Assertion (A):** A chemical reaction becomes faster at higher temperatures.

**Reason (R):** At higher temperatures, molecular motion becomes more rapid.

**Ans. Option (A) is correct.**

**Explanation:** A chemical reaction becomes faster at higher temperatures because at high temperature, the movement of particles are greater.

**Q. 3. Assertion (A):** After white washing the walls, a shiny white finish on walls is obtained after two to three days.

**Reason (R):** Calcium oxide reacts with carbon dioxide to form calcium hydrogen carbonate which gives shiny white finish.

**Ans. Option (C) is correct.**

**Explanation:** Calcium hydroxide is present in whitewash. It reacts slowly with the carbon dioxide in air to form a thin layer of calcium carbonate on the walls. Calcium carbonate is formed after two to three days of white washing. Hence the shiny white finish appears after two to three days on the walls.

**Q. 4. Assertion (A):** Burning of candle is a physical change.

**Reason (R):** In physical change, no new substance is formed.

**Ans. Option (D) is correct.**

**Explanation:** Burning of candle is chemical change. Burning of candle melts the wax and hence physical state of wax has changed from solid to liquid. Again the wax combines with the atmosphere oxygen and changes to carbon dioxide, heat and light.

**Q. 5. Assertion (A):** Sodium metal is stored under kerosene.

**Reason (R):** Metallic sodium melts when exposed to air.

**Ans. Option (C) is correct.**

**Explanation:** Sodium is a very reactive metal. It is kept in kerosene to prevent it from coming in contact with oxygen and moisture. If this happens, it will react with the moisture present in air and form sodium hydroxide. This is a strongly exothermic reaction, and lot of heat is generated.

**Q. 6. Assertion (A):** To dilute sulphuric acid, acid is added to water and not water to acid.

**Reason (R):** Specific heat of water is quite large.

**Ans. Option (A) is correct.**

**Explanation:** The mixing of water to an acid is highly exothermic in nature. If water is added to an acid it produces very large amount of heat which can break the container and sometimes even causes burning. So it is advised to add concentrated acid to water in very slow manner.

**Q. 7. Assertion:** In the reaction :



HCl is getting oxidized while  $\text{MnO}_2$  is getting reduced.

**Reason:** The process in which oxygen is added to a substance is called oxidation.

whereas the process in which oxygen is removed from a substance is called reduction.

**Ans. Option (A) is correct.**

**Explanation:** In the given reaction, HCl is oxidized to  $\text{Cl}_2$  while  $\text{MnO}_2$  is reduced to  $\text{MnCl}_2$ .

**Q. 8. Assertion (A):** Chips manufacturers usually flush bags of chips with gas such as nitrogen.

**Reason (R):** Nitrogen gas prevents the oil and fats of the chips from being oxidized.

**Ans. Option (A) is correct.**

**Explanation:** Chips manufacturers usually flush bags of chips with gas such as nitrogen to prevent the oil and fats of the chips from being oxidized or become rancid.



## CASE-BASED MCQs

Attempt any 4 sub-parts from each question.  
Each sub-part carries 1 mark.

I. Read the following and answer any four questions from Q.1. to Q.5. [CBSE QB 2021]

Marble's popularity began in ancient Rome and Greece, where white and off-white marble were used to construct a variety of structures, from handheld sculptures to massive pillars and buildings.



**Q. 1.** The substance not likely to contain  $\text{CaCO}_3$  is

- (A) Dolomite
- (B) A marble statue

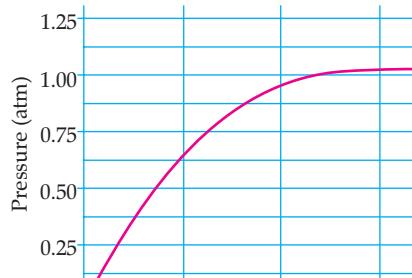
(C) Calcined gypsum

(D) Sea shells.

**Ans. Option (C) is correct.**

**Explanation:** The composition of gypsum is  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ . It does not have  $\text{CaCO}_3$ .

**Q. 2.** A student added 10g of calcium carbonate in a rigid container, secured it tightly and started to heat it. After some time, an increase in pressure was observed, the pressure reading was then noted at intervals of 5 minutes and plotted against time, in a graph as shown below. During which time interval did maximum decomposition took place?



- (A) 15-20 min      (B) 10-15 min  
 (C) 5-10 min      (D) 0-5 min

**Ans.** Option (D) is correct.

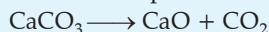
**Explanation:** The maximum decomposition is when the pressure is maximum. As we can see in graph that from 0 to 5 minutes, the pressure increases from 0 to 0.625 atm.

**Q. 3.** Gas A, obtained above is a reactant for a very important biochemical process which occurs in the presence of sunlight. Identify the name of the process -

- (A) Respiration      (B) Photosynthesis  
 (C) Transpiration    (D) Photolysis

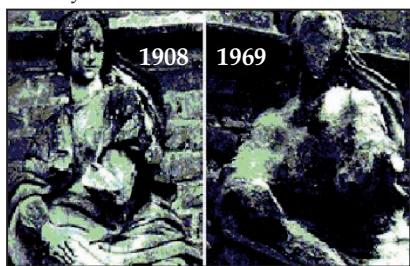
**Ans.** Option (B) is correct.

**Explanation:** When  $\text{CaCO}_3$  is heated, the following reaction takes place:



The gas evolved is carbon dioxide, which is utilised in the process of photosynthesis.

**Q. 4.** Marble statues are corroded or stained rain water. Identify the main reason.



- (A) decomposition of calcium carbonate to calcium oxide  
 (B) polluted water is basic in nature hence it reacts with calcium carbonate  
 (C) polluted water is acidic in nature hence it reacts with calcium carbonate  
 (D) calcium carbonate dissolves in water to give calcium hydroxide.

**Ans.** Option (B) is correct.

**Explanation:** Chemically, marble is Calcium Carbonate.

The atmosphere contains many oxides, which dissolve in water forming acids like sulfuric; nitric which are common due to modern pollution. Even carbon dioxide forms carbonic acid which also does damage.

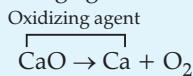
These will react with marble and result in formation of calcium salt, carbon dioxide and water. So, under extended periods, the wear of marble statues is expected.

**Q. 5.** Calcium oxide can be reduced to calcium, by heating with sodium metal. Which compound would act as an oxidizing agent in the above process?

- (A) sodium      (B) sodium oxide  
 (C) calcium      (D) calcium oxide

**Ans.** Option (D) is correct.

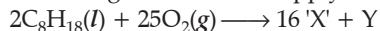
**Explanation:** A substance that undergoes reduction is an oxidizing agent. Here,  $\text{CaO}$  is losing oxygen and undergoing reduction. So,  $\text{CaO}$  is the oxidizing agent.



**II. Read the following and answer any four questions from Q.1. to Q.5.** [CBSE QB 2021]

**Chemistry in Automobiles:**

For an internal combustion engine to move a vehicle down the road, it must convert the energy stored in the fuel into mechanical energy to drive the wheels. In your car, the distributor and battery provide this starting energy by creating an electrical "spark", which helps in combustion of fuels like gasoline. Below is the reaction depicting complete combustion of gasoline in full supply of air:



**Q. 1.** Which of the following are the products obtained from the reaction mentioned in the above case?

Product 'X' Product 'Y'

- |                            |                        |
|----------------------------|------------------------|
| (A) $\text{CO}_2$          | $\text{H}_2\text{O}_2$ |
| (B) $\text{H}_2\text{O}$   | $\text{CO}$            |
| (C) $\text{CH}_3\text{OH}$ | $\text{H}_2\text{O}$   |
| (D) $\text{CO}_2$          | $\text{H}_2\text{O}$   |

**Ans.** Option (D) is correct.

**Explanation:** The complete combustion of gasoline in full supply of air results in production of carbon dioxide and water. The chemical reaction is as follows:



**Q. 2.** Identify the types of chemical reaction occurring during the combustion of fuel:

- (A) Oxidation & Endothermic reaction  
 (B) Decomposition & Exothermic reaction  
 (C) Oxidation & Exothermic reaction  
 (D) Combination & Endothermic reaction

**Ans.** Option (C) is correct.

**Explanation:** The addition of oxygen to a substance or removal of hydrogen from a substance is called oxidation. The reaction in which the heat energy is produced is called exothermic reaction.

**Q. 3.** On the basis of evolution/absorption of energy, which of the following processes are similar to combustion of fuel?

- (i) Photosynthesis in plants
  - (ii) Respiration in the human body
  - (iii) Decomposition of vegetable matter
  - (iv) Decomposition of ferrous sulphate.
- |                  |                |
|------------------|----------------|
| (A) (ii) & (iii) | (B) (i) & (ii) |
| (C) (iii) & (iv) | (D) (ii) & (i) |

**Ans.** Option (A) is correct.

**Explanation:** The process of respiration in the human body and decomposition of vegetable matter involves evolution of energy.

- Q. 4.** 'A student while walking on the road observed that a cloud of black smoke belched out from the exhaust stack of moving trucks on the road.' Choose the correct reason for the production of black smoke:
- Limited supply of air leads to incomplete combustion of fuel.
  - Rich supply of air leads to complete combustion of fuel.
  - Rich supply of air leads to a combination reaction.
  - Limited supply of air leads to complete combustion of fuel.

**Ans. Option (A) is correct.**

**Explanation:** The limited supply of air leads to incomplete combustion of fuel, which in turn leads to the production of black smoke.

- Q. 5.** 'Although nitrogen is the most abundant gas in the atmosphere, it does not combust'. Identify the correct reason for this statement.
- Nitrogen is a reactive gas
  - Nitrogen is an inert gas
  - Nitrogen is an explosive gas
  - Only hydrocarbons can take part in combustion

**Ans. Option (B) is correct.**

**Explanation:** The triple bond in nitrogen is too strong to be broken and hence it is an inert gas which does not take part in combustion.

### III. Read the given passage and answer any four questions from Q.1 to Q.5.

The physical states of the reactants and products can be represented by using the symbols (s) for solids, (l) for liquids, (g) for gases and (aq) for aqueous solution along with their respective formulae. The word aqueous is written if the reactant or product is present as a solution in water. Precipitate can also be represented by using an arrow pointing downwards ( $\downarrow$ ) instead of using symbol (s).

In the same way, the gaseous state of an evolved gas can be represented by using an arrow pointing upward direction ( $\uparrow$ ) instead of using symbol (g). The specific condition of the reaction like temperature, pressure, catalyst etc. is written above or below the arrow in the chemical equation.

- Q. 1.** If the reactant or product is present as a solution of water, it is represented as:

- (s)
- (l)
- (aq)
- $\downarrow$

**Ans. Option (C) is correct.**

**Explanation:** The word aqueous is written if the reactant or product is present as a solution in water.

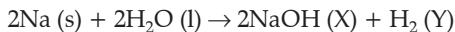
- Q. 2.** The correct way to represent the evolution of gas, is to use which of the following symbol:

- $\downarrow$
- $\rightarrow$
- $\uparrow$
- (g)

**Ans. Option (C) is correct.**

**Explanation:** The gaseous state of an evolved gas can be represented by using an arrow pointing upward direction ( $\uparrow$ ) instead of using symbol (g).

- Q. 3.** Complete the missing variable given as X and Y in the following reaction:



- (aq) and (g)
- (s) and (g)
- (g) and (l)
- (g) and (aq)

**Ans. Option (A) is correct.**

**Explanation:** Explanation: The complete reaction is :



- Q. 4.** Which of the following reaction is balanced?

- $\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 2\text{Cl}_2 + \text{H}_2$
- $2\text{NaCl} + \text{H}_2\text{O} \rightarrow 2\text{NaOH} + 2\text{Cl}_2 + \text{H}_2$
- $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$
- $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow \text{NaOH} + \text{Cl}_2 + \text{H}_2$

**Ans. Option (C) is correct.**

**Explanation:** The equation in which atoms of various elements on both sides of a chemical equation are equal in accordance with the law of conservation of mass are said to be balanced. Hence,  $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$  represents the correct balanced equation.

- Q. 5.** Which of the following reaction is balanced?

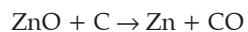
- $\text{Mg}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2\uparrow$
- $\text{Mg}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2\uparrow$
- $\text{Mg}(\text{s}) + \text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{MgSO}_4(\text{l}) + \text{H}_2(\text{g})$
- $\text{Mg}(\text{s}) + \text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{MgSO}_4(\text{s}) + \text{H}_2$

**Ans. Option (B) is correct.**

**Explanation:**  $\text{Mg}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2\uparrow$  is the balanced chemical reaction. A balanced equation is the one in which the atoms of every element will be the same on both the sides of the equation.

### IV. Read the given passage and answer any four questions from Q.1 to Q.5.

In the following chemical reaction "zinc oxide reacts with carbon to produce zinc metal and carbon monoxide."



- Q. 1.** Name the substance getting oxidised and reduced in the above reaction: [R]

- C and ZnO
- Zn and C
- ZnO and CO
- CO and ZnO

**Ans. Option (A) is correct.**

**Explanation:** C is getting oxidized to CO, ZnO is getting reduced to Zn, as carbon is gaining oxygen and ZnO is losing oxygen.

- Q. 2.** Name the type of reaction: [U]

- oxidation reaction

- (B) reduction reaction  
 (C) redox reaction  
 (D) decomposition reaction

**Ans.** Option (C) is correct.

**Explanation:** It is a redox reaction or oxidation and reduction reaction.

**Q. 3.** The reduction reaction involves: R

- (A) gain of electrons  
 (B) loss of electrons  
 (C) increase in oxidation state  
 (D) addition of oxygen

**Ans.** Option (A) is correct.

**Explanation:** Reduction is just reverse of oxidation. It is the process of gain of electron and losing oxygen or gaining hydrogen.

**Q. 4.** Which of the following is the effect of oxidation reaction in everyday life:

- (A) Precipitation  
 (B) Fermentation  
 (C) Corrosion  
 (D) Hydrogenation of oil

**Ans.** Option (C) is correct.

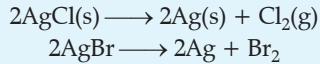
**Explanation:** Corrosion is a process in which metals are deteriorated by action of air, moisture, chemicals etc. It is a redox reaction where metal gets oxidised to metal oxide and oxygen gets reduced to oxide ion.

**Q. 5.** The reactions used in black and white photography: R

- (A) Decomposition of silver bromide  
 (B) Decomposition of silver chloride  
 (C) Both  
 (D) None of the above

**Ans.** Option (C) is correct.

**Explanation:** Decomposition reactions of silver chloride and silver bromide in presence of sunlight are used in black and white photography.



**V. P, Q and R are three elements which undergo chemical reactions according to the following equations. Answer any four question from Q.1 to Q.5.**

- (i)  $\text{P}_2\text{O}_3 + 2\text{Q} \rightarrow \text{Q}_2\text{O}_3 + 2\text{P}$   
 (ii)  $3\text{RSO}_4 + 2\text{Q} \rightarrow \text{Q}_2(\text{SO}_4)_3 + 3\text{R}$   
 (iii)  $3\text{RO} + 2\text{P} \rightarrow \text{P}_2\text{O}_3 + 3\text{R}$

**Q. 1.** The most reactive and the least reactive elements are: U

- (A) Q and P                    (B) Q and R  
 (C) R and Q                    (D) R and P

**Ans.** Option (B) is correct.

**Explanation:** Q is the most reactive as it has replaced both P and R from their compounds and R is least reactive element as it has been replaced by both P and Q.

**Q. 2.** The type of reaction is : R

- (A) Displacement reaction  
 (B) Combination reaction  
 (C) Neutralisation reaction  
 (D) Substitution reaction

**Ans.** Option (A) is correct.

**Explanation:** Displacement reaction is a type of reaction in which more active element displaces a less reactive element from its compound.

**Q. 3.**  $3\text{RSO}_4 + 2\text{Q} \rightarrow \text{Q}_2(\text{SO}_4)_3 + 3\text{R}$

The given reaction shows: AE

- (A) Q is more reactive than R  
 (B) Q is less reactive than R  
 (C) Q and R are equally reactive  
 (D) none of the above

**Ans.** Option (A) is correct.

**Explanation:** The given reaction shows that Q is the most reactive as it has replaced both P and R from their compounds.

**Q. 4.** Choose the correct statement: U

- (A) Zinc and lead are more reactive elements than copper.  
 (B) Zinc and lead are less reactive elements than copper.  
 (C) Zinc and copper are more reactive elements than lead.  
 (D) Copper and lead are more reactive elements than zinc.

**Ans.** Option (A) is correct.

**Explanation:** A more reactive metal has a tendency to get oxidized and a less reactive metal ion has a tendency to get reduced. Therefore, a more reactive metal displaces a less reactive metal from its salt solution.

**Q. 5.**  $\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$

The above reaction is an example of: R

- (A) Double displacement reaction.  
 (B) Displacement reaction.  
 (C) Can be both.  
 (D) None of the above.

**Ans.** Option (A) is correct.

**Explanation:** Double displacement reaction is a reaction in which two different ions or group of atoms in the reactant molecules are displaced by each other.  $\text{Na}^+$  being more reactive than  $\text{Ba}^{2+}$  displaces  $\text{Ba}^{2+}$  from its compound  $\text{BaCl}_2$  and form  $\text{NaCl}$ .

VI. The following diagram displays a chemical reaction. Observe carefully and answer any four questions from Q.1 to Q.5.



**Q. 1.** The type of chemical reaction that will take place is

- (A) Photochemical decomposition
  - (B) Displacement reaction
  - (C) Reduction reaction
  - (D) Combination reaction

**Ans.** Option (A) is correct.

**Explanation:** The type of chemical reaction that will take place is photochemical decomposition. This is a type of decomposition reaction which involves the use of light energy for decomposition.

**Q. 2.** What colour change is observed in silver chloride?

- (A) Silver chloride turns white.
  - (B) Silver chloride turns brown.
  - (C) Silver chloride shows no colour change.
  - (D) White silver chloride changes to grey.

**Ans.** Option (A) is correct.

**Explanation:** When silver chloride is exposed to sunlight, it decomposes to give silver metal and chlorine gas. In this reaction white color of silver chloride changes to grayish white due to the formation of silver metal.

**Q. 3.** The correct balanced chemical equation involves:

(A)  $2\text{AgCl}(\text{s}) \xrightarrow{\text{sunlight}} 2\text{Ag}(\text{s}) + \text{Cl}_2(\text{g})$

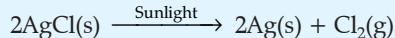
(B)  $\text{Ag} + \text{Cl} \rightarrow \text{AgCl}$

(C)  $\text{AgCl}_2 \rightarrow \text{Ag}_2 + \text{Cl}_2$

(D)  $\text{Ag}_2\text{Cl} \xrightarrow{\text{sunlight}} 2\text{Ag} + \text{Cl}_2$

**Ans.** Option (A) is correct.

**Explanation:** The decomposition reaction of silver chloride into silver and chlorine by light can be depicted as:



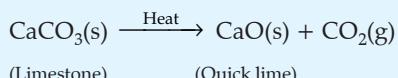
**Q. 4.** When decomposition is carried out by heating, it is called as:

- (A) Heat decomposition
  - (B) Photolytic decomposition
  - (C) Electrolytic decomposition
  - (D) Thermal decomposition

**Ans.** Option (D) is correct.

**Explanation:** Thermal decomposition reaction uses the energy in the form of heat. For example,

Calcium carbonate on heating decomposes to give calcium oxide and carbon dioxide.

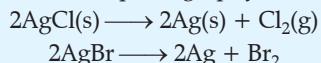


**Q.5.** The other silver salt which behaves like silver chloride in sunlight is: [U]

- (A) silver hydride
  - (B) silver bromide
  - (C) silver iodide
  - (D) silver nitrite

Ans. Option (B) is correct.

**Explanation:** silver bromide gives silver metal and bromine gas on photolytic decomposition. Decomposition reactions of silver chloride and silver bromide in presence of sunlight are used in black and white photography.

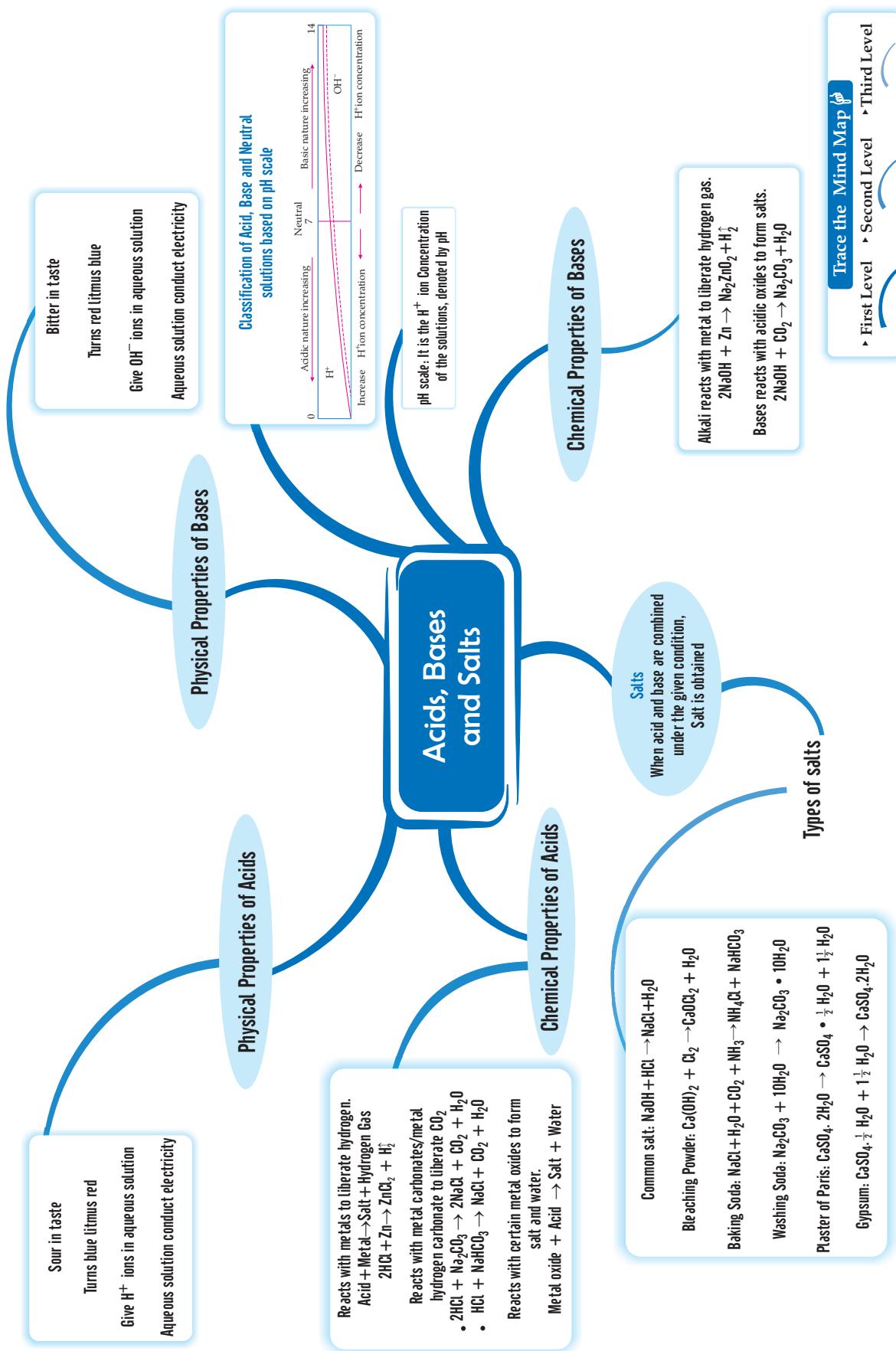


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## CHAPTER

# 2

# ACIDS, BASES AND SALTS

## Syllabus

*Acids, bases and salts: Their definitions in terms of furnishing of  $H^+$  and  $OH^-$  ions, general properties, examples and uses, concept of pH scale (Definition relating to logarithm not required), importance of pH in everyday life; preparation and uses of Sodium Hydroxide, Bleaching powder, Baking soda, Washing soda and Plaster of Paris.*



## Revision Notes

## Acids and Bases

### Introduction

- Acids are sour in taste. They turn blue litmus red. Acids are the substances that furnish  $H^+$  ions in aqueous solution.
- If in an aqueous solution, concentration of acid is low, it is called **dilute solution** and if concentration of acid is high, it is called **concentrated solution**.
- Hydrochloric acid is released in stomach to make medium acidic in nature. It leads to coagulation of protein and helps in their digestion. HCl kills bacteria coming in the stomach along with the food.
- When a burning matchstick is brought near the hydrogen gas, it burns with a pop sound.
- When  $CO_2$  gas is passed through lime water, it turns milky. If  $CO_2$  is passed in excess, milkiness disappears.
- There are many natural substances like red onion peels, red cabbage leaves, beetroot extract, coloured petals of some flowers, which are called indicators because they indicate the presence of acid or base by showing the change in colour.
- Acids react with certain metal oxides to form salt and water. Acids react with metal carbonates and hydrogen carbonates to produce carbon dioxide gas.
- Strong bases react with active metals to produce hydrogen gas. Bases react with non-metallic oxides to produce salt and water.
- Both acids and bases conduct free electric current in their aqueous solution due to the presence of free ions.
- Strength of an acid or base depends on the number of  $H^+$  ions or  $OH^-$  ions produced by them respectively. More the  $H^+$  ions produced by an acid, stronger is the acid. More the  $OH^-$  ions produced by a base, stronger is the base.

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Acid

- **Indicators:** These are the substances which change their colour / smell in different types of substances.
- **Types of Indicators:**

S. No.	Indicator	Smell/Colour In Acid Solution	Smell/Colour In Basic Solution
Natural Indicator	1. Litmus	Red	Blue
	2. Red cabbage leaf extract	Red	Green
	3. Flowers of hydrangea plant	Blue	Pink
	4. Turmeric	No change	Red
Synthetic Indicator	1. Phenolphthalein	Colourless	Pink
	2. Methyl orange	Red	Yellow
	3. Onion	Characteristic smell	No smell
Olfactory Indicator	1. Vanilla essence	Retains smell	No smell
	2. Clove oil	Retains smell	Loses smell
	3.		

➤ **Chemical Properties of Acids and Bases:**

**1. Reaction of Metals with:**

Acids	Bases
Acid + Metal → Salt + Hydrogen gas	Base + Metal → Salt + Hydrogen gas
e.g., $2\text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2\uparrow$ (Zinc chloride)	e.g., $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\uparrow$ (Sodium zincate)

**Test for H<sub>2</sub> gas:** Hydrogen gas released can be tested by bringing a burning candle near gas bubbles, it bursts with pop sound.

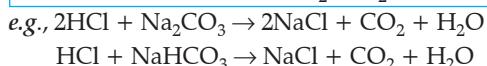
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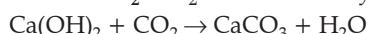
Base

**2. Reaction of Metal Carbonates / Metal Hydrogen Carbonates with:**

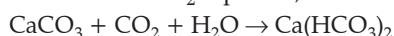
Acids	Bases
Acid + Metal Carbonate / Metal hydrogen Carbonate ↓ Salt + CO <sub>2</sub> + H <sub>2</sub> O	Base + Metal Carbonate / Metal Hydrogen Carbonate ↓ No Reaction



**Test for CO<sub>2</sub>:** CO<sub>2</sub> can be tested by passing it through lime water. Lime water turns milky.



When excess CO<sub>2</sub> is passed, milkiness disappears.



**3. Reaction of Acids and Bases With Each Other**

**Neutralization Reaction:** Reaction of acid with base is called neutralization reaction.



➤ **If:**



➤ pH of stomach is 1.5-3.0 due to secretion of HCl. In case of indigestion, acidity increases, which can be neutralised by antacids like milk of magnesia.

➤ Cold drinks, chocolates and sweets are harmful to tooth. They produce acids in mouth which are responsible for tooth decay.

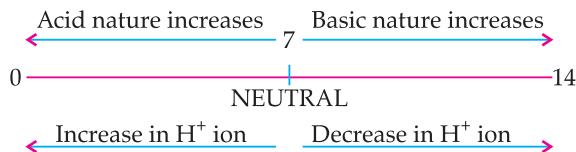
➤ Salts of a strong acid and a strong base are neutral with pH value of 7.

➤ Salts have various uses in everyday life and in industries.

➤ A salt is soluble if it dissolves in water to give a solution with a concentration of at least 0.1 moles per litre at room temperature.

➤ **pH Scale:** A scale for measuring H<sup>+</sup> ion concentration in a solution. p in pH stands for 'potenz' a German word which means power.

- pH = 7 → neutral solution
- pH < 7 → acidic solution
- pH > 7 → basic solution
- On diluting an acid: pH increases ↑
- On diluting a base: pH decreases ↓



➤ **Importance of pH in everyday life:**

- Plants and animals are pH sensitive.
- Our body works within the pH range of 7 – 7.8.
- When pH of rain water is less than 5.6, it is called acid rain.
- Plants require a specific pH range for their healthy growth.

## Salts, their Properties and Uses

➤ **Salts:** Salts are formed when an acid and base reacts with each other.

➤ **Types of Salts:**

**1. Common Salt (NaCl):**

**Preparation:**  $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

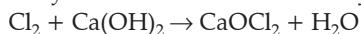
**Properties:**  $2\text{NaCl}(aq) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{Cl}_2(g) + \text{H}_2(g)$

**Users of common salt:**

- Used it daily food
- Used as preservative
- Used in manufacture of metal (Na ) & gas (Cl<sub>2</sub>) in molten state by electrolysis.

**2. Bleaching Powder (CaOCl<sub>2</sub>):**

**Preparation:** It is produced by the action of chlorine on dry slaked lime.



**Properties:**

- It has a strong smell of Chlorine.
- Soluble in water.
- It loses Chlorine by the action of carbon di oxide.

**Uses:**

- Bleaching cotton and linen in textile industry.
- Bleaching wood pulp in paper factories.
- Oxidizing agent in chemical industries.
- Disinfecting drinking water.

**3. Baking Soda ( Sodium hydrogen carbonate) (NaHCO<sub>3</sub>):**

**Preparation:**  $\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl} + \text{NaHCO}_3$   
Baking soda

**Properties:**

It is mild non-corrosive base.

When it is heated during cooking:



**Uses:**

- For making baking powder (mixture of baking soda and tartaric acid). When baking powder is heated or mixed with water, CO<sub>2</sub> is produced which causes bread and cake to rise making them soft and spongy.
- $\text{NaHCO}_3 + \text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Sodium Salt of an Acid}$
- An ingredient in antacid.

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Salt

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More about salts

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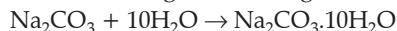


Are crystals dry

- (c) Used in soda acids, fire extinguishers.

**4. Washing Soda ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ):**

**Preparation:** Recrystallization of sodium carbonate gives washing soda. It is a basic salt.



**Properties:**

- (a) Transparent crystalline solid.
- (b) It has 10 molecules of water of crystallization.
- (c) It dissolves in water and the aqueous solution is alkaline.
- (d) It liberates Carbon di oxide when treated with Hydrochloric acid and Sulphuric acid.

**Uses:**

- (a) In glass, soap and paper industry.
- (b) Manufacture of borax.
- (c) It can be used as cleaning agent.
- (d) It can be used for removing permanent hardness of water.

**5. Plaster of Paris (Calcium sulphate hemihydrates) ( $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ ):**

**Preparation:** On heating gypsum  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  at 373K, it loses water molecules and becomes Plaster of Paris (POP). It is white powder and on mixing with water it changes to gypsum.



**Properties:**  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + \frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

**Uses:**

- (a) Doctors use POP for supporting fractured bones.
- (b) For making toys and material for decoration.



## Mnemonics

Concept: Natural indicators	Concept: pH scale
Mnemonics: <b>PG.RCT</b>	Mnemonics: <b>Phone Iao 7A mein</b>
<b>Interpretation:</b> Petunia Geranium Red cabbage Turmeric	<b>Interpretation:</b> <b>pH less than 7 --- Acid</b>



## Know the Terms

- **Mineral acids:** The acids which are obtained from minerals are called **mineral acids**.
- **Organic acids:** Acids which are obtained from plants and animals are called **organic acids**.
- **Strong acids:** The acids which ionise almost completely are called **strong acids**, e.g., mineral acids.
- **Weak acids:** The acids which ionise only partially or to a lesser extent are called **weak acids**, e.g., organic acids.
- **Strong bases:** The substances / bases which ionise completely to furnish  $\text{OH}^-$  ions are called **strong bases**, e.g., KOH, NaOH etc.
- **Weak bases:** The bases which ionize partially are called **weak bases**, e.g.,  $\text{Mg}(\text{OH})_2$ ,  $\text{Cu}(\text{OH})_2$  etc.
- **Alkalies:** Water soluble bases are called **alkalies**, e.g., NaOH, KOH. Thus, all alkalies are bases but all bases are not alkali.



## STAND ALONE MCQs

(1 Mark each)

[AI] Q. 1. An aqueous solution 'A' phenolphthalein solution colour is pink. On addition of an aqueous solution 'B' to 'A', the pink colour disappears. The following statement is true for solution 'A' and 'B'.

[Outside Delhi 2020]

- (A) A is strongly basic and B is a weak base.
- (B) A is strongly acidic and B is a weak acid.
- (C) A has pH greater than 7 and B has pH less than 7.
- (D) A has pH less than 7 and B has pH greater than 7.

Ans. Option (C) is correct.

**Q. 2.** Identify the basic salt from the following salts:

- (A)  $\text{Na}_2\text{CO}_3$       (B)  $\text{NH}_4\text{Cl}$   
 (C)  $\text{NaNO}_3$       (D)  $\text{KCl}$  [Board SQP, 2020]

**Ans.** Option (A) is correct.

**Explanation:**  $\text{Na}_2\text{CO}_3$  is a basic salt.

**Q. 3.** Which one of the following can be used as an acid-base indicator by a visually impaired student?

- (A) Litmus      (B) Turmeric  
 (C) Vanilla essence      (D) Petunia leaves

**Ans.** Option (C) is correct.

**Explanation:** Vanilla essence can be used as an acid-base indicator by visually impaired students as it is an olfactory indicator whose odour changes in acidic or basic media.

**AI Q. 4.** Which of the following is acidic in nature?

- (A) Lime juice      (B) Human blood  
 (C) Lime water      (D) Antacid

**Ans.** Option (A) is correct.

**Explanation:** Lime juice is acidic in nature as the juice is obtained from lime, a citrus fruit. This contains citric acid, and is therefore sour in taste.

**Q. 5.** During the preparation of hydrogen chloride gas on a humid day, the gas is usually passed through the guard tube containing calcium chloride. The role of calcium chloride taken in the guard tube is to

- (A) absorb the evolved gas.  
 (B) moisten the gas.  
 (C) absorb moisture from the gas.  
 (D) absorb  $\text{Cl}^-$  ions from the evolved gas.

**Ans.** Option (C) is correct.

**Explanation:** The role of calcium chloride taken in the guard tube is to absorb moisture from the gas. This is because calcium chloride is used as a drying agent which absorbs moisture from the hydrogen chloride ( $\text{HCl}$ ) gas.

**Q. 6.** Which of the following are present in a dilute aqueous solution of hydrochloric acid?

- (A)  $\text{H}_3\text{O}^+$  +  $\text{Cl}^-$       (B)  $\text{H}_3\text{O}^+$  +  $\text{OH}^-$   
 (C)  $\text{Cl}^-$  +  $\text{OH}^-$       (D) Unionized  $\text{HCl}$

**Ans.** Option (A) is correct.

**Explanation:** In a dilute aqueous solution of hydrochloric acid,  $\text{H}_3\text{O}^+$  +  $\text{Cl}^-$  ions are present.

**Q. 7.** What happens when a solution of an acid is mixed with a solution of a base in a test tube?

- (i) The temperature of the solution increases  
 (ii) The temperature of the solution decreases  
 (iii) The temperature of the solution remains the same  
 (iv) Salt formation takes place  
 (A) (i) only      (B) (i) and (iii)  
 (C) (ii) and (iii)      (D) (i) and (iv)

**Ans.** Option (D) is correct.

**Explanation:** When a solution of acid is mixed with a solution of base in a test tube then the temperature of the solution increases and salt formation takes place. This is because the process is exothermic that is excess heat is produced by the acid-base reaction which is the net result of the processes of bond-breaking and bond-making.

**AI Q. 8.** Which of the following is used for dissolution of gold?

- (A) Hydrochloric acid      (B) Sulphuric acid  
 (C) Nitric acid      (D) Aqua regia

**Ans.** Option (D) is correct.

**Explanation:** Aqua Regia is a mixture of concentrated  $\text{HNO}_3$  and concentrated  $\text{HCl}$ . Concentrated  $\text{HNO}_3$  acts as a very strong oxidising agent which ionises Au atoms and Concentrated  $\text{HCl}$  produces nascent chlorine which in turn reacts with ionised Au atoms thus forming auric chloride.

**Q. 9.** Which of the following salts does not contain water of crystallisation?

- (A) Blue vitriol      (B) Baking soda  
 (C) Washing soda      (D) Gypsum

**Ans.** Option (B) is correct.

**Explanation:** Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. Potassium nitrate, barium sulphate, potassium chloride, sodium nitrate, baking soda, etc., are the salts that do not contain water of crystallisation.

**AI Q. 10.** Sodium carbonate is a basic salt because it is a salt of

- (A) strong acid and strong base.  
 (B) weak acid and weak base.  
 (C) strong acid and weak base.  
 (D) weak acid and strong base.

**Ans.** Option (D) is correct.

**Explanation:** Sodium carbonate is a basic salt of weak acid i.e. carbonic acid and a strong base i.e. sodium hydroxide.

**Q. 11.** Common salt besides being used in kitchen can also be used as the raw material for making

- (i) washing soda.      (ii) bleaching powder.  
 (iii) baking soda.      (iv) slaked lime.  
 (A) (i) and (ii)      (B) (i), (ii) and (iv)  
 (C) (i) and (iii)      (D) (i), (iii) and (iv)

**Ans.** Option (C) is correct.

**Explanation:** The common salt obtained is an important raw material for various materials of daily use, such as sodium hydroxide, baking soda, washing soda and many more.

**Q. 12.** One of the constituents of baking powder is sodium hydrogen carbonate, the other constituent is

- (A) hydrochloric acid.      (B) tartaric acid.  
 (C) acetic acid.      (D) sulphuric acid.

**Ans. Option (B) is correct.**

**Explanation:** Baking powder is a mixture of baking soda (sodium hydrogen carbonate) and a mild edible acid such as tartaric acid.

**Q. 13.** Which of the following is not a salt?

- (A) Sodium chloride
- (B) Slaked lime
- (C) Lead sulphide
- (D) Zinc nitrate

**Ans. Option (B) is correct.**

**Explanation:** Slaked lime or  $\text{Ca}(\text{OH})_2$  is not a salt.

**Q. 14.** A compound is prepared from gypsum upon heating to a temperature of 373 K and it changes back to gypsum on adding water. Which is the incorrect statement about the compound?

- (A) The compound is used for setting fractured bones.
- (B) The compound is called plaster of Paris which is calcium sulphate dehydrate with a formula  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ .
- (C) If heated at higher temperature, the compound becomes dehydrated and is called dead burnt plaster.
- (D) Both (A) and (B).

**Ans. Option (B) is correct.**

**Explanation:** The compound is called plaster of Paris which is calcium sulphate hemihydrate with a formula  $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$ .

**Q. 15.** A milk man adds a very small amount of baking soda to fresh milk. Why?

- (A) To increase the rate of fermentation
- (B) To decrease the rate of fermentation
- (C) To increase its quality
- (D) To make paneer

**Ans. Option (B) is correct.**

**Explanation:** A milk man adds a very small amount of baking soda to fresh milk to decrease the rate of fermentation.

**Q. 16.** Which of the given substances is used in the following applications?

- I. It is used as a fire proofing material.
  - II. It is used for sealing gaps in laboratory apparatus.
  - III. It is used in making toys.
- (A) Bleaching powder
  - (B) Plaster of Paris
  - (C) Baking soda
  - (D) Washing soda

**[A]**

**Ans. Option (B) is correct.**

**Explanation:** The chemical formula for Plaster of paris is  $(\text{Ca}(\text{SO}_4)_{1/2}\text{H}_2\text{O})$  which is commonly used as fire proofing insulating material on walls, for casting toys and can be used in sealing pots and lab apparatus.



## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

- (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 true but R is false.
- (D) A is false and R is True.

**Q. 1. Assertion (A):** After white washing the walls, a shiny white finish on walls is obtained after two to three days.

**Reason (R):** Calcium Oxide reacts with Carbon dioxide to form Calcium Hydrogen Carbonate which gives shiny white finish. [SQP 2020-2021]

**Ans. Option (C) is correct.**

**[CBSE Marking Scheme, 2020]**

**Explanation:** Calcium hydroxide is obtained by reaction of calcium oxide and water.

**Q. 2. Assertion (A):** When zinc is added to dilute hydrochloric acid, hydrogen is given off.

**Reason (R):** Hydrogen chloride molecules contain hydrochloric acid and hydrogen atoms.

**Ans. Option (B) is correct.**

**Explanation:** The metal zinc readily reacts with hydrochloric acid to produce hydrogen gas ( $\text{H}_2$ ) and zinc chloride ( $\text{ZnCl}_2$ ).

**Q. 3. Assertion (A):** Gas bubbles are observed when sodium carbonate is added to dilute hydrochloric acid.

**Reason (R):** Carbon dioxide is given off in the reaction.

**Ans. Option (A) is correct.**

**Explanation:** Sodium carbonate reacts with excess hydrochloric acid to form sodium chloride, water and carbon dioxide. In this reaction, bubbles of carbon dioxide are observed.

**Q. 4. Assertion (A):** Ammonia solution is an alkali.

**Reason (R):** Ammonia solution turns blue litmus paper red.



- (A) Acidic oxide      (B) Basic oxide  
 (C) Neutral oxide      (D) Amphoteric oxide

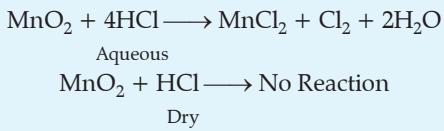
**Ans. Option (B) is correct.**

**Explanation:** Manganese is a metal and Metal oxides are basic oxides.

- Q. 5.** What will happen if we take dry HCl gas instead of aqueous solution of HCl?  
 (A) Reaction will occur faster.  
 (B) Reaction will not occur.  
 (C) Reaction rate will be slow.  
 (D) Reaction rate will remain the same.

**Ans. Option (B) is correct.**

**Explanation:** Dry HCl will not dissociate to produce H<sup>+</sup> ions thus reaction will not occur.



- II. Read the following and answer any four questions from Q.1 to Q.5.** [CBSE-QB 2021]

Frothing in Yamuna:

The primary reason behind the formation of the toxic foam is high phosphate content in the wastewater because of detergents used in dyeing industries, dhobi ghat Yamuna's pollution level is so bad that parts of it have been labelled 'dead' as there is no oxygen in it for aquatic life to survive.



- Q. 1.** Predict the pH value of the water of river Yamuna if the reason for froth is high content of detergents dissolved in it.

- (A) 10-11      (B) 5-7  
 (C) 2-5      (D) 7

**Ans. Option (A) is correct.**

**Explanation:** Detergents are bases and bases have pH greater than 7.

- Q. 2.** Which of the following statements is correct for the water with detergents dissolved in it?

- (A) low concentration of hydroxide ion (OH<sup>-</sup>) and high concentration of hydronium ion (H<sub>3</sub>O<sup>+</sup>).  
 (B) high concentration of hydroxide ion (OH<sup>-</sup>) and low concentration of hydronium ion (H<sub>3</sub>O<sup>+</sup>).  
 (C) high concentration of hydroxide ion (OH<sup>-</sup>) as well as hydronium ion (H<sub>3</sub>O<sup>+</sup>).

- (D) equal concentration of both hydroxide ion (OH<sup>-</sup>) and hydronium ion (H<sub>3</sub>O<sup>+</sup>).

**Ans. Option (B) is correct.**

**Explanation:** Detergents are bases. Bases ionise to form OH<sup>-</sup> and thus there will be high concentration of OH<sup>-</sup>.



- Q. 3.** The table provides the pH value of four solutions P, Q, R and S

Solution	pH value
P	2
Q	9
R	5
S	11

Which of the following correctly represents the solutions in increasing order of their hydronium ion concentration?

- (A) P>Q>R>S      (B) P>S>Q>R  
 (C) S<Q<R<P      (D) S<P<Q<R

**Ans. Option (C) is correct.**

**Explanation:** The pH value and hydrogen ion concentration are inversely proportional. This means if hydronium concentration increases, the pH decreases, causing solution to become more acidic. So hydronium ion concentration will be of the order: S<Q<R<P

- Q. 4.** High content of phosphate ion in river Yamuna may lead to:

- (A) decreased level of dissolved oxygen and increased growth of algae.  
 (B) decreased level of dissolved oxygen and no effect of growth of algae.  
 (C) increased level of dissolved oxygen and increased growth of algae.  
 (D) decreased level of dissolved oxygen and decreased growth of algae.

**Ans. Option (A) is correct.**

**Explanation:** The phosphate ion promote the growth of algae in water. So, the high level of phosphate ion in river Yamuna may lead to decreased level of oxygen and increased growth of algae. This process is known as eutrophication.

- Q. 5.** If a sample of water containing detergents is provided to you, which of the following methods will you adopt to neutralize it?

- (A) Treating the water with baking soda  
 (B) Treating the water with vinegar  
 (C) Treating the water with caustic soda  
 (D) Treating the water with washing soda

**Ans. Option (B) is correct.**

**Explanation:** Neutralisation takes place when acid and base react to form salt and water. Since, detergent is a base and vinegar is an acid, thus neutralization takes place.

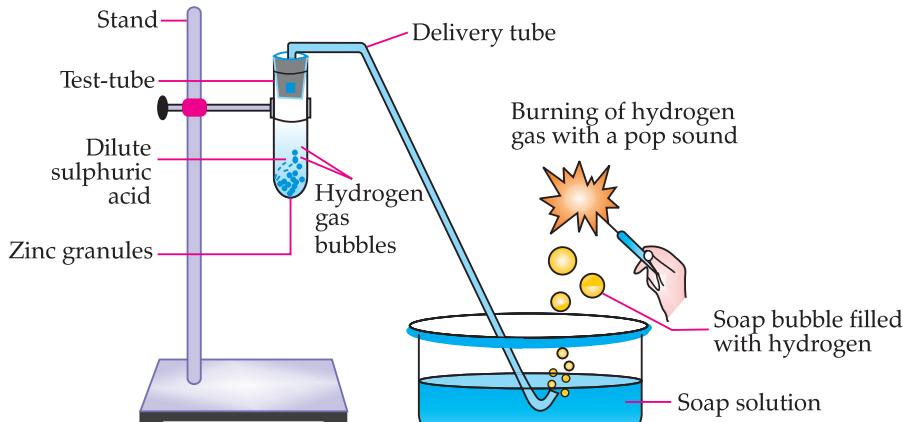


- (D) bulb glows in NaOH solution as well as in alcohol.

**Ans. Option (B) is correct.**

**Explanation:** After replacement, bulb glows in B as NaOH solution contains  $\text{Na}^+$  and  $\text{OH}^-$  ions, which are responsible for electrical conductivity.

**V. Study the given experimental set-up and answer the following questions.**



- Q. 1.** The above experimental set up shows reaction between metal and  
 (A) Acid  
 (B) Metal carbonate  
 (C) Metal hydrogen carbonate  
 (D) Metal oxide

**Ans. Option (A) is correct.**

**Explanation:** It is a reaction between a metal ( $\text{Zn}$ ) and an acid ( $\text{H}_2\text{SO}_4$ )

- Q. 2.** Which gas is liberated during the process?  
 (A) Hydrogen gas  
 (B) Carbon dioxide gas  
 (C) Nitrogen gas  
 (D) Hydrogen sulphide gas

**Ans. Option (A) is correct.**

**Explanation:** During the reaction between a metal and an acid, hydrogen gas is released.

- Q. 3.** Write the products formed in the above process:

- (A) Zinc sulphate only  
 (B) Only hydrogen gas  
 (C) Zinc sulphate and hydrogen gas  
 (D) Zinc sulphide and hydrogen gas

**Ans. Option (C) is correct.**

**Explanation:** During the reaction between a zinc and sulphuric acid, zinc sulphate and hydrogen gas is released.



- Q. 4.** A new product sodium zincate is formed if sulphuric acid is replaced with:  
 (A) Sodium hydroxide (B) Sodium oxide  
 (C) Zinc oxide (D) water

**Ans. Option (A) is correct.**

**Explanation:** If sulphuric acid is replaced with sodium hydroxide, it will produce sodium zincate (Salt) and hydrogen gas.



**VI. Read the given passage and answer the following questions from Q.1 to Q.4.**

P, Q, R are different colourless solids, while S is a colourless solution. They are (in random order) Sodium chloride ( $\text{NaCl}$ ), Calcium Carbonate ( $\text{CaCO}_3$ ), Acetic acid ( $\text{CH}_3\text{COOH}$ ) and Phenolphthalein indicator. Small amount of the above substances were added in pairs (e.g. P with Q; Q with R etc.) to a small amount of water in a test tube. They give the following results as shown in the observation table.

**Observation Table:**

	P	Q	R
Q	No reaction	-	No reaction
R	Dark Pink Colour	No reaction	-
S	No reaction	No reaction	Effervescence

- Q. 1.** The chemicals are:

	P	Q	R	S
(A)	NaCl	$\text{CaCO}_3$	$\text{CH}_3\text{COOH}$	Phenolphthalein
(B)	Phenolphthalein	NaCl	$\text{CaCO}_3$	$\text{CH}_3\text{COOH}$

(C)	CH <sub>3</sub> COOH	Phenolphthalein	NaCl	CaCO <sub>3</sub>
(D)	CaCO <sub>3</sub>	CH <sub>3</sub> COOH	Phenolphthalein	NaCl

**Ans. Option (B) is correct.**

*Explanation:* The chemical P is Phenolphthalein, Q is NaCl, R is CaCO<sub>3</sub>, and S is CH<sub>3</sub>COOH.

**Q. 2.** Which of the following reaction is incorrect ?

- (A) Phenolphthalein (P) + NaCl (Q) → No reaction
- (B) Phenolphthalein + CaCO<sub>3</sub> (R) → Alkaline medium (Dark Pink Colour)
- (C) Phenolphthalein + NaCl → Acidic medium (Blue colour)
- (D) CaCO<sub>3</sub> (R) + 2CH<sub>3</sub>COOH (S) → (CH<sub>3</sub>COO)<sub>2</sub>Ca + CO<sub>2</sub> (effervescence) + 2H<sub>2</sub>O

**Ans. Option (C) is correct.**

*Explanation:* The correct reactions are:

- (i) Phenolphthalein (P) + NaCl (Q) → No reaction
- (ii) Phenolphthalein + CaCO<sub>3</sub> (R) → Alkaline medium (Dark Pink Colour)
- (iii) CaCO<sub>3</sub> (R) + 2CH<sub>3</sub>COOH (S) → (CH<sub>3</sub>COO)<sub>2</sub>Ca + CO<sub>2</sub> (effervescence) + 2H<sub>2</sub>O

**Q. 3.** The chemicals that can be used as an acid-base indicator by a visually impaired student is \_\_\_\_\_.

- (A) Petunia leaves (B) Vanilla essence
- (C) Phenolphthalein (D) Turmeric

**Ans. Option (B) is correct.**

*Explanation:* Vanilla essence can be used as an acid-base indicator by visually impaired students as it is an olfactory indicator whose odour changes in acidic or basic media.

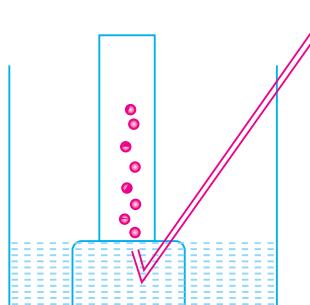
**Q. 4.** If acetic acid and hydrochloric acid of same concentration are taken, HCl is a stronger acid because it contains:

- (A) more of Cl<sup>-</sup> ions.
- (B) more of H<sup>+</sup> ions.
- (C) less of H<sup>+</sup> ions
- (D) more of CH<sub>3</sub>COO<sup>-</sup> ions.

**Ans. Option (B) is correct.**

*Explanation:* HCl is stronger because it gives rise to more H<sup>+</sup> ions than acetic acid.

**VII.** A metal is treated with dilute sulphuric acid. The gas evolved is collected by the method shown in the figure:



**Q. 1.** Name the gas evolved:

- (A) Hydrogen
- (B) Oxygen
- (C) Sulphur dioxide gas
- (D) Carbon dioxide

**Ans. Option (A) is correct.**

*Explanation:* Hydrogen gas. It is soluble in water.

**Q. 2.** The gas evolved is :

- (A) Lighter than air
- (B) Heavier than air

**Ans. Option (A) is correct.**

*Explanation:* Lighter than air. When a burning splinter is brought near the gas it burns with a pop sound.

**Q. 3.** If the metal used above is zinc, choose the correct balanced chemical equation for the evolution of gas ?

- (A) 2Zn(s) + H<sub>2</sub>SO<sub>4</sub>(dil) → 2ZnSO<sub>4</sub>(aq) + H<sub>2</sub>(g)↑
- (B) Zn(s) + H<sub>2</sub>SO<sub>4</sub>(dil) → ZnSO<sub>4</sub>(aq) + H<sub>2</sub>(g)↑
- (C) Zn(s) + 2H<sub>2</sub>SO<sub>4</sub>(dil) → 2ZnSO<sub>4</sub>(aq) + H<sub>2</sub>(g)↑
- (D) 2Zn(s) + H<sub>2</sub>SO<sub>4</sub>(dil) → ZnSO<sub>4</sub>(aq) + 2H<sub>2</sub>(g)↑

**Ans. Option (B) is correct.**

*Explanation:* The balanced chemical equation is : Zn(s) + H<sub>2</sub>SO<sub>4</sub>(dil) → ZnSO<sub>4</sub>(aq) + H<sub>2</sub>(g)↑

**Q. 4.** What nature of hydrogen is used as a fuel in rocket ?

- (A) solid
- (B) liquid
- (C) gaseous
- (D) all of the above

**Ans. Option (B) is correct.**

*Explanation:* Liquid hydrogen is used as a fuel in rockets.

**VIII.** Read the given passage and answer the following questions from Q. 1. to Q. 4.

Suhana wanted her house to be white washed. She bought 10 kg of quicklime from the market and

dissolved it in 30 L of water. On adding lime to water, she observed that the water started boiling even when it was not being heated.

**Q. 1.** Name the product when water is added to quicklime.

- (A) Calcium oxide    (B) Calcium hydroxide  
(C) Calcium dioxide    (D) Calcium carbonate

**Ans. Option (B) is correct.**

*Explanation:* Calcium hydroxide,  $\text{Ca}(\text{OH})_2$   
 $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + \text{Heat}$

**Q. 2.** The common name for quick lime is:

- (A) Calcium hydroxide (B) Calcium oxide  
(C) Calcium dioxide (D) Calcium carbonate

**Ans. Option (B) is correct.**

*Explanation:* The common name for quick lime is  $\text{CaO}$ .

**Q. 3.** The correct formula for calcium hydroxide is:

- (A)  $\text{Ca}(\text{OH})$     (B)  $\text{Ca}(\text{OH})_2$   
(C)  $\text{Ca}(\text{OH})_2$     (D)  $\text{Ca}_2\text{OH}_2$

**Ans. Option (C) is correct.**

*Explanation:* The chemical formula for calcium hydroxide is  $\text{Ca}(\text{OH})_2$   
 $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + \text{Heat}$

**[AI] Q. 4.** Which of the following statements is correct about the above reaction based on your observations?

- (i) It is an endothermic reaction.
  - (ii) It is an exothermic reaction
  - (iii) The pH of the resulting solution will be more than seven.
  - (iv) The pH of the resulting solution will be less than seven.
- (A) (i) and (ii)    (B) (ii) and (iii)  
(C) (i) and (iv)    (D) (iii) and (iv)

**Ans. Option (B) is correct.**

*Explanation:* It is an exothermic reaction because heat is given out. The resulting compound is  $\text{Ca}(\text{OH})_2$  which is basic in nature. So the pH of the resulting solution will be more than seven.

**[AI] IX.** Read the given passage and answer the following questions from Q.1. to Q.4.

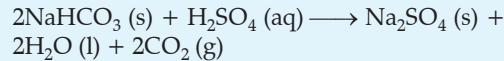
Sanjana while preparing cake used baking soda in small amounts. It helps to make the cake soft and spongy. An aqueous solution of baking soda also turns red litmus blue. It is also used in soda acid extinguisher.

**Q. 1.** Name the gas produced by the reaction of baking soda and acid which helps as fire extinguisher:

- (A) Carbon monoxide (B) Carbon dioxide  
(C) Hydrogen    (D) Oxygen

**Ans. Option (B) is correct.**

**Explanation:** The  $\text{CO}_2$  gas produced by the reaction of baking soda and acid in the soda – acid fire extinguisher, helps in extinguishing fire.



**Q. 2.** Name the products formed when baking soda is heated:

- (A) Sodium sulphate and carbon dioxide gas.  
(B) Sodium carbonate and water.  
(C) Sodium carbonate, carbon dioxide and water.  
(D) Sodium oxide carbon dioxide and water.

**Ans. Option (C) is correct.**

*Explanation:* When it is heated, it disintegrates into sodium carbonate, water and carbon dioxide.



**Q. 3.** The pH of baking soda solution is :

- (A) more than 7  
(B) less than 7  
(C) equal to 7  
(D) less than 7 but more than 3.

**Ans. Option (A) is correct.**

*Explanation:* pH value of baking soda solution is higher than 7 i.e., it is alkaline.

**Q. 4.** What is the chemical name for baking soda?

- (A) Sodium carbonate  
(B) sodium bicarbonate  
(C) calcium carbonate  
(D) calcium bicarbonate.

**Ans. Option (B) is correct.**

*Explanation:* The chemical name for baking soda is sodium bicarbonate.

**X.** Read the given passage and answer the following questions from Q.1. to Q.4.

A dry pellet of a common base B when kept in open absorbs moisture and turns sticky. The compound is also a by-product of chloro-alkali process.

**Q. 1.** Identify B:

- (A) Sodium chloride    (B) Sodium hydroxide  
(C) Carbon dioxide    (D) Sodium carbonate

**Ans. Option (B) is correct.**

*Explanation:* B is sodium hydroxide ( $\text{NaOH}$ ). It is obtained by the electrolytic decomposition of solution of sodium chloride (brine). When electricity is passed through an aqueous solution of sodium chloride (brine), it decomposes to form sodium hydroxide. Chlorine gas is given off at the anode, and the hydrogen gas at the cathode. The process is called chlor - alkali process because of the products formed- Chlor for chlorine and alkali for sodium hydroxide.

- Q. 2.** What type of reaction occurs when B is treated with an acidic oxide?
- Neutralisation
  - Double decomposition
  - Combination
  - Displacement

**Ans. Option (A) is correct.**

*Explanation:* Neutralisation reaction occurs when B is treated with an acidic oxide.

- Q. 3.** What is the raw material used in chloro-alkali?
- Aqueous solution of sodium chloride
  - Sodium chloride in dry form
  - Sodium hydroxide
  - Sodium carbonate

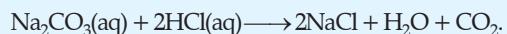
**Ans. Option (A) is correct.**

*Explanation:* The raw material used in chloro-alkali is NaOH.

- $$2\text{NaOH}(\text{s}) + \text{CO}_2(\text{g}) \longrightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$$
- Q. 4.** When aqueous sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) reacts with  $\text{HCl}$  (aq), it gives
- $\text{NaOH}, \text{H}_2$  and  $\text{CO}_2$
  - $\text{NaCl}, \text{H}_2\text{O}$  and  $\text{CO}_2$
  - $\text{NaHCO}_3, \text{H}_2$  and  $\text{CO}_2$
  - $\text{NaHCO}_3, \text{H}_2\text{O}$  and  $\text{CO}_2$

**Ans. Option (B) is correct.**

*Explanation:* The chemical reaction is as follows:

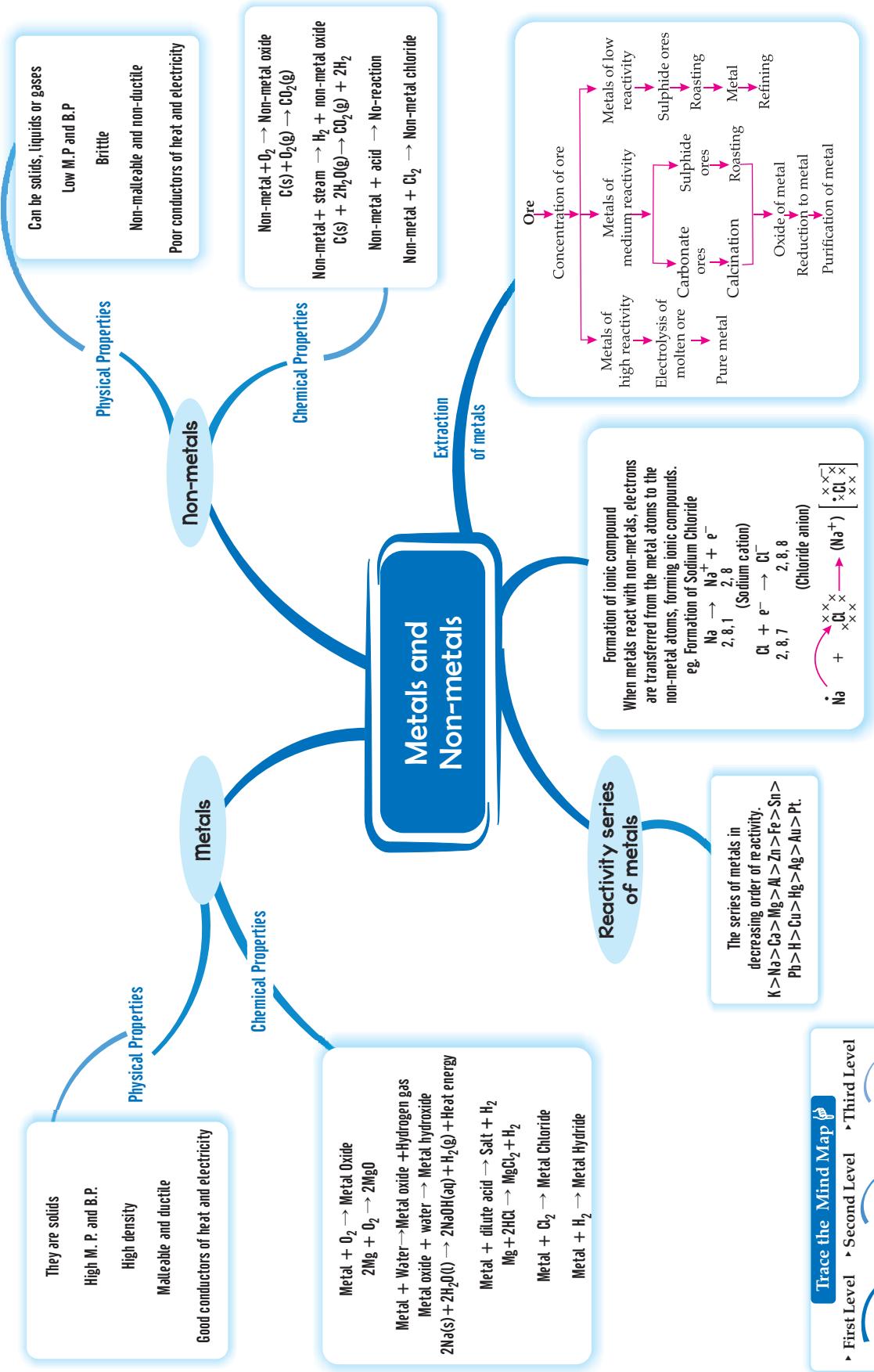


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**CHAPTER****3****METALS AND  
NON-METALS****Syllabus**

*Metals and nonmetals: Properties of metals and non-metals; Reactivity series; Formation and properties of ionic compounds.*

**Revision Notes****Properties of Metal and Non-Metals****Introduction**

- Metals are mostly solids, possessing high density. They have high melting and boiling points. They are lustrous and sonorous. They are good conductors of heat and electricity.
- Most of the metals are hard. However, some of the metals like sodium, potassium are soft metals and can be easily cut with knife.
- All metals are solids except Mercury, Caesium, Francium, Germanium and Gallium which are solids with low melting point. Gallium becomes liquid if kept on palm but Gallium has very high boiling point which makes it useful for high temperature thermometers.
- **Physical Properties:**

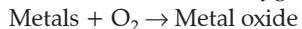
Property	Metals	Non-Metals
1. Lustre	Metals have shining surface.	They do not have shining surface. <ul style="list-style-type: none"><li>● Except Iodine.</li></ul>
2. Hardness	They are generally hard. <ul style="list-style-type: none"><li>● Except Sodium, Lithium and Potassium which are soft and can be easily cut with knife.</li></ul>	Generally soft. <ul style="list-style-type: none"><li>● Except Diamond, a form of carbon which is the hardest natural substance.</li></ul>
3. State	Exist as solids. <ul style="list-style-type: none"><li>● Except Mercury that exists in liquid.</li></ul>	Exist as solids or gases <ul style="list-style-type: none"><li>● Except Bromine that exists in liquid.</li></ul>
4. Malleability	Metals can be beaten into thin sheets. <ul style="list-style-type: none"><li>● Gold, Silver and Aluminium are the most malleable metals.</li></ul>	Non-metals are non-malleable. <ul style="list-style-type: none"><li>● They are brittle.</li></ul>
5. Ductility	Metals can be drawn into thin wires.	They are non-ductile.
6. Conductor of heat & electricity	Metals are good conductors of heat and electricity.	Non-metals are poor conductors of heat and electricity. <ul style="list-style-type: none"><li>● Except Graphite.</li></ul>

7. Density and Melting point	Generally metals have high density and high melting point. • Except Sodium and Potassium	Non metals have low density and low melting point.
8. Sonorous	Metals produce a sound on striking a hard surface.	They are not sonorous.
9. Oxides	Metallic oxides are basic in nature.	Non-metallic oxides are acidic in nature.

➤ **Chemical Properties:**

(A) **Reaction with Air:**

Metals combine with oxygen to form metal oxide.



Examples:

- (i)  $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$   
Copper (II) oxide (black)
- (ii)  $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$   
Aluminium oxide
- (iii)  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$   
Magnesium oxide

Scan to know  
more about  
this topic



Metals and non  
metals

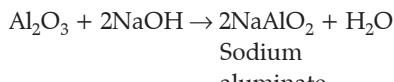
➤ Different metals show different reactivity towards  $\text{O}_2$ .

- Na and K react so vigorously with oxygen that they catch fire if kept in open. So they are kept immersed in kerosene.
- Surfaces of Mg, Al, Zn and Pb are covered with a thin layer of oxide which prevent them from further oxidation.
- Fe does not burn on heating but iron filings burn vigorously.
- Cu does not burn but is coated with black copper (II) oxide.
- Au and Ag do not react with oxygen.

➤ **Amphoteric Oxides:** Metal oxides which react with both acids as well as bases to produce salt and water are called amphoteric oxides.



Aluminium  
chloride



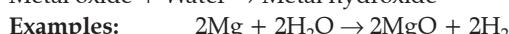
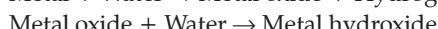
Sodium  
aluminate

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this topic

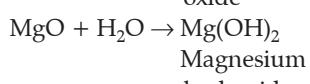


Difference between  
metals and  
non-metals

(B) **Reaction of Metals with Water:**

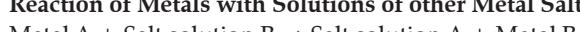


Magnesium  
oxide

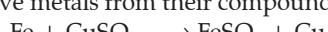


Magnesium  
hydroxide

(C) **Reaction of Metals with Solutions of other Metal Salts:**



➤ Reactive metals can displace less reactive metals from their compounds in solution form.



➤ All the metals do not react with the same rate. Some react very fast, some react moderately whereas others react very slowly. The series of metals in decreasing order of reactivity is called **reactivity or activity series of metals**. The metals at the top (K at the top most) are most reactive whereas metals at the bottom (Pt at the extreme bottom) least reactive.



➤ Metals react with dilute acids to form salt and hydrogen gas. The metal replaces hydrogen of the acid to form salt.

➤ **Aqua Regia** is a mixture of conc. HCl and conc.  $\text{HNO}_3$  in the ratio of 3: 1. It can dissolve gold and platinum. Aqua Regia is a strong oxidizing agent due to the formation of  $\text{NOCl}$  (Nitrosyl chloride) and chlorine produced by reaction of two acids.

➤ **Alloys** are homogeneous mixtures of two or more metals. One of them can be non-metal also, e.g., Brass is an alloy of copper and zinc. When a metal is alloyed with mercury, it is called an **amalgam**.

➤ Metals in reactivity series, if placed above hydrogen, can displace hydrogen from dilute acids ( $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ ).

## Ionic compounds, Metallurgy and Corrosion

➤ **Ionic Compounds**

The compounds formed by the transfer of electrons from a metal to a non-metal are called ionic compounds or electrovalent compounds.

➤ **Properties of Ionic Compounds**

- (i) **Physical nature:** They are solid and hard, generally brittle.
- (ii) **Melting and Boiling Point:** They have high melting and boiling points.
- (iii) **Solubility:** Generally soluble in water and insoluble in solvents such as kerosene, petrol etc.
- (iv) **Conduction of electricity:** Ionic compounds conduct electricity in molten and solution form but not in solid state.

➤ **Occurrence of Metals**

- **Minerals:** The elements or compounds which occur naturally in the earth's crust are called minerals.
- **Ores:** Minerals that contain very high percentage of particular metal and the metal can be profitably extracted from it, such minerals are called ores.



### Mnemonics

#### Concept: Activity series of metals

**Mnemonics:**

Popular Scientists Can Make A Zoo InThe Low Humid Country More Satisfactorily

**Interpretation:**

P - Potassium

S - Sodium

C - Calcium

M - Magnesium

A - Aluminium

Z - Zinc

I - Iron

T - Tin

L - Lead

H - Hydrogen

C - Copper

M - Mercury

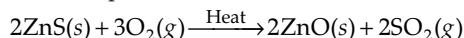
S - Silver



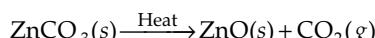
### Know the Terms

- **Malleability:** The ability of a metal due to which it can be beaten into large thin sheets is called **malleability**.
- **Ductility:** It is the ability of metal due to which it can be drawn into thin and long wires. Copper, aluminium and iron can be drawn into wires. Silver, gold and platinum are highly ductile metals.
- **Electrical conductance:** It is the property due to which electric current can pass through the metal. It is due to presence of free electrons or mobile electrons. Copper, silver, gold and aluminium are good conductors of electricity.
- **Thermal conductivity:** It is the property due to which metals can conduct heat. e.g., Copper, silver, aluminium, gold and iron are good conductors of heat.
- **Metallic lustre:** Metals in their pure state have bright shining surfaces. This property is called **metallic lustre**.
- **Sonorously:** When metals are struck with a hard substance, they produce sound. This property is called **sonorously** and the metals are said to be **sonorous**.
- **Neutral oxides:** The oxides which are neither acidic nor basic in nature, are known as **Neutral oxides**. They neither react with acids nor with bases. Some non-metals form neutral oxides. Example CO, NO, N<sub>2</sub>O etc.
- **Ore-dressing:** It is a process of removing unwanted substances from the ore. This is also known as concentration of the ore or enrichment of ore. It is usually done by hydraulic washing, magnetic separation or froth floatation process.
- **Froth floatation process:** It is the process based on the principle that the mineral particles are more wetted by the oil, whereas the gangue particles are wetted by water. Compressed air is bubbled through the mixture. As a result of agitation, oil froth is formed which contains minerals which float on the top of water and can be separated easily.

- **Gangue:** The unwanted material present in the ores mined from earth is called **Gangue**. It needs to be removed prior to the extraction process.
  - **Leaching:** It makes use of difference in the chemical properties of minerals and gangue. The ore is treated with suitable reagent which reacts with the ore, but not with the gangue. The purified ore is regenerated by sequence of reactions. An example of leaching is Bayer's method of obtaining pure aluminium oxide from Bauxite.
  - **Roasting:** It is the process in which ore is heated in the presence of air so as to obtain metal oxides, which can be reduced easily to get free metal. Sulphide ores are converted into oxides by roasting.



- **Calcination:** It is the process of heating ore in absence of air so as to remove moisture, volatile impurities and to convert carbonate ores into oxides.



- **Thermite process:** It is a process in which molten metal oxides are treated with aluminium powder. It is highly exothermic reaction. The molten metal obtained is used for welding of railway tracks or cracked machine parts.



- **Refining:** It is a process of converting impure metal into pure metal by different processes depending on the nature of metals. It is a process of purification of metal.
  - **Flux:** The substance which reacts with gangue to form a fusible mass which can easily be removed is known as flux. e.g., CaO (Calcium oxide) is used as flux so as to remove  $\text{SiO}_2$  (Silica) as gangue.
  - **Slag:** The fusible mass formed by the reaction of flux and gangue is known as **slag**. Slag is lighter than molten metal, hence floats over molten metal and can be easily removed. It prevents metal from oxidation.



# STAND ALONE MCQs

**(1 Mark each)**



**Ans.** Option (D) is correct.

**Explanation:** Metals like aluminium, zinc, iron do not react with hot/cold water. They react with water only when water is in the form of steam.



- Q. 2.** What happens when calcium is treated with water?

  - (i) It does not react with water.
  - (ii) It reacts violently with water.
  - (iii) It reacts less violently with water.
  - (iv) Bubbles of hydrogen gas formed stick to the surface of calcium.

**(A)** (i) and (iv)      **(B)** (ii) and (iii)  
**(C)** (i) and (ii)      **(D)** (iii) and (iv)      **U**

**Ans.** Option (D) is correct.

**Explanation:** Calcium reacts slowly with water. The reaction forms calcium hydroxide,  $\text{Ca}(\text{OH})_2$  and hydrogen gas ( $\text{H}_2$ ). The calcium metal sinks in water and after an hour or so bubbles of hydrogen are observed, stuck to the surface of the metal.

- Q. 3.** Generally, non-metals are not lustrous. Which of the following non-metal is lustrous?

(A) Sulphur                    (B) Oxygen  
(C) Nitrogen                    (D) Iodine

**Ans.** Option (D) is correct.

**Explanation:** Iodine is a non-metal but it is lustrous.

- Q. 4.** An element A is soft and can be cut with a knife. This is very reactive to air and cannot be kept open in air. It reacts vigorously with water. Identify the element from the following:

**Ans.** Option (B) is correct.

**Explanation:** Sodium is so soft that can be cut using a knife. It reacts with oxygen or moisture present in air readily and reacts with water vigorously. Because of this sodium is stored in kerosene oil to prevent any reaction or accident.

- AI** Q. 5. Which among the following statements is incorrect for magnesium metal?

- (A) It burns in oxygen with a dazzling white flame
- (B) It reacts with cold water to form magnesium oxide and evolves hydrogen gas
- (C) It reacts with hot water to form magnesium hydroxide and evolves hydrogen gas
- (D) It reacts with steam to form magnesium hydroxide and evolves hydrogen gas

**Ans.** Option (B) is correct.

**Explanation:** Magnesium when reacts with water gives magnesium hydroxide and hydrogen gas and not magnesium oxide.

- Q. 6.** Electrical wires have a coating of an insulating material. The material, generally used is  
 (A) Sulphur                   (B) Graphite  
 (C) PVC                       (D) All can be used      [U]

**Ans. Option (C) is correct.**

**Explanation:** PVC is a polymer and bad conductor of electricity. It is used as an insulating material for covering electric wires. Graphite is good conductor of electricity, so cannot be used as insulating material. Sulphur is a non-metal although non-conductor of electricity but brittle in nature. So, cannot be used as insulating material.

- Q. 7.** Food cans are coated with tin and not with zinc because  
 (A) zinc is costlier than tin  
 (B) zinc has a higher melting point than tin  
 (C) zinc is more reactive than tin  
 (D) zinc is less reactive than tin      [A]

**Ans. Option (C) is correct.**

**Explanation:** Food cans are coated with tin and not with zinc because zinc is more reactive than tin.

- Q. 8.** Which of the given metals is stored under kerosene to prevent oxidation?  
 (A) Copper                   (B) Potassium  
 (C) Magnesium              (D) Calcium      [R]

**Ans. Option (B) is correct.**

**Explanation:** Potassium and Sodium react vigorously with oxygen in air and catch fire. These metals are stored under kerosene oil to prevent oxidation.

- Q. 9.** Which of the following metals exist in their native state in nature?  
 (i) Cu                       (ii) Au  
 (iii) Zn                     (iv) Ag  
 (A) (i) and (ii)           (B) (ii) and (iii)  
 (C) (ii) and (iv)          (D) (iii) and (iv)

**Ans. Option (C) is correct.**

**Explanation:** Metals such as gold and silver are found as native metals.

- Q. 10.** Galvanization is a method of protecting iron from rusting by coating with a thin layer of  
 (A) Gallium               (B) Aluminium  
 (C) Zinc                   (D) Silver

**Ans. Option (C) is correct.**

**Explanation:** In the process of galvanization, iron is covered by a coat of zinc. This layer of zinc prevents iron from getting rusted.

- Q. 11.** Which of the following metals are obtained by electrolysis of their chlorides in molten state?

- |                   |                    |
|-------------------|--------------------|
| (i) Na            | (ii) Ca            |
| (iii) Fe          | (iv) Cu            |
| (A) (i) and (iv)  | (B) (iii) and (iv) |
| (C) (i) and (iii) | (D) (i) and (ii)   |

**Ans. Option (D) is correct.**

**Explanation:** Sodium and calcium fall towards the top of reactivity series. Since, sodium and calcium are very reactive, these metals cannot be reduced to pure form, from their oxides or carbonates. Thus, sodium and calcium are obtained by the process of electrolysis of their chlorides.

- Q. 12.** An electrolytic cell consists of  
 (i) positively charged cathode  
 (ii) negatively charged anode  
 (iii) positively charged anode  
 (iv) negatively charged cathode  
 (A) (i) and (ii)           (B) (iii) and (iv)  
 (C) (i) and (iii)          (D) (ii) and (iv)      [R]

**Ans. Option (B) is correct.**

**Explanation:** Positively charged ions are called cations as they are deposited at negatively charged pole. Negatively charged ions are called anions as these are deposited at positively charged pole. That's why the negatively charged pole is called cathode and positively charged pole is called anode.

- Q. 13.** Alloys are homogeneous mixtures of a metal with a metal or non-metal. Which among the following alloys contain non-metal as one of its constituents?  
 (A) Brass                   (B) Bronze  
 (C) Amalgam              (D) Steel

**Ans. Option (D) is correct.**

**Explanation:** Steel is an alloy of iron and carbon. Mixing of carbon gives strength to iron.

- Q. 14.** Which of the following are not ionic compounds?  
 (i) KCl                   (ii) HCl  
 (iii) CCl<sub>4</sub>               (iv) NaCl  
 (A) (i) and (ii)          (B) (ii) and (iii)  
 (C) (iii) and (iv)       (D) (i) and (iii)      [U]

**Ans. Option (B) is correct.**

**Explanation:** HCl and CCl<sub>4</sub> are not ionic compounds because they are formed by sharing of electrons. These are covalent compounds.

- Q. 15.** Metals are refined by using different methods. Which of the following metals are refined by electrolytic refining?  
 (i) Au                   (ii) Cu  
 (iii) Na                   (iv) K  
 (A) (i) and (ii)       (B) (i) and (iii)  
 (C) (ii) and (iii)      (D) (iii) and (iv)      [U]

**Ans. Option (A) is correct.**

**Explanation:** Sodium and potassium are extracted by electrolytic reduction. Metals obtained after electrolytic reduction are in pure form. But, copper and gold are in impure form after extraction. Copper and gold are refined by electrolytic refining methods.

- Q. 16.** During electrolytic refining of zinc, it gets  
 (A) deposited on cathode

- (B) deposited on anode  
 (C) deposited on cathode as well as anode  
 (D) remains in the solution

**Ans. Option (A) is correct.**

**Explanation:** Ions of zinc are positively charged, thus while electrolytic refining of zinc, zinc is deposited at cathode (negatively charged pole).



## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

- (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 true but R is false.  
 (D) A is false and R is true.

- Q. 1. Assertion (A):** When a piece of copper metal is added to dilute sulphuric acid, the solution turns blue.

**Reason (R):** Copper reacts with dilute sulphuric acid to form blue copper (II) sulphate solution.

**Ans. Option (D) is correct.**

**Explanation:** When a piece of copper metal is added to dilute sulphuric acid, then it shows no reaction at normal temperature. It is because, copper reacts only with heated sulphuric acid to form blue copper (II) sulphate solution.

- Q. 2. Assertion (A):** Metals are sonorous.

**Reason (R):** They are generally brittle in the solid state; they break into pieces when hammered.

**Ans. Option (C) is correct.**

**Explanation:** Metals are sonorous, malleable and ductile while non-metals are brittle.

- Q. 3. Assertion (A):** Gas bubbles are observed when sodium carbonate is added to dilute hydrochloric acid.

**Reason (R):** Carbon dioxide is given off in the reaction.

**Ans. Option (A) is correct.**

**Explanation:** Gas bubbles are observed when sodium carbonate is added to dilute hydrochloric acid as  $\text{CO}_2$  gas is released.

- Q. 4. Assertion (A):** A mineral is called ore, when metal is extracted from it conveniently and economically.

**Reason (R):** All ores are minerals but all minerals are not ores.

**Ans. Option (B) is correct.**

**Explanation:** Minerals are naturally occurring chemical substances in the earth's crust obtained by mining. But a mineral is called an ore only when the metal can be extracted from it conveniently and economically. Thus, all ores are minerals but all minerals are not ores.

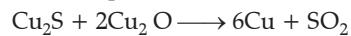
- Q. 5. Assertion (A):** Usually the sulphide ore is converted to oxide before reduction.

**Reason (R):** Reduction of oxides occurs easier.

**Ans. Option (A) is correct.**

**Explanation:** Usually the sulphide ore is converted to oxide before reduction as oxides are easier to reduce.

- Q. 6. Assertion (A):** While the extraction of copper, one of the steps involved is



**Reason (R):** In this reaction  $\text{Cu}_2\text{S}$  is the reducing agent whereas  $\text{Cu}_2\text{O}$  is the oxidising agent.

**Ans. Option (C) is correct.**

**Explanation:** The  $\text{Cu}^{2+}$  ion in both the compounds gets reduced while sulphur gets oxidised.

- Q. 7. Assertion (A):** In alumino thermite process, the metals like iron melts due to the heat evolved in the reaction.

**Reason (R):** The reaction is:



**Ans. Option (A) is correct.**

**Explanation:** Large amount of heat is evolved which melts iron and can be used for welding.



## CASE-BASED MCQs

**AI** Attempt any 4 sub-parts from each question. Each sub-part carries 1 mark.

**I. Read the following and answer any four questions from Q.1. to Q.5.**

A student took the samples of four metals A, B, C and D and added following solutions one by one. The results obtained have been tabulated as follows:

Metal	Iron (II) Sulphate	Copper (II) Sulphate	Zinc Sulphate	Silver Nitrate
A	No reaction	Displacement	-	-
B	Displacement	-	No reaction	-
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

**Q. 1.** Choose the most reactive metal:

- (A) A                                  (B) B  
 (C) C                                    (D) D

**Ans.** Option (B) is correct.

**Explanation:** B is the most reactive metal as it displaces iron from its salt solution.

**Q. 2.** Which of the following will displace Cu from its solution of sulphate:

- (A) A only                             (B) B only  
 (C) Both A and B                    (D) None of the above

**Ans.** Option (B) is correct.

**Explanation:** B will displace Cu from  $\text{CuSO}_4$  solution because B is more reactive than copper.

**Q. 3.** Which is the correct decreasing order of reactivity?

- (A)  $\text{B} > \text{A} > \text{C} > \text{D}$       (B)  $\text{A} > \text{B} > \text{D} > \text{C}$   
 (C)  $\text{D} > \text{B} > \text{A} > \text{C}$       (D)  $\text{B} > \text{A} > \text{D} > \text{C}$

**Ans.** Option (A) is correct.

**Explanation:** The order of decreasing reactivity is :  $\text{B} > \text{A} > \text{C} > \text{D}$

B will displace Cu from  $\text{CuSO}_4$  solution because B is more reactive than copper.

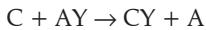
**Q. 4.** The gas produced when dil. HCl is added to a reactive metal:

- (A) Oxygen                            (B) Nitrogen  
 (C) Hydrogen                        (D) None of the above

**Ans.** Option (C) is correct.

**Explanation:** Hydrogen gas is produced when dilute HCl is added to a reactive metal.

**Q. 5.** On the basis of sequence of reactions, identify the most and least reactive elements.



- (A) Most reactive: C; Least reactive: B  
 (B) Most reactive: B; Least reactive: C  
 (C) Most reactive: A; Least reactive: B  
 (D) Most reactive: B; Least reactive: A

**Ans.** Option (A) is correct.

**Explanation:** The most reactive metal is C and the least reactive metal is B.

**II. Read the following and answer any four questions from Q.1. to Q.5.**

**Based on this information, answer any four questions from Q. 1. to Q. 5.**

When a silvery grey powder of a solid (A) is mixed with a powder of solid (B) no reaction occurs. But if the mixture is ignited and lighted using magnesium ribbon a reaction occurs with evolution of large amount of heat forming product (C) which settles down as liquid metal and the solid product (D) formed floats on the liquid (C). (C) in solid form reacts with moisture to form rust. The amount of heat generated during the reaction is so high that the reaction is used in welding of electric conductors, joints in railway tracks.

**Q. 1.** Identify A and C?

- (A) A – Al and C – Fe      (B) A – Fe and C – Al  
 (C) A – Mg and C – Al      (D) A – Al and C - Cu

**Ans.** Option (A) is correct.

**Explanation:** A is Al, and C is Fe,  $\text{O}_3$   
 $2\text{Al} (\text{A}) + \text{Fe}_2\text{O}_3 \longrightarrow 2\text{Fe} (\text{C}) + 2\text{Al}_2\text{O}_3$

**Q. 2.** Identify B and D which are oxides of:

- (A) B – Fe, D – Al      (B) B – Mg , D – Al  
 (C) B – Al, D - Cu      (D) B – Al, D – Fe

**Ans.** Option (A) is correct.

**Explanation:** B is  $\text{Fe}_2\text{O}_3$ , and D is  $\text{Al}_2\text{O}_3$   
 $2\text{Al} + \text{Fe}_2\text{O}_3 (\text{B}) \longrightarrow 2\text{Fe} + 2\text{Al}_2\text{O}_3 (\text{D})$

**Q. 3.** Amphoteric oxides are:

- (A) Metal oxides which do not react with acids but reacts with bases.  
 (B) Metal oxides which reacts with both acids as well as bases.  
 (C) Metal oxides which reacts with acids but do not react with bases.  
 (D) Metal oxides which shows no reaction with either acids or bases.

**Ans. Option (B) is correct.**

**Explanation:** Metal oxides which react with both acids as well as bases to produce salt and water are called amphoteric oxides.

**Examples:**



**Q. 4.** Which of the following is amphoteric in nature?

- (A) Both aluminium oxide and zinc oxide
- (B) Only zinc oxide
- (C) Only aluminium oxide
- (D) Neither of them.

**Ans. Option (A) is correct.**

**Explanation:** Aluminium oxide reacts with hydrochloric acid to produce aluminium chloride (salt) and behaves as basic oxide. Similarly, it also reacts with sodium hydroxide (base) to produce sodium aluminate (salt) and behaves as acidic oxide.



Zinc oxide reacts with hydrochloric acid to produce zinc chloride and behaves as basic oxide. Similarly, it also reacts with sodium hydroxide to produce sodium zincate and behaves as acidic oxide.

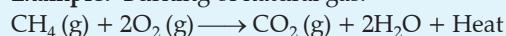
**Q. 5.** The reaction in which heat is generated is called as:

- (A) Exothermic reaction
- (B) Endothermic reaction
- (C) Decomposition reaction
- (D) Precipitation reaction

**Ans. Option (A) is correct.**

**Explanation:** Reaction in which heat is released along with formation of products are called exothermic reactions.

**Example:** Burning of natural gas.



**III. Read the following and answer any four questions from Q.1. to Q.5.**

Sohan went door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was sad but after a futile argument, the man beat a hasty retreat.

**Q. 1.** Which of the following is used for dissolution of gold?

- (A) Hydrochloric acid (B) Sulphuric acid
- (C) Nitric acid (D) Aqua regia

**Ans. Option (D) is correct.**

**Explanation:** Aqua Regia is a mixture of concentrated  $\text{HNO}_3$  and concentrated HCl. It is used for dissolution of gold.

**Q. 2.** The composition of aqua-regia is

- (A) Dil. HCl: Conc.  $\text{HNO}_3$  3: 1
- (B) Conc. HCl: Dil.  $\text{HNO}_3$  3: 1
- (C) Conc. HCl: Conc.  $\text{HNO}_3$  3: 1
- (D) Dil. HCl: Dil.  $\text{HNO}_3$  3: 1

**Ans. Option (C) is correct.**

**Explanation:** Aqua regia is a mixture of nitric acid and hydrochloric acid, that is 3 part conc. HCl and one part conc.  $\text{HNO}_3$  (3 : 1).

**Q. 3.** Which of the following is incorrect?

- (A) Aqua regia is a strong oxidising agent.
- (B) Aqua regia is a strong reducing agent.
- (C) Aqua regia dissolves gold in it.
- (D) Aqua regia is a mixture of hydrochloric acid and nitric acid.

**Ans. Option (B) is correct.**

**Explanation:** Aqua Regia is a strong oxidizing agent due to the formation of  $\text{NOCl}$  (Nitrosyl chloride) and chlorine produced by reaction of two acids.

**Q. 4.** Aqua regia dissolves:

- (A) Gold and platinum
- (B) Gold and silver
- (C) Platinum and silver
- (D) Only gold

**Ans. Option (A) is correct.**

**Explanation:** Aqua Regia is a mixture of concentrated  $\text{HNO}_3$  and concentrated HCl. Concentrated  $\text{HNO}_3$  acts as a very strong oxidising agent which ionises Au atoms and Concentrated HCl produces nascent chlorine which in turn reacts with ionised Au atoms thus forming auric chloride.

**Q. 5.** Examples of Noble metals are:

- |              |                      |
|--------------|----------------------|
| (A) Gold     | (B) Silver           |
| (C) Platinum | (D) All of the above |

**Ans. Option (D) is correct.**

**Explanation:** The noble metals are a group of metals that resist oxidation and corrosion in moist air. The noble metals are not easily attacked by acids. Gold, silver and copper are noble metals.

**IV. Read the following and answer any four questions from Q.1. to Q.5.**

During extraction of metals, electrolytic refining is used to obtain pure metals. During the process, the impure metal is made the anode and a thin strip of pure metal is made the cathode. The solution of the metal salt is used as an electrolyte. On passing the current through the electrolyte, the pure metal from the anode dissolves from the electrolyte. An equivalent of pure metal from the electrolyte is deposited on the cathode.

**Q. 1.** The process of purification of the metal obtained after reduction, is called:

- (A) Extraction      (B) Refining  
 (C) Froth floatation      (D) Electrolysis

**Ans.** Option (B) is correct.

**Explanation:** Refining of metal is the process of purification of the metal obtained after reduction.

**Q. 2.** Which of the metals are refined by electrolytic refining?

- (i) Au      (ii) Cu  
 (iii) Na      (iv) K  
 (A) (i) and (ii)      (B) (i) and (iii)  
 (C) (ii) and (iii)      (D) (ii) and (iv)

**Ans.** Option (A) is correct.

**Explanation:** Metals like Cu, Zn, Ag and Au are refined by electrolytic refining.

**Q. 3.** During electrolytic refining of zinc, it gets

- (A) deposited on cathode.  
 (B) deposited on anode.  
 (C) deposited on cathode as well as anode.  
 (D) remains in the solution.

**Ans.** Option (A) is correct.

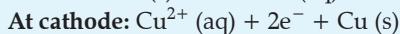
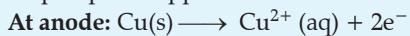
**Explanation:** Ions of zinc are positively charged, thus while electrolytic refining of zinc, zinc is deposited at cathode (negatively charged pole).

**Q. 4.** In electrolytic refining of copper, impure copper act as \_\_\_\_\_ and pure copper as \_\_\_\_\_ :

- (A) cathode, anode      (B) cathode, electrolyte  
 (C) anode, cathode      (D) electrolyte, cathode

**Ans.** Option (C) is correct.

**Explanation:** In electrolytic refining of copper, anode act as impure copper while cathode is a strip of pure copper.



**Q. 5.** The anode is \_\_\_\_\_ and the reaction at the anode is \_\_\_\_\_.

- (A) negative, oxidation (B) negative, reduction  
 (C) positive, oxidation (D) positive, reduction

**Ans.** Option (C) is correct.

**Explanation:** The anode is positive and cathode is negative electrode. The reaction at the anode is oxidation and that at the cathode is reduction.

**V. Read the following and answer any four questions from Q.1. to Q.5.**

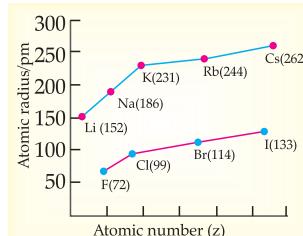
#### Metallic Character:

The ability of an atom to donate electrons and form positive ion (cation) is known as electro-positivity or metallic character. Down the group, metallic character increases due to increase in atomic size and across the period, from left to right electro-positivity decreases due to decrease in atomic size.

#### Non-Metallic Character:

The ability of an atom to accept electrons to form a negative ion (anion) is called non-metallic character or electronegativity. The elements having high electro-negativity have a higher tendency to gain electrons and form anion.

Down the group, electronegativity decreases due to increase in atomic size and across the period, from left to right electro-negativity increases due to decrease in atomic size.



**Q. 1.** Which of the following correctly represents the decreasing order of metallic character of Alkali metals plotted in the graph? [U]

- (A) Cs > Rb > Li > Na > K  
 (B) K > Rb > Li > Na > Cs  
 (C) Cs > Rb > K > Na > Li  
 (D) Cs > K > Rb > Na > Li

**Ans.** Option (C) is correct.

**Explanation:** As we move down the group atomic radius increases so the metallic character also increases. So, the correct sequence is : Cs > Rb > K > Na > Li

**Q. 2.** Hydrogen is placed along with Alkali metals in the modern periodic table though it shows non-metallic character: [U]

- (A) as Hydrogen has one electron & readily loses electron to form negative ion.  
 (B) as Hydrogen can easily lose one electron like alkali metals to form positive ion.  
 (C) as Hydrogen can gain one electron easily like Halogens to form negative ion.  
 (D) as Hydrogen shows the properties of non-metals.

**Ans.** Option (B) is correct.

**Explanation:** Hydrogen is placed along with Alkali metals in the modern periodic table though it shows non-metallic character as Hydrogen can easily lose one electron like alkali metals to form positive ion.

**Q. 3.** Which of the following has highest electronegativity? [C]

- (A) F      (B) Cl  
 (C) Br      (D) I

**Ans.** Option (A) is correct.

**Explanation:** Electronegativity increases when moves towards period and decrease when toward group.

- Q. 4.** Identify the reason for the gradual change in electronegativity in halogens down the group.
- Electronegativity increases down the group due to decrease in atomic size.
  - Electronegativity decreases down the group due to decrease in tendency to lose electrons.
  - Electronegativity decreases down the group due to increase in atomic radius/ tendency to gain electron decreases.
  - Electronegativity increases down the group due to increase in forces of attractions between nucleus & valence electrons.

**Ans.** Option (C) is correct.

*Explanation:* Electronegativity decreases down the group due to increase in atomic radius/ tendency to gain electron decreases.

- Q. 5.** Which of the following reason correctly justifies that "Fluorine (72pm) has smaller atomic radius than Lithium (152pm)"?
- F and Li are in the same group. Atomic size increases down the group
  - F and Li are in the same period. Atomic size increases across the period due to increase in number of shells
  - F and Li are in the same group. Atomic size decreases down the group
  - F and Li are in the same period and across the period atomic size/radius decreases from left to right.

**Ans.** Option (D) is correct.

*Explanation:* F and Li are in the same period and across the period atomic size/radius decreases from left to right.

**VI.** In a thermite reaction, a compound of iron reacts with a metal.

**Q. 1.** The metal used is:

- Zinc
- Aluminium
- Magnesium
- None of these.

**Ans.** Option (B) is correct.

*Explanation:* Aluminium (Al) is used in thermite process. Al is the reducing agent.

- Q. 2.** After completion of this reaction, a metal is obtained

in the molten state. Identify the metal:

- Zinc
- Aluminium
- Iron
- Magnesium

**Ans.** Option (C) is correct.

*Explanation:* Al reacts with oxygen to form aluminium oxide ( $\text{Al}_2\text{O}_3$ ) which is amphoteric in nature.

- Q. 3.** The correct equation to justify thermite reaction is:

- $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 - \text{Heat}$ .
- $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 + \text{Heat}$ .
- $\text{Al}_2\text{O}_3 + 2\text{Fe} \rightarrow 2\text{Al} + \text{Fe}_2\text{O}_3 + \text{Heat}$ .
- $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3$ .

**Ans.** Option (B) is correct.

*Explanation:* In the thermite process, iron (III) oxide is heated with aluminium, which results in evolution of high amount of heat which melts iron. This molten iron is used to fill the cracked machine parts.



- Q. 4.** The correct name for  $\text{Fe}_2\text{O}_3$  is:

- Ferrous oxide
- Ferric oxide
- Ferrous hydroxide
- Ferric hydroxide

**Ans.** Option (B) is correct.

*Explanation:* The correct name for  $\text{Fe}_2\text{O}_3$  is ferric oxide.

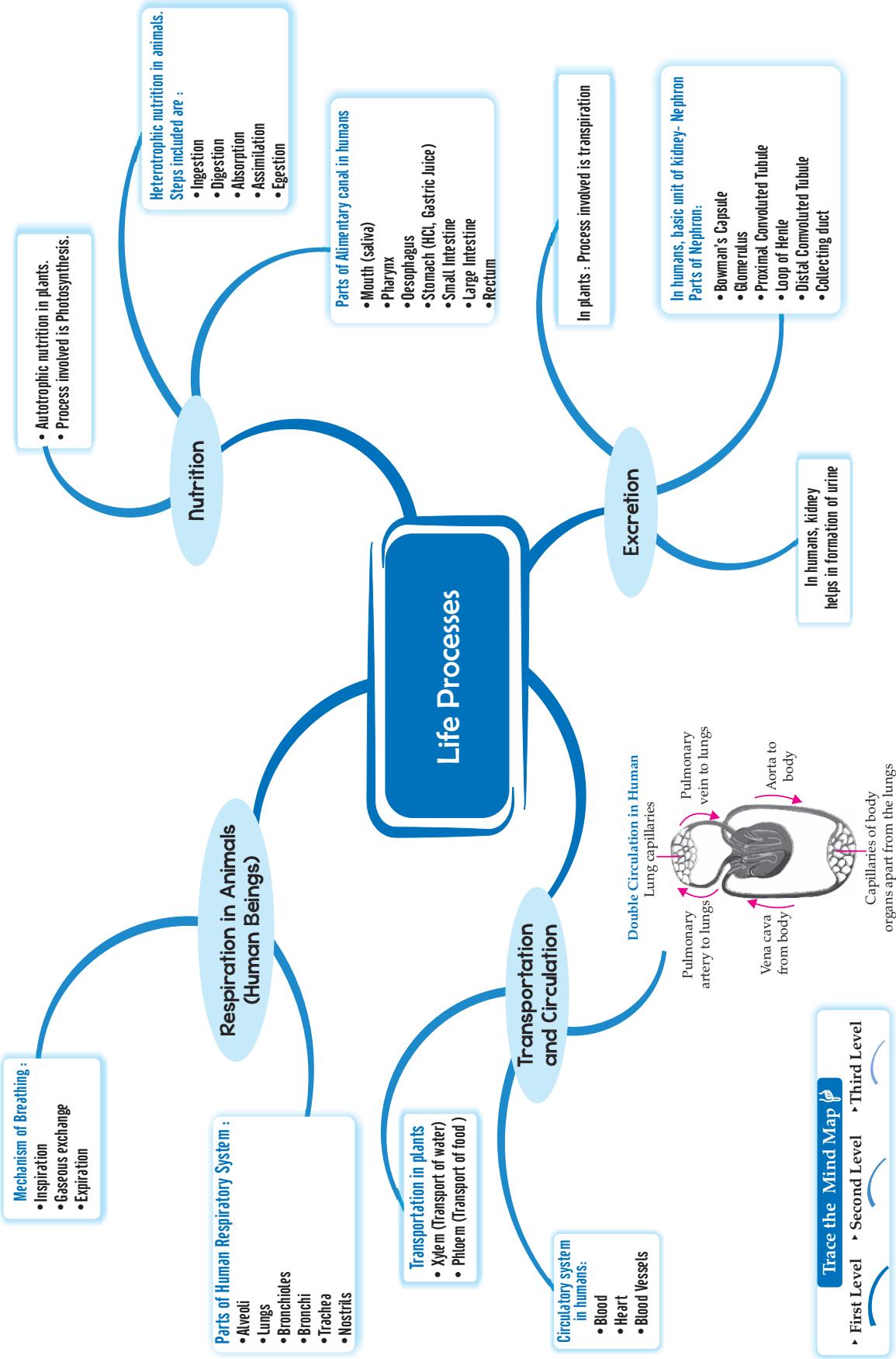


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## UNIT II: WORLD OF LIVING

CHAPTER

# 4

# LIFE PROCESSES

## Syllabus

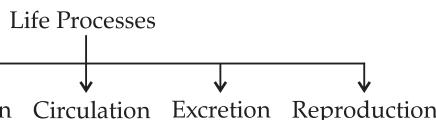
*Life process: Living Being; Basic concept of nutrition, respiration, transport and excretion in plants and animals.*



## Revision Notes

### Nutrition

- All living things perform certain life processes like growth, excretion, respiration, circulation and reproduction etc.
- The basic functions performed by living organisms for their survival and body maintenance are called life processes.
- **Basic life processes are:**



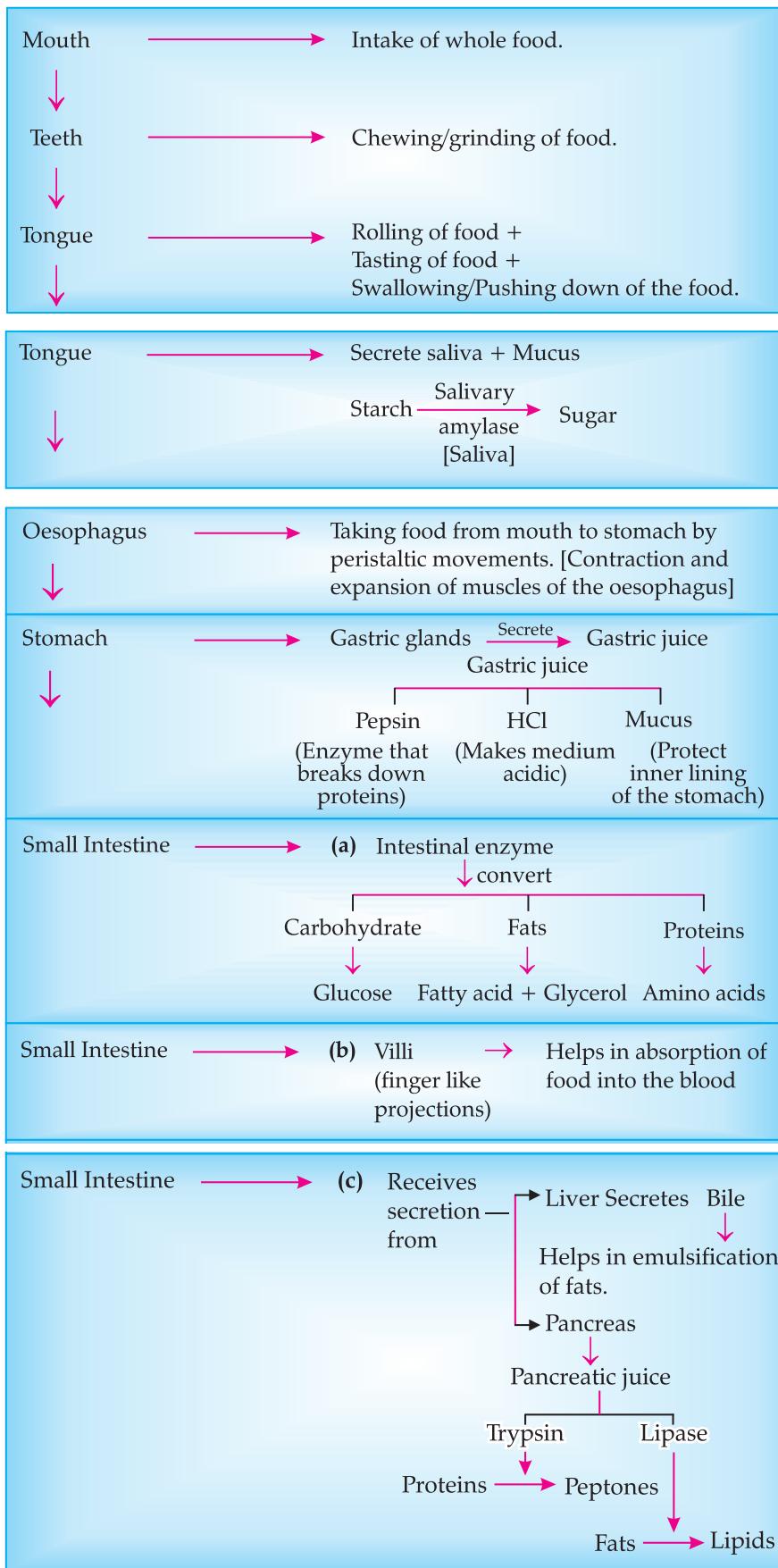
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**Nutrition in Human  
beings**

- Energy required to carry out the different life processes, is obtained from carbon-based food sources through nutrition.
- Depending on the mode of nutrition, organisms are classified as autotrophs and heterotrophs.
  - (i) **Autotrophs** can prepare their own food from simple inorganic sources like carbon dioxide and water. (e.g., green plants, some bacteria).
  - (ii) **Heterotrophs** cannot synthesise their own food and are dependent on the autotrophs for obtaining complex organic substances for nutrition. (e.g., animals)
- Green plants manufacture their food by the process of **photosynthesis**. Here, they utilise CO<sub>2</sub> and H<sub>2</sub>O in presence of sunlight, with the help of chlorophyll and gives out O<sub>2</sub> as a by-product.
- In the light reaction of photosynthesis, light energy is absorbed and converted into chemical energy in the form of ATP and NADPH. Also, water molecules split into hydrogen and oxygen.
- Carbon dioxide is reduced to carbohydrates in the dark phase of photosynthesis.
- Plants carry out exchange of gases with surrounding atmosphere through stomata.
- In humans, digestion of food takes place in the alimentary canal, made up of various organs and glands.

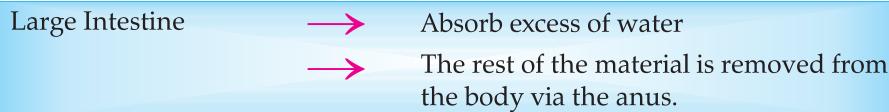
- Liver secretes bile, which emulsifies fat.



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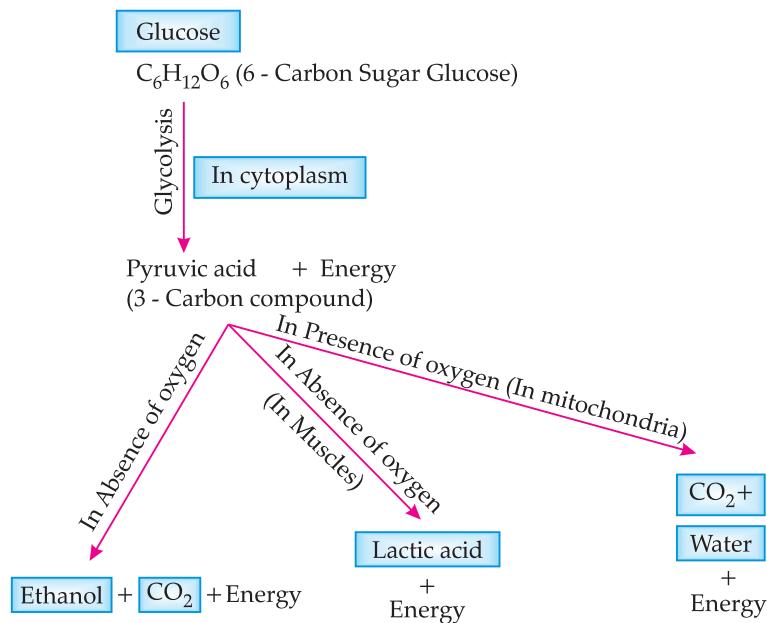


Digestive gland in stomach



## Respiration

- Respiration is the process in living organisms, which involves:
  - (i) **Gaseous exchange:** Intake of oxygen from the atmosphere and release of  $\text{CO}_2 \rightarrow$  Breathing
  - (ii) Breakdown of simple food in order to release energy inside the cell  $\rightarrow$  Cellular respiration
- **Breakdown of Glucose by Various Pathways:**



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Respiration

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Respiration in Plants

- **Types of Respiration:**

Respiration	
Aerobic	Anaerobic
Takes place in the presence of oxygen.	Takes place in the absence of oxygen.
Occurs in mitochondria.	Occurs in cytoplasm.
End products are $\text{CO}_2$ and $\text{H}_2\text{O}$ .	End products are alcohol or lactic acid.
More amount of energy is released.	Less amount of energy is released.
Examples: Most plants and animals.	Examples: Muscles, bacteria, yeast and parasitic worm etc.

- **In humans, air takes the following path on entering the nostrils:**

- Nostrils  $\rightarrow$  Nasal passage  $\rightarrow$  Pharynx  $\rightarrow$  Larynx  $\rightarrow$  Trachea  $\rightarrow$  Bronchus  $\rightarrow$  Bronchiole  $\rightarrow$  Alveolus.
- The alveoli of lungs are richly supplied with blood and are the sites where exchange of gases ( $\text{O}_2$  and  $\text{CO}_2$ ) occurs between blood and atmosphere.
- In humans, the respiratory pigment haemoglobin carries oxygen from lungs to different tissues of the body.
- In plants, gaseous exchange takes place through stomata in leaves, lenticels in stems, general surface of roots and transpiration.

## Circulation and Transportation

### Human Circulatory System

- The circulatory system in human beings consists of: A circulatory medium (blood and lymph), blood vessels (veins, arteries and capillaries) and heart.

- Humans have double circulation system. Blood travels twice through the heart in one complete cycle of the body.
- **Pulmonary Circulation:** Blood moves from the heart to the lungs and back to the heart.
- **Systemic Circulation:** Blood moves from the heart to rest of the body and back to the heart.
- Differences between arteries and veins:

Arteries		Veins	
1.	Carry oxygenated blood from heart to different body parts except pulmonary artery.	1.	Carry deoxygenated blood from different body parts to the heart except pulmonary vein.
2.	Also called distributing vessel.	2.	Also called collecting vessel.
3.	Walls thick, elastic and muscular.	3.	Thin, non muscular and less elastic.
4.	Deep seated	4.	Superficial as compared to arteries.
5.	Have no valves	5.	Have valves, which prevent backward flow of blood.

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Circulation in  
humans

- There are two main conducting channels in vascular plants. These are Xylem and Phloem.

Xylem		Phloem	
1.	Transports water and minerals from the roots to upper parts of the plant.	1.	Transports product of photosynthesis from leaves to the non-photosynthesising parts of the plants such as root & stem.
2.	No energy is used for transport.	2.	Energy is used from ATP for transport.
3.	On maturity, the xylem becomes dead tissue and gives mechanical support to the plant.	3.	Phloem exists as living soft tissue.

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Transportation of  
water in plant cells

- **Transpiration:** It is the process of loss of water as vapours from aerial parts of the plant.

## Excretion

### Excretion in Human

- During excretion, the harmful metabolic nitrogenous wastes like urea and uric acid generated are removed from the body.
- Nephrons are the basic filtration units of kidneys. They carry out filtration, selective reabsorption and tubular secretion to form urine in kidney, which is then passed out through the urethra, via the ureters and urinary bladder.
- Each kidney contains many filtration units called as nephrons.
- Nephrons are made up of a cluster of thin walled capillaries called glomerulus which is associated with a cup like structure called as Bowman's capsule and the long tube which terminates through this capsule.
- The renal artery brings oxygenated blood to the kidneys along with the nitrogenous wastes like urea and uric acid and many other substances.
- The blood gets filtered through the glomerulus and this filtrate enters the tubular part of nephron.
- As this filtrate moves down the tubular part, glucose, amino acids, salts and excess of water gets selectively reabsorbed by the blood vessels surrounding tubules.
- **The amount of water re-absorbed depends upon:**
  - (A) How much excess of water is there in the body and,
  - (B) How much nitrogenous wastes need to be excreted out.
- The fluid now flowing in the tubular part is urine, which gets collected in collecting ducts of nephrons.
- These collecting ducts together leave the kidney at a common point by forming the ureter.
- Each ureter drains the urine in the urinary bladder where it is stored until the pressure of expanded bladder leads to an urge to pass it out through urethra.
- This bladder is a muscular structure which is under nervous control.
- 180 litres of filtrate is formed daily but only 2 litres is excreted out as urine so the rest is reabsorbed in the body.
- In case of kidney failure, haemodialysis is the process of purifying blood by an artificial kidney.
- **Excretion in plants:** In plants, excretion of oxygen, CO<sub>2</sub> and water takes place through stomata by the process of transpiration.

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Excretion  
in Plants



## Mnemonics

**Concept: Parts of an alimentary canal in humans.**

**Mnemonics: MOSS DJ I LA – remember this as “Kate MOSS is a DJ In LA”**

**Interpretation:**

**M = Mouth**

**S = Stomach**

**D = Duodenum**

**I = Ileum**

**A = Anus**

**O = Oesophagus**

**S = Small Intestine (made up of)**

**J = Jejunum**

**L = Large Intestine**



## Know the Terms

- **Metabolism:** It is the sum total of all the chemical reactions which occur in a living being due to interaction amongst its molecules. It has two components: Anabolism (build-up reactions) and Catabolism (breakdown reactions).
- **Photosynthesis:** It is the process of synthesis of organic food from inorganic raw materials like  $\text{CO}_2 + \text{H}_2\text{O}$  with the help of light energy, inside chlorophyll containing cells.
- **Photolysis:** Photolysis of water is photocatalytic splitting of water into its components, hydrogen and oxygen.  

$$2\text{H}_2\text{O} \longrightarrow 4\text{H}^+ + 4\text{e}^- + \text{O}_2$$
- **Peristalsis:** It is a wave of contraction behind the food and expansion in the region of contained food that occurs in the alimentary canal for pushing the food from anterior to posterior ends.
- **Succus Entericus:** It is the name of digestive juice of small intestine, also known as intestinal juice.
- **Emulsification:** Emulsification of fats is conversion of large fat pieces into very fine fat globules.
- **Phagocytosis:** It is the process of ingestion of solid food particle by a cell or unicellular organism.
- **Circumvallation:** This is the method of intake of food when *Amoeba* comes in contact with a food particle or prey, it throws pseudopodia all around the prey. The tips of encircling pseudopodia fuse and the prey comes to lie in a vesicle or phagosome.
- **Cutaneous Respiration:** It is the mode of exchange of respiratory gases that occurs through skin.
- **Branchial Respiration:** It is the respiration performed with the help of gills.
- **Aerobic respiration:** It is the step-wise complete oxidative breakdown of respiratory substrate into carbon dioxide and water with the help of oxygen that act as terminal oxidant.
- **Glycolysis (EMP pathway):** It is the first step of breakdown of respiratory substrate which occurs in cytoplasm and produces two molecules of pyruvate from a molecule of glucose.
- **Kreb's Cycle:** It is a cyclic series of metabolic reactions of aerobic respiration that occur inside mitochondria.
- **Haemolysis:** It is the process of destruction of RBC's.
- **Serum:** It is a whitish watery fluid that is squeezed out from contracting blood clot.
- **Diapedesis:** It is the crawling of white blood corpuscles out of blood capillaries into surrounding tissues.
- **Pulse:** It is a repeated throb felt in a superficial artery of the body due to forceful pumping of the blood. It depends on the rate of heart beat.
- **Ascent of Sap:** It is the upward movement of absorbed water or sap from root to the top of the plant. It occurs through xylem.
- **Excretion:** It is the process of throwing out of waste products and other harmful chemicals from the body.
- **Nephric Filtrate:** It is the fluid passed out of glomerulus due to ultrafiltration in the malpighian capsule of a nephron.
- **Ultrafiltration:** It is the filtration under pressure of small particles, solutes and solvents, through a finely porous membrane.

- **Glomerulus:** It is a bunch of fine blood vessels or capillaries present in the depression of Bowman's capsule where ultrafiltration occurs.
- **Micturition:** It is the expulsion of urine from the body.
- **Bowman's Capsule:** It is a broad, blind, cup-shaped, proximal end of a nephron in which glomerulus is located for ultrafiltration.
- **Osmoregulation:** It is the maintenance of a fixed osmotic concentration of body fluids by controlling the amount of water and salts.



## STAND ALONE MCQs

(1 Mark each)

- Q. 1.** Which of the following statements about the autotrophs is incorrect?
- They synthesise carbohydrates from carbon dioxide and water in the presence of sunlight and chlorophyll.
  - They store carbohydrates in the form of starch.
  - They convert carbon dioxide and water into carbohydrates in the absence of sunlight.
  - They constitute the first trophic level in food chains
- Ans. Option (C) is correct.**
- Explanation:* Autotrophs take in food from the outside world and convert them into stored forms of energy. This material is taken in the form of carbon dioxide and water which is converted into carbohydrates in the presence of sunlight and chlorophyll.
- Q. 2.** In which of the following groups of organisms, food material is broken down outside the body and absorbed?
- Mushroom, green plants, *Amoeba*
  - Yeast, mushroom, bread mould
  - Paramecium, Amoeba, Cuscuta*
  - Cuscuta*, lice, tapeworm
- Ans. Option (B) is correct.**
- Explanation:* These are saprotrophs and digestion in saprotrophs take place before ingestion. They break down and convert complex organic molecules present in dead and decaying matter into simpler substances outside their body.
- Q. 3.** Which is the correct sequence of parts in human alimentary canal?
- Mouth → stomach → small intestine → oesophagus → large intestine
  - Mouth → oesophagus → stomach → large intestine → small intestine
  - Mouth → stomach → oesophagus → small intestine → large intestine
  - Mouth → oesophagus → stomach → small intestine → large intestine
- Ans. Option (D) is correct.**
- Explanation:* The sequence of organs in human alimentary canal are: Mouth, oesophagus, stomach, small intestine, large intestine and anus.
- Q. 4.** If salivary amylase is lacking in the saliva, which of the following events in the mouth cavity will be affected?
- Proteins breaking down into amino acids
  - Starch breaking down into sugars
  - Fats breaking down into fatty acids and glycerol
  - Absorption of vitamins
- Ans. Option (B) is correct.**
- Explanation:* If salivary amylase is lacking in the saliva, the process of starch digestion will get disturbed as salivary amylase helps in digestion of starch.
- Q. 5.** Select the correct statement.
- Heterotrophs do not synthesise their own food.
  - Heterotrophs utilise solar energy for photosynthesis.
  - Heterotrophs synthesise their own food.
  - Heterotrophs are capable of converting carbon dioxide and water into carbohydrates.
- Ans. Option (A) is correct.**
- Explanation:* Heterotrophs are organisms which cannot make their own food from inorganic substances like CO<sub>2</sub> and water as they do not have chlorophyll to trap solar energy. They depend on other organisms for their food. Autotrophs synthesize their own food through photosynthesis by utilizing solar energy, e.g., green plants.
- Q. 6.** The autotrophic mode of nutrition requires
- carbon dioxide and water
  - chlorophyll
  - sunlight
  - all of these
- Ans. Option (D) is correct.**
- Explanation:* The autotrophic mode of nutrition requires carbon dioxide, water, chlorophyll and sunlight.
- Q. 7.** The inner lining of stomach is protected by one of the following from hydrochloric acid. Choose the correct one.
- Pepsin
  - Mucus
  - Salivary amylase
  - Bile

**Ans. Option (B) is correct.**

**Explanation:** The stomach has a lining of mucus cells. The mucus is secreted in the gastric juice by the glands present in the stomach wall. It helps to protect the wall of stomach from its own secretions of hydrochloric acid. If mucus is not secreted, HCl will cause the erosion of inner lining of stomach leading to ulcer formation.

**Q. 8.** A few drops of iodine solution were added to rice water. The solution turned blue-black in colour. This indicates that rice water contains

- (A) complex proteins (B) simple proteins  
(C) fats (D) starch

[A]

**Ans. Option (D) is correct.**

**Explanation:** The formation of blue-black colour of rice water confirms the presence of starch. Starch forms a dark blue complex with iodine. When iodine is added it will show no colour change in case of proteins or fats.

**Q. 9.** The breakdown of pyruvate to give carbon dioxide, water and energy takes place in

- (A) cytoplasm (B) mitochondria  
(C) chloroplast (D) nucleus

**Ans. Option (B) is correct.**

**Explanation:** The breakdown of pyruvate to give carbon dioxide, water and energy takes place in mitochondria.

**[AI] Q. 10.** The correct sequence of anaerobic reactions in yeast is

- (A) Glucose  $\xrightarrow{\text{cytoplasm}}$  Pyruvate  $\xrightarrow{\text{mitochondria}}$  Ethanol + Carbon dioxide  
(B) Glucose  $\xrightarrow{\text{cytoplasm}}$  Pyruvate  $\xrightarrow{\text{cytoplasm}}$  Lactic acid  
(C) Glucose  $\xrightarrow{\text{cytoplasm}}$  Pyruvate  $\xrightarrow{\text{mitochondria}}$  Lactic acid  
(D) Glucose  $\xrightarrow{\text{cytoplasm}}$  Pyruvate  $\xrightarrow{\text{cytoplasm}}$  Ethanol + Carbon dioxide

[U]

**Ans. Option (D) is correct.**

**Explanation:** Yeast is an unicellular eukaryote which carries out ethanol fermentation. In the first phase, glucose is converted into pyruvate (glycolysis) in the cytoplasm of the cell. Due to limited oxygen availability, pyruvate remains in cytoplasm where pyruvate decarboxylase and alcohol dehydrogenase enzymes carry out the second phase of anaerobic respiration and produce ethanol and carbon dioxide.

**[AI] Q. 11.** Which of the following statement(s) is (are) correct?

- (i) Pyruvate can be converted into ethanol and carbon dioxide by yeast.  
(ii) Fermentation takes place in aerobic bacteria.

(iii) Fermentation takes place in mitochondria.

(iv) Fermentation is a form of anaerobic respiration.

- (A) (i) and (iii) (B) (ii) and (iv)  
(C) (i) and (iv) (D) (ii) and (iii)

[R]

**Ans. Option (C) is correct.**

**Explanation:** Yeast is a unicellular organism which brings out ethanol fermentation. The first stage is break down of one molecule of glucose into two molecules of pyruvate that occurs in cytoplasm. Because of limited oxygen availability, pyruvate remains in cytoplasm where pyruvate decarboxylase and alcohol dehydrogenase enzymes carry out the second phase of anaerobic respiration and produce ethanol and carbon dioxide.

**Q. 12.** During deficiency of oxygen in tissues of human beings, pyruvic acid is converted into lactic acid in the

- (A) cytoplasm (B) chloroplast  
(C) mitochondria (D) golgi body

**Ans. Option (A) is correct.**

**Explanation:** Lactic acid is formed after anaerobic respiration in muscle cells and this happens in cytoplasm.

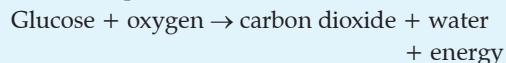
**Q. 13.** Which of the following completes the given equation? Glucose + Oxygen  $\rightarrow$  (?)

- (A) Only carbon dioxide + water + energy  
(B) Only carbon dioxide + water  
(C) Only carbon dioxide  
(D) Only water + energy

[U]

**Ans. Option (A) is correct.**

**Explanation:** The given equation represents aerobic respiration.



**Q. 14.** Which of the following take place after we exercise?

- (A) Our body needs more oxygen.  
(B) Our body needs to replace the energy used.  
(C) Our body needs to get rid of excess carbon dioxide.  
(D) All of these

[U]

**Ans. Option (D) is correct.**

**Explanation:** Our body needs more energy when we do exercise. We get energy by the oxidation of food. Due to exercise the body is able to get rid of excess carbon dioxide.

**Q. 15.** Which of these statements is correct about alveoli?

- (A) They form a very large surface area.  
(B) They have a very thin wall.  
(C) They are covered with blood capillaries.  
(D) All of these

**Ans. Option (D) is correct.**

**Explanation:** Alveoli have a large surface area with very thin walls which is richly supplied with blood vessels and are always moist.

- Q. 16.** As air passes through the nasal cavity, it is

  - (A) Filtered in the nostrils
  - (B) Moistened by mucus
  - (C) Warmed to the body temperature
  - (D) All of these

**Ans.** Option (D) is correct.

**Explanation:** Before air is breathed into the lungs, it is filtered in the nostrils, moistened by mucus and gets warmer equal to the body temperature.

- Q. 17.** What prevents back flow of blood inside the heart during contraction?

(A) Valves in heart  
(B) Thick muscular walls of ventricles  
(C) Thin walls of atria  
(D) All of the above

Ans. Option (A) is correct.

**Explanation:** Valves ensure that blood does not flow backwards when the atria or ventricles contract. Semilunar valves, the valves present between ventricles and their attached vessels, serve to prevent the backflow of blood to ventricles from their respective attached vessels. Likewise, atrioventricular (AV) valve between atrium and ventricle directs the flow of blood and prevents any backflow into atria.

- Q. 18.** Single circulation, i.e., blood flows through the heart only once during one cycle of passage through the body, is exhibited by

  - (A) *Labeo, Chameleon, Salamander*
  - (B) *Hippocampus, Exocoetus, Anabas*
  - (C) *Hyla, Rana, Draco*
  - (D) *Whale, Dolphin, Turtle*

Ans. Option (B) is correct.

**Explanation:** *Hippocampus*, *Exocoetus*, *Anabas* belong to class pisces. Fishes have two chambered heart and exhibit single circulation while three chambered heart of amphibians and reptiles and four chambered heart of birds and mammals exhibit double circulation.

- Q. 19.** The blood leaving the tissues becomes richer in  
(A) carbon dioxide      (B) water  
(C) haemoglobin      (D) oxygen

**Ans.** Option (A) is correct.

**Explanation:** The anterior vena cava collects deoxygenated blood from the head, chest, and arms and enters the right atrium while the inferior vena cava collects blood from the lower body regions. Both venae cavae pass the deoxygenated blood to the right atrium. Therefore, blood from tissues is rich in carbon dioxide.

- Q. 20.** The xylem in plants are responsible for  
(A) transport of water  
(B) transport of food

- (C) transport of amino acids
  - (D) transport of oxygen

**Ans. Option (A) is correct.**

**Explanation:** In a plant, the xylem is responsible for transport of water.

- Q. 21.** Which of the following statement(s) is (are) true about heart?

- (i) Left atrium receives oxygenated blood from different parts of body while right atrium receives deoxygenated blood from lungs.
  - (ii) Left ventricle pumps oxygenated blood to different body parts while right ventricle pumps deoxygenated blood to lungs.
  - (iii) Left atrium transfers oxygenated blood to right ventricle which sends it to different body parts.
  - (iv) Right atrium receives deoxygenated blood from different parts of the body while left ventricle pumps oxygenated blood to different parts of the body

Ans. Option (C) is correct

**Explanation:** Blood from right atrium enters right ventricle and pulmonary arteries carry deoxygenated blood from right ventricle to lungs for oxygenation.

- Q. 22.** In which of the following vertebrate group/ groups, heart does not pump oxygenated blood to different parts of the body?

- (A) Pisces and amphibians
  - (B) Amphibians and reptiles
  - (C) Amphibians only
  - (D) Pisces only

Ans. Option (D) is correct

**Explanation:** In fishes, heart sends the blood to gills from where blood is circulated to different organs.

- Q.23.** Choose the correct statement that describes arteries.

- (A) They have thick elastic walls, blood flows under high pressure; collect blood from different organs and bring it back to the heart.
  - (B) They have thin walls with valves inside, blood flows under low pressure and carry blood away from the heart to various organs of the body.
  - (C) They have thick elastic walls, blood flows under low pressure; carry blood from the heart to various organs of the body.
  - (D) They have thick elastic walls without valves inside, blood flows under high pressure and carry blood away from the heart to different parts of the body. [U]

**Ans.** Option (D) is correct.

**Explanation:** Arteries are the valveless blood vessels which serve to transport the blood away from the heart to various body parts. The thick strong elastic walls of arteries withstand the high pressure of blood coming from heart.

**Q. 24.** Which of these statements is correct about the function of blood?

- (A) It helps in transportation of respiratory gases.
- (B) It regulates body temperature.
- (C) It helps in transportation of waste products.
- (D) All the above

**Ans. Option (D) is correct.**

**Explanation:** Blood has many different functions, like transporting oxygen and nutrients to the lungs and tissues, regulating body temperature, forming blood clots to prevent excess blood loss, and carrying cells and antibodies that fight infection.

**Q. 25.** The filtration units of kidneys are called

- (A) ureter
- (B) urethra
- (C) neurons
- (D) nephrons

R

**Ans. Option (D) is correct.**

**Explanation:** Nephrons are the structural and functional unit of kidney that serve in filtration, reabsorption and secretion. Ureters are small muscular tubes that extend from the kidney and carry urine into the urinary bladder.

The urethra is a canal that carries urine from bladder and expels it out of body. Neurons are structural and functional unit of nervous system.

**Q. 26.** The kidneys in human beings are a part of the system for

- (A) nutrition
- (B) respiration
- (C) excretion
- (D) transportation.

R

**Ans. Option (C) is correct.**

**Explanation:** In human beings, the kidneys are a part of the system for excretion.

**AI Q. 27.** Match the words of Column (A) with that of Column (B)

S. No.	Column (A)		Column (B)
A	Phloem	(i)	Excretion
B	Nephron	(ii)	Translocation of food
C	Veins	(iii)	Clotting of blood
D	Platelets	(iv)	Deoxygenated blood

- (A) A - (ii), B - (i), C - (iv), D - (iii)
- (B) A - (iii), B - (ii), C - (i), D - (iv)
- (C) A - (iv), B - (iii), C - (ii), D - (i)
- (D) A - (i), B - (iv), C - (iii), D - (iv)

**Ans. Option (A) is correct.**

**Explanation:**

S. No.	Column (A)	Column (B)	Explanation
A	Phloem	(ii)	Phloem helps in translocation of food.
B	Nephron	(i)	Nephron helps in excretion.
C	Veins	(iv)	Veins carry deoxygenated blood.
D	Platelets	(iii)	Platelets helps in clotting of blood.

**Q. 28.** Which of the following is the structural and functional unit of the excretory system?

- (A) Neuron
- (B) Nephron
- (C) Alveolus
- (D) Both (A) and (B)

**Ans. Option (B) is correct.**

**Explanation:** Nephron is the structural and functional unit of excretory system.

**Q. 29.** Choose the correct path of urine in our body :

- (A) kidney → ureter → urethra → urinary bladder
- (B) kidney → urinary bladder → urethra → ureter
- (C) kidney → ureters → urinary bladder → urethra
- (D) urinary bladder → kidney → ureter → urethra

**Ans. Option (C) is correct.**

**Explanation:** Kidneys are the paired organ where urine formation takes place. Small muscular tube, called as ureter, extend from kidneys and carry blood to urinary bladder. The urethra is a small tube that extends from the urinary bladder to an external opening.

**Q. 30.** Which of the following substances are removed from blood in the kidneys?

- (A) Water
- (B) Urea
- (C) Sodium
- (D) Ammonia

**Ans. Option (B) is correct.**

**Explanation:** Urea is removed by the blood in kidneys by filtration.

**Q. 31.** Each nephron has a cup shaped upper end called \_\_\_\_\_, which contains a \_\_\_\_\_.

- (A) Bowman's capsule, Ampulla
- (B) Capillaries, Bowman's capsule
- (C) Ampulla, Glomerulus
- (D) Bowman's capsule, Glomerulus

**Ans. Option (D) is correct.**

**Explanation:** The upper cup shaped end of a nephron is called Bowman's capsule. It contains glomerulus which is a group of blood capillaries.

- Q. 32.** Which of the following is used artificially to remove nitrogenous waste products from the blood?
- (A) Ventilator      (B) Transfusion  
 (C) Hemodialysis    (D) Angiogram

**Ans. Option (C) is correct.**

**Explanation:** Hemodialysis is used to remove nitrogenous waste products from the blood.



## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- (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 true but R is false.  
 (D) A is false and R is true.

- Q. 1. Assertion (A):** HCl converts pepsinogen into active enzyme pepsin.

**Reason (R):** Pepsin converts protein into proteoses and peptones.

**Ans. Option (B) is correct.**

**Explanation:** HCl creates an acidic medium, which facilitates activation of pepsinogen into pepsin. The active enzyme pepsin converts proteins into proteoses and peptones.

- Q. 2. Assertion (A):** Digestion breaks large complex molecules to simple smaller molecules which can be easily absorbed.

**Reason (R):** Digestion is necessary for the absorption of all molecules.

**Ans. Option (C) is correct.**

**Explanation:** Digestion breaks large complex organic molecules to simple smaller ones which can be easily absorbed. However, certain molecules such as glucose, vitamin C etc, do not need any digestion before their absorption.

- Q. 3. Assertion (A):** Muscles of stomach wall possess thick layers of muscle fibers.

**Reason (R):** These muscles help in mixing the food with the enzymes present in the alimentary canal.

**Ans. Option (A) is correct.**

**Explanation:** The lining of alimentary canal has muscles that contract rhythmically in order to push the food forward. This is known as *peristaltic movement*.

- Q. 4. Assertion (A):** Lipases help in emulsification of fats.

**Reason (R):** Lipases hydrolyses fats and oils.

**Ans. Option (D) is correct.**

**Explanation:** Bile helps in emulsification of fats whereas lipases are the enzymes which hydrolyze fats and oils.

- Q. 5. Assertion (A):** Photosynthesis is an anabolic process.

**Reason (R):** The process of photosynthesis occurs in chlorophyll.

**Ans. Option (C) is correct.**

**Explanation:** Photosynthesis is an anabolic process as it takes  $\text{CO}_2$  and  $\text{H}_2\text{O}$  and then assembles them into glucose. The process of photosynthesis occurs in chloroplast.

- Q. 6. Assertion (A):** Energy is used during the process of respiration.

**Reason (R):** Respiration stores energy in the form of ATP.

**Ans. Option (D) is correct.**

**Explanation:** Respiration involves the oxidation of glucose inside the mitochondria to produce energy, which is stored in the high energy bonds of ATP molecules as biologically useful energy.

- Q. 7. Assertion (A):** Humans are not truly aerobic.

**Reason (R):** They produce lactic acid anaerobically.

**Ans. Option (B) is correct.**

**Explanation:** Humans are aerobically respiring animals, but sometimes anaerobic respiration takes place in certain tissues like skeletal muscles, which do not get immediately as much oxygen as it requires. Therefore, the muscles respire anaerobically and produce lactic acid from glucose.

- Q. 8. Assertion (A):** In humans, there is a complex respiratory system.

**Reason (R):** Human skin is impermeable to gases.

**Ans. Option (B) is correct.**

**Explanation:** Humans need more oxygen to maintain their high metabolic rates. Thus, a complex respiratory system has evolved so as to meet this need.

- Q. 9. Assertion (A):** Alveoli contain an extensive network of blood vessels.

**Reason (R):** Alveoli is the site where exchange of gases occurs.

**Ans. Option (A) is correct.**

**Explanation:** The alveoli of lungs are richly supplied with blood and are the sites where exchange of gases ( $O_2$  and  $CO_2$ ) occurs between blood and atmosphere.

**Q. 10. Assertion (A):** The muscular walls of ventricles are thicker than auricles.

**Reason (R):** This helps in preventing the back flow of blood.

**Ans. Option (C) is correct.**

**Explanation:** Since ventricles have to pump blood into various organs, they have thicker muscular walls than atria do. Valves prevent back flow of blood.

**Q. 11. Assertion (A):** In human heart, there is no mixing of oxygenated and deoxygenated blood.

**Reason (R):** Valves are present in the heart which allows the movement of blood in one direction only.

**Ans. Option (B) is correct.**

**Explanation:** There is no mixing of oxygenated and deoxygenated blood due to presence of inter-auricular and inter - ventricular septum.

On the other hand, valves are present in the heart which allows the movement of blood in one direction only.

**Q. 12. Assertion (A):** Valves are present in the arteries.

**Reason (R):** Arteries carry oxygenated blood from heart to different body parts except pulmonary artery.

**Ans. Option (D) is correct.**

**Explanation:** Valves are absent in arteries, whereas it is present in veins, which prevent back flow of blood.

**Q. 13. Assertion (A):** Plants have low energy needs.

**Reason (R):** Plant bodies have large proportion of dead cells.

**Ans. Option (A) is correct.**

**Explanation:** Because plants have a large proportion of dead cells in many tissues. So, their energy needs are low and they can afford to have slow transport system.

**Q. 14. Assertion (A):** Human body produces highly toxic substances, which if not eliminated may cause the death.

**Reason (R):** Excretory substance removes nitrogenous waste from the body.

**Ans. Option (B) is correct.**

**Explanation:** The biological process which involves the removal of harmful metabolic wastes from the body is called excretion. If these harmful wastes are not removed from the body, then it may cause the death of the organism.

**Q. 15. Assertion (A):** Excretory unit of kidneys are nephrons.

**Reason (R):** It has no role in secretion of urine.

**Ans. Option (C) is correct.**

**Explanation:** Nephrons are the basic filtration unit of kidneys. They carry out filtration, selective reabsorption and tubular secretion to form urine in kidneys, which is then passed out through the urethra, via the ureters and urinary bladder.

**Q. 15. Assertion (A):** Haemodialysis can save the life of patients with kidney failure.

**Reason (R):** Waste products like urea can be removed from the blood by haemodialysis.

**Ans. Option (A) is correct.**

**Explanation:** In case of kidney failure, haemodialysis is the process of purifying blood (or removing waste products like urea) by an artificial kidney. This can save the life of the patient.

**Q. 16. Assertion (A):** In humans, major amount of water is absorbed by the tubular part of nephron.

**Reason (R):** Absorption of water depends on the dissolved waste to be excreted from the body.

**Ans. Option (B) is correct.**

**Explanation:** Major amount of water is selectively re-absorbed by the tubular part of nephron in humans. It depends on the amount of excess water present in the body and dissolved waste to be excreted from the body.



## CASE-BASED MCQs

**Attempt any 4 sub-parts from each question.  
Each sub-part carries 1 mark.**

**I. Read the given passage and answer any of the four questions from Q.1. to Q.5.**

Sanjana is suffering from a frequent stomach pain and vomiting. She went to the Doctor. The doctor asked her to go for an ultrasound. In the report, a

stone was found in her gall bladder. Doctor asked her to remove the gall bladder by operation. But she was reluctant to go for the operation.

**Q. 1. The role played by gall bladder in human body is**

- (A) To store bile
- (B) To secrete bile
- (C) To emulsify fats
- (D) To digest fats

**Ans. Option (A) is correct.**

**Explanation:** Gall bladder stores bile.

**Q. 2.** Removal of gall bladder

- (A) affects the person's health
- (B) Has no effect on the person's health
- (C) Effects the secretion of bile
- (D) Effects the digestion of proteins

**Ans. Option (B) is correct.**

**Explanation:** No, the removal of gall bladder will not affect person's health.

**Q. 3.** Which of the following statement is correct about bile?

- (A) It helps in emulsification of fat.
- (B) It helps in digestion of carbohydrates
- (C) It helps in absorption of digested food.
- (D) It helps in egestion of undigested food.

**Ans. Option (A) is correct.**

**Explanation:** Bile helps in emulsification of fat.

**Q. 4.** Which part of alimentary canal receives bile from the liver?

- (A) Stomach
- (B) Small intestine
- (C) Large intestine
- (D) Oesophagus

**Ans. Option (B) is correct.**

**Explanation:** Bile is dark green or a yellowish brown fluid which is produced by the liver and comes to the small intestine through hepatopancreatic duct.

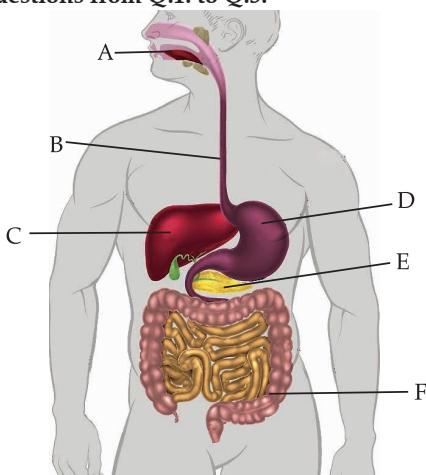
**Q. 5.** What is the function of bile salt in the intestine?

- (A) Activator of lipase
- (B) Emulsifier
- (C) Co factor of cholesteryl esterase
- (D) Inhibitor of lipid absorption

**Ans. Option (B) is correct.**

**Explanation:** Bile contains bile salts that help in proper digestion of fats by breaking down large fat globules into smaller ones, so that enzyme can easily act on it and digest them. This process is known as emulsification of fats.

**AI II.** The given diagram is of human digestive system. Study the diagram and answer any of the four questions from Q.1. to Q.5.



**Q. 1.** Which of these correctly represent the labels B, C, D and E?

- (A) B- Oesophagus, C- Liver, D- Stomach, E- pancreas
- (B) B- Pancreas, C- Oesophagus, D- Liver, E- Stomach
- (C) B- Stomach, C- Pancreas, D- Oesophagus, E- Liver
- (D) B- Liver, C- Stomach, D- Pancreas, E- Oesophagus

**Ans. Option (A) is correct.**

**Explanation:** In the given picture of human digestive system, B is Oesophagus, C is Liver, D is Stomach, and E is pancreas.

**Q. 2.** The secretion that is released by label C is:

- |            |                   |
|------------|-------------------|
| (A) Bile   | (B) Pepsin        |
| (C) Saliva | (D) Gastric juice |

**Ans. Option (A) is correct.**

**Explanation:** Label C represents liver. Liver secretes bile, which is stored in gall bladder.

**Q. 3.** Name the digestive juice that lacks enzyme but helps in digestion.

- |                |                      |
|----------------|----------------------|
| (A) Bile juice | (B) Pancreatic juice |
| (C) Ptyalin    | (D) Pepsin           |

**Ans. Option (A) is correct.**

**Explanation:** Bile juice doesn't contain any enzyme. It helps in digestion of fats.

**Q. 4.** The digestion of food starts in

- |       |       |
|-------|-------|
| (A) A | (B) D |
| (C) E | (D) F |

**Ans. Option (A) is correct.**

**Explanation:** Label A represents mouth. The digestion of food starts in mouth.

**Q. 5.** In case of diarrhoea, which major process does not takes place normally in region F?

- (A) Absorption of food
- (B) Absorption of water
- (C) Secretion of hormones
- (D) Removal of waste material

**Ans. Option (B) is correct.**

**Explanation:** Absorption of water is not occurring normally in region F (Large intestine).

**III.** Study the given flow chart and answer any of the four questions from Q.1. to Q.5.

Carbohydrate

x

Pyruvic acid

y

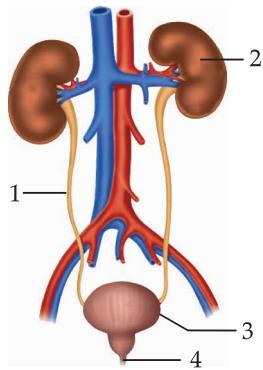
z



**AI Q. 1.** Identify X, Y and Z.

- (A) X-Glycolysis, Y-Anaerobic, Z-Aerobic
- (B) X-Krebs's cycle, Y-Aerobic, Z-Anaerobic





**Q. 1.** Identify the part 1 in excretion.

- (A) Kidney                      (B) Ureter  
(C) Urethra                      (D) Nephron

**Ans. Option (B) is correct.**

**Explanation:** Part 1 is ureter. It transports urine from kidney to urinary bladder.

**Q. 2.** Which of these is the structural and functional unit of part 2?

- (A) Alveoli                      (B) Nephron  
(C) Neuron                      (D) None of these

**Ans. Option (B) is correct.**

**Explanation:** Nephrons are the structural and functional filtration unit of kidney that serve in filtration, reabsorption and secretion.

**Q. 3.** How can we purify the blood by artificial methods?

- (A) Filtration                      (B) Dialysis  
(C) Reabsorption                      (D) All of these

**Ans. Option (B) is correct.**

**Explanation:** Urea is the main waste present in the urine.

**Q. 4.** The main waste present in the urine is:

- (A) Glucose                      (B) Urea  
(C) Blood                              (D) Protein

**Ans. Option (B) is correct.**

**Explanation:** Dialysis is a procedure to remove waste products and excess fluid from the blood when the kidneys stop working properly. It often involves diverting blood to a machine to be cleaned.

**Q. 5.** Choose the correct path of urine in our body:

- (A) kidney → ureter → urethra → urinary bladder  
(B) kidney → urinary bladder → urethra → ureter  
(C) kidney → ureters → urinary bladder → urethra  
(D) urinary bladder → kidney → ureter → urethra

**Ans. Option (C) is correct.**

**Explanation:** Kidneys are the paired organs where urine formation takes place. Small muscular tube, called as ureter, extend from kidneys and carries urine to urinary bladder. The urethra is a small tube that extends from the urinary bladder to an external opening.

**VI. Read the given passage and answer any of the four questions from Q.1. to Q.5.**

Oxygen-rich blood from the lungs comes to the thin-walled upper chamber of the heart on the left. The left upper chamber (A) then relaxes. It then

contracts and the blood is allowed to enter the next chamber (B), as it expands. When the muscular left lower chamber of heart contracts the blood is pumped out to the body via aorta.

Deoxygenated blood reaches from the body to the upper chamber on the right side of heart (C) and it expands. As this part contracts, the corresponding lower chamber (D) dilates. This transfers the blood to right ventricle, which in turn pumps it to the lungs for oxygenated.

**Q. 1.** Which of these correctly represents the label A, B, C and D in the above passage?

- (A) A- Left atrium, B- Left Ventricle, C- Right atrium, D- Right ventricle  
(B) A- Right ventricle, B- Left atrium, C- Left Ventricle, D- Right atrium  
(C) A- Right atrium, B- Right ventricle, C- Left atrium, D- Left ventricle  
(D) A- Left ventricle, B- Right atrium, C- Right ventricle, D- Left atrium

**Ans. Option (A) is correct.**

**Explanation:** A is Left atrium, B is Left Ventricle, C is Right atrium, and D is Right ventricle.

**Q. 2.** Which chambers of human heart contain oxygenated blood?

- (A) A and B                      (B) A and C  
(C) C and B                      (D) C and D

**Ans. Option (A) is correct.**

**Explanation:** A (Left atrium) and B (Left ventricle) contain oxygenated blood from lungs.

**Q. 3.** What is the correct route of blood in a human?

- (A) A → B → Lungs → C → D  
(B) A → B → D → C → Lungs  
(C) C → D → B → A → Lungs  
(D) C → D → Lung → A → B

**Ans. Option (D) is correct.**

**Explanation:** The correct route of blood in a human is : C (Right atrium) → D (Right ventricle) → Lungs → A (Left atrium) → B (Left ventricle).

**Q. 4.** What prevents backflow of blood inside the heart during contraction?

- (A) Valves in heart  
(B) Thick muscular walls of ventricles  
(C) Thin walls of atria  
(D) All of the above

**Ans. Option (A) is correct.**

**Explanation:** Valves prevent the back flow of blood inside the heart during contraction of heart chambers (atria or ventricles).

**Q. 5. Assertion (A):** Human heart does not allow mixing of oxygen rich blood with carbon dioxide rich blood.

**Reason (R):** Human heart has different chambers.

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

- (B) Both A and R are true but R is not the correct explanation of the assertion.
- (C) A is true but R is false.
- (D) A is false but R is true.

**Ans. Option (C) is correct.**

**Explanation:** Human heart is four chambered. It is composed of four chambers : right atrium, right ventricle, left ventricle and left atrium. The chambers are separated by a muscular wall that prevents the mixing of the blood rich in oxygen with the blood rich in carbon dioxide.

**VII. Read the passage and answer any of the four questions from Q.1. to Q.5.**

Some experiments were carried out using *Croton sp.* plants to understand the process of photosynthesis. It was observed that the leaves of the plant exposed to light for longer duration accumulated more starch. However, due to presence of pre-formed starch in the leaves, it was difficult to find the net productivity on a fixed exposure to light source. Therefore, it was necessary to obtain starch free leaves in the plant before starting the experiment.

- Q.1.** Which of the following would help obtain starch free leaves in the plant?
- (A) Expose the leaves to blue light for 48 hours before starting the experiment.
  - (B) Keep the plant in dark for about 48 hours before starting the experiment.
  - (C) Remove starch from the leaves by exosmosis, 48 hours before starting the experiment.
  - (D) Keep the leaves to red light for 48 hours before starting the experiment.

**Ans. Option (B) is correct.**

**Explanation:** The starch free leaves can be obtained by keeping the plant in dark, so that already present starch is utilized in 48 hrs.

- Q.2.** After a period of illumination, the leaves were boiled in alcohol to make them colourless. Which of the following could be used to test the end product stored in the leaves?
- (A) Cobalt chloride paper
  - (B) Litmus paper
  - (C) Iodine solution
  - (D) Copper sulphate solution

**Ans. Option (C) is correct.**

**Explanation:** Starch presence can be tested by adding iodine solution which gives bluish black colour of starch – iodine mixture.

- Q.3.** Some of the starch free leaves were coated with wax on both the surfaces. The plant was maintained under normal environmental conditions. At the end of the experiment, the wax coated leaves are likely to show \_\_\_\_.
- (A) Accumulation of more water.
  - (B) Wilting of the wax coated leaves.
  - (C) Increase in sucrose accumulation.
  - (D) Decrease in number of chloroplasts

**Ans. Option (B) is correct.**

**Explanation:** Wilting occurs due to wax blocks the transpiration so water transportation inhibits.

- Q.4.** During the morning hours, using a fine blade, an incision was made to the leaves such that the phloem tissue was cut open. Analysis of the liquid oozing out was found to contain high amount of:
- (A) Xylose                   (B) Ribose
  - (C) Sucrose                   (D) Galactose

**Ans. Option (C) is correct.**

**Explanation:** The transport of glucose, occurs in the form of sucrose, in phloem therefore, when cell sap oozes out, liquid contains sucrose.

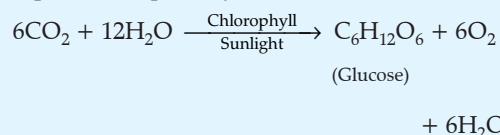
- Q.5.** The equation given below represents photosynthesis. Identify P and Q.
- $$\text{P} + \text{water} \xrightarrow[\text{chlorophyll}]{\text{sunlight}} \text{glucose} + \text{Q}$$

- (A) P - Carbon dioxide, Q - Oxygen
- (B) P - Oxygen, Q - Oxygen
- (C) P - Carbon dioxide, Q - Carbon dioxide
- (D) P - Oxygen, Q - Carbon dioxide

**Ans. Option (A) is correct.**

**Explanation:** The process by which autotrophs take in  $\text{CO}_2$  and  $\text{H}_2\text{O}$  and convert these into carbohydrates in the presence of chlorophyll, and sunlight is called photosynthesis.

Equation for photosynthesis is :

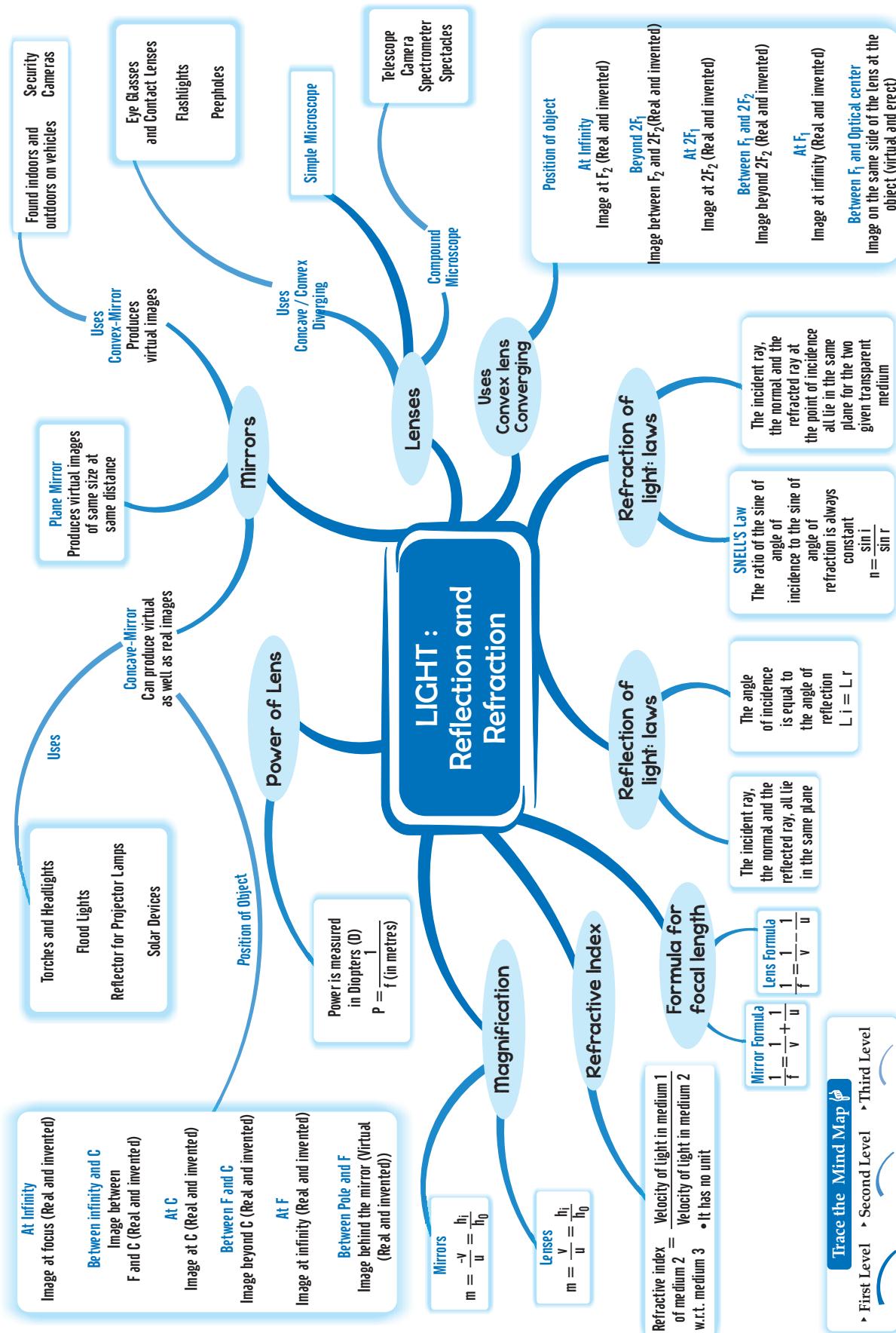


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## UNIT III: Natural Phenomena

CHAPTER

# 5

# LIGHT-REFLECTION AND REFRACTION

## Syllabus

*Reflection of light by curved surfaces; Images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula (Derivation not required), magnification, Refraction; Laws of refraction, refractive index, Refraction of light by spherical lens; Image formed by spherical lenses; Lens formula (Derivation not required); Magnification, Power of a lens.*

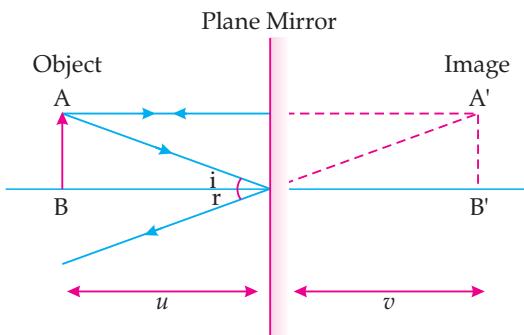


## Revision Notes

### Reflection of Light, Images Formed by Spherical Mirrors

#### Introduction

- When light falls on a body, it may be absorbed, may be transmitted or light may get reflected back to the same medium.
- **Reflection of light** is the phenomenon of bouncing back of the light rays in the same medium.
- **Laws of Reflection:**
  - (i) The incident ray, the reflected ray, the normal, all lie in the same plane at the point of incidence.
  - (ii) The angle of incidence is equal to the angle of reflection.
- **Real image** is obtained when the rays of light after reflection or refraction actually meet at some point. It can be obtained on the screen and can be seen with the eye.
- **Virtual image** forms when rays of light do not actually meet, but appear to meet when produced backwards. It cannot be obtained on the screen.
- **Image Formed by plane Mirror:**



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this topic



Reflection of  
Light

➤ **Characteristics of Image:**

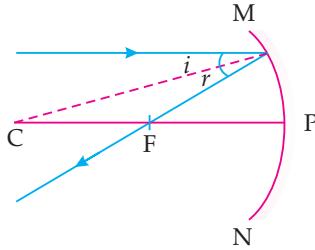
- (i) Virtual and erect.
- (ii) Size of image is equal to the size of object.
- (iii) Image is formed as far as behind the mirror as the object is in front of it.
- (iv) Laterally inverted.

➤ **Lateral Inversion:** The phenomenon due to which the right side of the object appears as left and the left side of the object appears as right. *i.e.*, the image is inverted sideways.

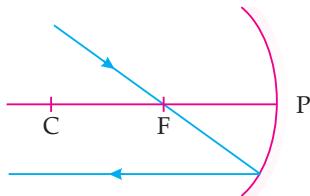
- A spherical mirror whose reflecting surface recessed inward, is concave mirror.
- The spherical mirror, whose reflecting surface bulges towards light source, is a convex mirror.
- Concave mirror mostly forms real images, which can be obtained on the screen. Convex mirror always forms virtual images, which cannot be obtained on the screen.
- **Differentiating between a plane mirror, a concave mirror and a convex mirror, without touching them:**
  - (i) If the formed image is erect, of same size and equidistant as of object, then it is a plane mirror
  - (ii) If the formed image formed is erect but smaller in size, then it is a convex mirror
  - (iii) If the formed image is erect, real and magnified when the mirror is close to the object, then it is a concave mirror
- Solar concentrators use huge concave mirrors to focus large amount of solar energy thereby producing high temperature conditions in a solar power plant.
- The centre of the reflecting surface of a spherical mirror is called the pole of the mirror and it is usually represented by P.
- The horizontal line passing through the centre of curvature and pole of the spherical mirror is known as principal axis.
- The centre of curvature of a spherical mirror is the centre of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by C.
- The radius of curvature of a spherical mirror is the radius of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by R.
- The diameter of the reflecting surface, *i.e.*, twice the radius is called its aperture.
- Radius of curvature ( $R$ ) =  $2 \times$  focal length ( $f$ ).

➤ **Rules for making ray diagrams by concave mirror:**

- (i) A ray parallel to the principal axis will pass through the principal focus, after reflection.



- (ii) A ray passing through the principal focus of concave mirror will be parallel to principal axis after reflection.

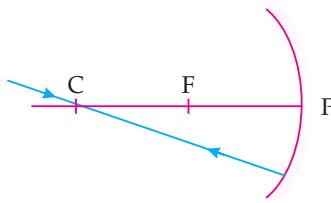


- (iii) A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path as it is a normally incident ray.

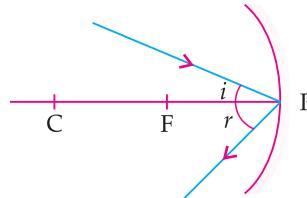
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Image formation in  
Spherical mirror



- (iv) A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angle.



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Image formation in concave mirror

➤ **Image formation by a concave mirror for different positions of the object:**

Position of Object	Position of Image	Size of Image	Nature of Image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

➤ **Image formation by a convex mirror for different positions of the object:**

Position of Object	Position of Image	Size of Image	Nature of Image
At infinity	At the focus F, behind the mirror	Highly diminished, point-sized	Virtual and erect
Between infinity and the pole P of the mirror	Between P and F, behind the mirror	Diminished	Virtual and erect

➤ **Mirror Formula:**

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

Where,

$v$  = Image distance

$u$  = Object distance

$f$  = Focal length

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Image formation in convex mirror

➤ **Magnification of Spherical Mirrors:**

It is the ratio of the height of image to the height of object.

$$m = \frac{\text{Height of image}}{\text{Height of object}}$$

$$m = \frac{h_i}{h_o} = -\frac{v}{u}$$

If ' $m$ ' is negative, image is real.

If ' $m$ ' is positive, image is virtual.

If  $h_i = h_o$  then  $m = 1$ , i.e., image is equal to object.

If  $h_i > h_o$  then  $m > 1$  i.e., image is enlarged.

If  $h_i < h_o$  then  $m < 1$  i.e., image is diminished.

➤ Magnification of plane mirror is always + 1.

'+' sign indicates virtual image.

'1' indicates that image is equal to object's size.

➤ If ' $m$ ' is '+ve' and less than 1, it is a convex mirror.

➤ If ' $m$ ' is '+ve' and more than 1, it is a concave mirror.

➤ If ' $m$ ' is '-ve', it is a concave mirror.

➤ The phenomenon of change in the path of light from one medium to another is called refraction of light.

➤ The angle formed between the incident ray and the normal is called angle of incidence and the angle formed between the refracted ray and the normal is called angle of refraction.

➤ The cause of refraction is the change in the speed of light as it goes from one medium to another medium.

➤ Larger the difference in speed of light between the two media across the interface, the greater will be the deviation and vice-versa.

➤ When a ray of light passes from a rarer medium to a denser medium, it bends towards the normal. Also, the angle of incidence is greater than the angle of refraction.

➤ When a ray of light passes from a denser medium to a rarer medium, it bends away from the normal. Also, the angle of incidence is less than the angle of refraction.

➤ **Laws of refraction:**

**First law:** The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.

**Second law:** The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given color and for the given pair of media. This law is also known as **Snell's law** of refraction.

$$n = \frac{\sin i}{\sin r}$$

➤ **Refractive index ( $n$ ):** The ratio of speed of light in a given pair of media,

$$n = \frac{\text{Velocity of light in medium 1}}{\text{Velocity of light in medium 2}}$$

$n_{21}$  means refractive index of second medium with respect to first medium and,

$$n_{21} = \frac{v_1}{v_2}$$

$n_{12}$  means refractive index of first medium with respect to second medium.

$$n_{12} = \frac{v_2}{v_1}$$

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Refraction of  
Light

➤ **Absolute Refractive Index:** Refractive index of a medium with respect to vacuum or air.

$$n = \frac{c}{v} \text{ where, } c = 3 \times 10^8 \text{ ms}^{-1}$$

➤ Refractive index of one medium is reciprocal of other's refractive index in a given pair.

$$n_{12} = \frac{1}{n_{21}}$$

➤ If refractive index of medium 1 w.r.t. air is given as  ${}_1n^{\text{air}}$  and if refractive index of medium 2 w.r.t. air is given as  ${}_2n^{\text{air}}$ ,

then refractive index of medium 1 w.r.t. medium 2 =  $\frac{{}_1n^{\text{air}}}{{}_2n^{\text{air}}} = {}_1n^2$

➤ Refractive index of diamond is the highest till date. It is 2.42. It means speed of light is  $\frac{1}{2.42}$  times less in diamond than in vacuum.

- **Lens Formula:**

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

- **Magnification:**

$$m = \frac{h_i}{h_o} = \frac{v}{u}$$

- **Power of a lens:** It is defined as the reciprocal of focal length in meter.

- The degree of convergence or divergence of light rays is expressed in terms of power.

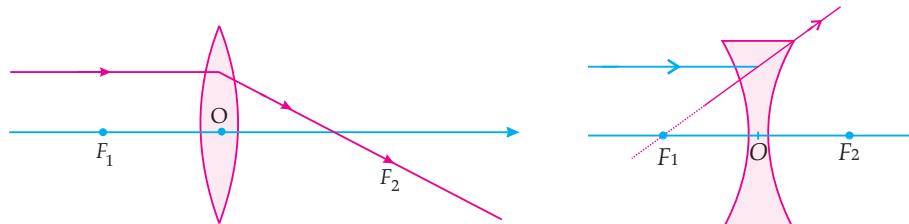
$$\text{Power} = \frac{1}{\text{Focal length (in meter)}} \text{ or } P = \frac{1}{f}$$

- SI unit of Power = dioptre = D,  $1 \text{ D} = 1 \text{ m}^{-1}$

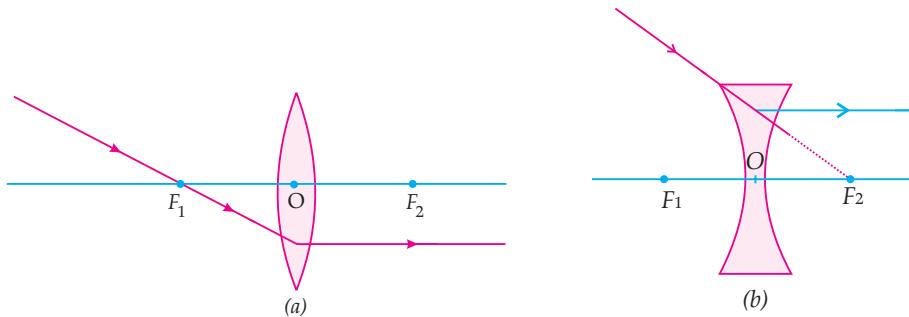
- 1 dioptre is the power of lens whose focal length is one meter.

- **Rules for making ray diagrams by lens:**

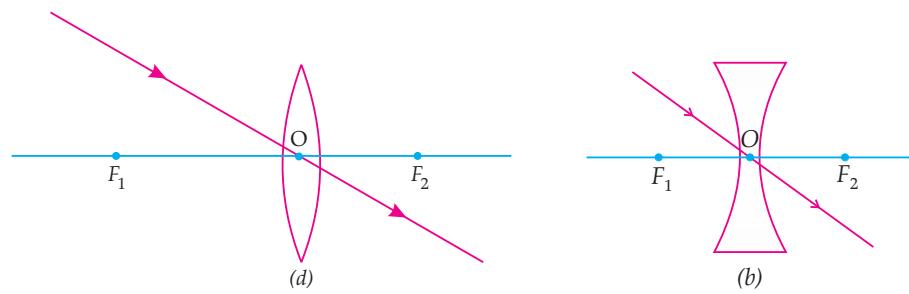
- (i) A ray of light from the object parallel to the principal axis passes through the focus after refraction.



- (ii) A ray of light passing through a principal focus becomes parallel to the principal axis after refraction.



- (iii) A ray of light passing through the optical centre travels undeviated even after refraction.



- Nature, position and relative size of the image formed by a convex lens for various positions of the object:

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus $F_2$	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between $F_2$ and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_2$	Same size	Real and inverted
Between $F_1$ and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted

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Magnification, power of lens

At focus $F_1$	At infinity	Infinitely large or highly enlarged	Real and inverted
Between focus $F_1$ and optical centre	On the same side of the lens as the object	Enlarged	Virtual and erect

- Nature, position and relative size of the image formed by a concave lens for various positions of the object:

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus $F_1$	Highly diminished, point-sized	Virtual and erect
Between infinity and optical centre O of the lens	Between focus $F_1$ and optical centre O	Diminished	Virtual and erect



## Mnemonics

### Concept: Image formation by concave mirror

#### Mnemonics: Mnemonics:54321 to be converted in 12345

At F	1
Between C and F	2
At C	3
Beyond C	4
Infinity	5
Between F and P	Exception

Object	1	2	3	4	5
Image	5	4	3	2	1

#### Interpretation:

If object is at infinity (5), image will be formed at F (1)

If object is at beyond C (4), image will be formed at between C and F (2)

And so on.



## Know the Terms

- **Ray and beam:** Rectilinear propagation light travels in a straight line. The straight line indicating the path of the light (arrow-direction) is called a ray. A bundle of rays originating from the same source of light in a particular direction is called a beam of light.
- **Parallel beam:** When the rays which constitute the beam are parallel to one another, then it is called a parallel beam of light.
- **Convergent beam:** When the rays actually meet or appear to meet at a point, then the beam is called convergent beam and rays are called convergent rays.
- **Divergent beam:** When the rays actually diverge or appear to diverge from a point, then the beam is called divergent beam and rays are called divergent rays.
- **Image:** The point of convergence or the point from where the light appears to diverge after reflection or refraction is called an image.
- **Aperture:** The width of the reflecting refractions surface from which reflection refraction takes place is called aperture.
- **Pole:** The central point of the reflecting spherical surface is called pole (P). It lies on the surface of the mirror.

- **Centre of curvature:** The centre of the hollow sphere of which the spherical mirror lens is a part, is called centre of curvature (C).
- **Radius of curvature:** The separation between the pole optical centre and the centre of the hollow sphere, of which the mirror lens is a part, is called radius of curvature (R).
- **Principal axis:** The straight line joining the pole optical centre and the centre of curvature is called principal axis.
- **Focus:** The point F on the principal axis, where a beam of light parallel to the principal axis actually meet after reflection refraction or appear to come from it is called its principal focus.
- **Focal length:** The distance between the pole optical centre and the focus is called focal length.



## STAND ALONE MCQs

(1 Mark each)

**Q. 1.** The laws of reflection hold true for:

- (A) plane mirrors only  
 (B) concave mirrors only  
 (C) convex mirrors only  
 (D) all reflecting surfaces

[CBSE Delhi 2020]

**Ans. Option (D) is correct.**

*Explanation:* The laws of reflection hold true for all reflecting surfaces.

**Q. 2.** When an object is kept within the focus of a concave mirror, an enlarged image is formed behind the mirror. This image is:

- (A) real  
 (B) inverted  
 (C) virtual and inverted  
 (D) virtual and erect

[CBSE Delhi, 2020]

**Ans. Option (D) is correct.**

*Explanation:* When an object is kept within the focus of a concave mirror, an enlarged image is formed behind the mirror. This image is virtual and erect.

**Q. 3.** Consider the following properties of virtual images:

- (i) cannot be projected on the screen
- (ii) are formed by both concave and convex lens
- (iii) are always erect
- (iv) are always inverted

The correct properties are:

- (A) (i) and (iv)      (B) (i) and (ii)  
 (C) (i), (ii) and (iii)      (D) (i), (ii) and (iv)

[CBSE Delhi 2020, Set-3]

**Ans. Option (C) is correct.**

*Explanation:* A virtual image is formed when reflected rays appear to meet. Such images cannot be obtained on screen. Plane mirrors, convex mirror and concave lens always forms virtual image. They are always erect.

**Q. 4.** A real image is formed by the light rays after reflection or refraction when they:

- (i) actually meet or intersect with each other.

- (ii) actually converge at a point.

- (iii) appear to meet when they are produced in the backward direction.

- (iv) appear to diverge from a point.

Which of the above statements are correct?

- (A) (i) and (iv)      (B) (ii) and (iv)  
 (C) (i) and (ii)      (D) (ii) and (iii)

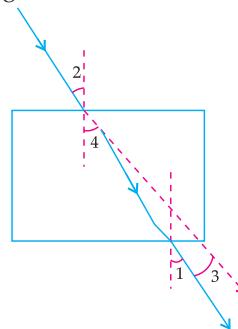
[CBSE Delhi 2020, Set-3]

**Ans. Option (C) is correct.**

*Explanation:* A real image is formed when light rays actually meet or intersect at a point after reflection or refraction.

**Q. 5.** The correct sequencing of angle of incidence, angle of emergence, angle of refraction and lateral displacement shown in the following diagram by digits 1, 2, 3 and 4 is:

[Delhi Set-1, 2017]



- (A) 2, 4, 1, 3      (B) 2, 1, 4, 3  
 (C) 1, 2, 4, 3      (D) 2, 1, 3, 4

**Ans. Option (B) is correct.**

*Explanation:* Angle 2 is angle of incidence, as it is formed between the incident ray and the normal.

Angle 1 is angle of emergence, as it is formed between the emergent ray with normal.

Angle 4 is angle of reflection as it is formed between the refracted ray and the normal.

3 shows the lateral displacement.

Hence, the correct answer is 2,1, 4, 3.

**Q. 6.** A student obtained a sharp image of a candle flame placed at the distant end of the laboratory table on a screen using a concave mirror to determine its focal length. The teacher suggested him to focus a

distant building about 1 km far from the laboratory, for getting more correct value of the focal length. In order to focus the distant building on the same screen the student should slightly move the:

- (A) mirror away from the screen
- (B) screen away from the mirror
- (C) screen towards the mirror
- (D) screen towards the building

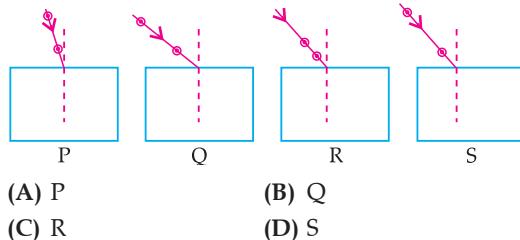
[AE] [CBSE Delhi Set-1, 2016]

**Ans.** Option (C) is correct.

**Explanation:** The object is at infinity, so to obtain sharp image screen should be moved towards mirror.

**Q. 7.** Select from the following the best experimental set-up for tracing the path of a ray of light passing through a rectangular glass slab:

[CBSE Delhi, 2016]



**Ans.** Option (D) is correct.

**Explanation:** Among the given options, S will be the most suitable set up for tracing a ray of light passing through a rectangular glass slab.

**Q. 8.** To determine the approximate value of the focal length of a given concave mirror, you focus the image of a distant object formed by the mirror on a screen. The image obtained on the screen, as compared to the object is always:

- (A) Laterally inverted and diminished
- (B) Inverted and diminished
- (C) Erect and diminished
- (D) Erect and highly diminished

[CBSE Outside Delhi Set-1, 2016]

**Ans.** Option (B) is correct.

**Explanation:** When the object is at infinity, diminished, inverted and real image is formed.

**Q. 9.** In your laboratory you trace the path of light rays through a glass slab for different values of angle of incidence ( $\angle i$ ) and in each case measure the values of the corresponding angle of refraction ( $\angle r$ ) and angle of emergence ( $\angle e$ ).

On the basis of your observation your correct conclusion is:

- (A)  $\angle i$  is more than  $\angle r$ , but nearly equal to  $\angle e$
- (B)  $\angle i$  is less than  $\angle r$ , but nearly equal to  $\angle e$

- (C)  $\angle i$  is more than  $\angle e$ , but nearly equal to  $\angle r$
  - (D)  $\angle i$  is less than  $\angle e$ , but nearly equal to  $\angle r$  [U]
- [CBSE Outside Delhi Set-1, 2016]

**Ans.** Option (A) is correct.

**Explanation:** When a ray of light passes through the glass slab, then the angle of incidence is found to be nearly equal to angle of emergence and greater than angle of refraction.

**Q. 10.** Which of the following can make a parallel beam of light when light from a point source is incident on it?

- (A) Concave mirror as well as convex lens
- (B) Convex mirror as well as concave lens
- (C) Two plane mirrors placed at  $90^\circ$  to each other
- (D) Concave mirror as well as concave lens

**Ans.** Option (A) is correct.

**Explanation:** When a point source of light is placed at the focus of concave mirror then all light rays after reflection through mirror will become parallel to the principal axis.

When this point source of light is placed at the focus of convex lens then after refraction by light rays convex lens will become parallel to the principal axis.

**Q. 11.** Magnification produced by a rear-view mirror fitted in vehicles

- (A) is less than one.
- (B) is more than one.
- (C) is equal to one.
- (D) can be more than or less than one depending upon the position of the object in front of it.

**Ans.** Option (A) is correct.

**Explanation:** Convex mirror is used as rear-view mirror in vehicles. It forms virtual, erect, and diminished images of the objects.

Magnification is ratio of height of image to the height of the object, hence, magnification produced by a rear-view mirror fitted in vehicles is less than one.

**Q. 12.** Rays from sun converge at a point 15 cm in front of a concave mirror. Where should an object be placed so that size of its image is equal to the size of the object?

- (A) 15 cm in front of the mirror
- (B) 30 cm in front of the mirror
- (C) Between 15 cm and 30 cm in front of the mirror
- (D) More than 30 cm in front of the mirror [AE]

**Ans.** Option (B) is correct.

**Explanation:** The distance of the sun is infinite as compared to the radius of curvature of concave mirror, so, light rays from sun incident parallel all the rays converge at the principal focus. So, the focal length is 15 cm.

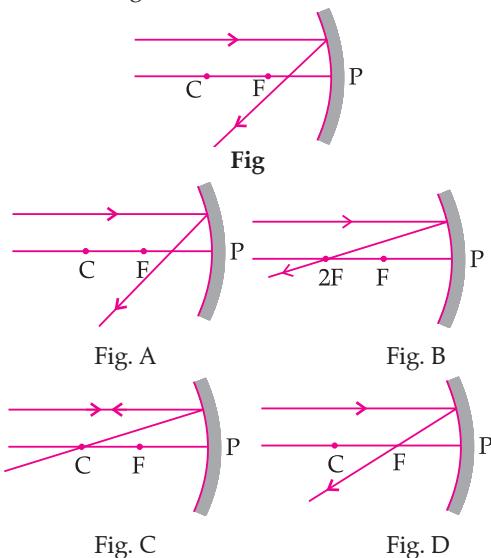
In case of a concave mirror, the size of image and object will be same if the object is placed at  $2f$ . Hence, in this case object must be placed at  $2f$  or  $2 \times 15 = 30$  cm.

- Q. 13. In torches, search lights and headlights of vehicles, the bulb is placed
- between the pole and the focus of the reflector.
  - very near to the focus of the reflector.
  - between the focus and centre of curvature of the reflector.
  - at the centre of curvature of the reflector. [U]

Ans. Option (B) is correct.

**Explanation:** The rays of light passing through the principal focus will go parallel to principal axis after reflection thus, forming a concentrated beam of light. So, due to this reason in torches, search lights, and headlights of vehicles, the bulb is placed very near to the focus of the reflector.

- [AI] Q. 14. Which of the following ray diagrams is correct for the ray of light incident on a concave mirror as shown in figure?



- (A) Fig. A      (B) Fig. B  
(C) Fig. C      (D) Fig. D [U]

Ans. Option (D) is correct.

**Explanation:** In case of concave mirror, an incident ray parallel to principle axis passes through F after reflection.

- Q. 15. A student determines the focal length of a device 'X' by focussing the image of a distant object on a

screen placed 20 cm from the device on the same side as the object. The device 'X' is

- Concave lens of focal length 10 cm
- Convex lens of focal length 20 cm
- Concave mirror of focal length 10 cm
- Concave mirror of focal length 20 cm [AE]

[CBSE Board, Foreign Scheme, 2016]

Ans. Option (D) is correct.

**Explanation:** Image formed by the concave mirror in this case is same as when object is at infinity. Due to the great distance, light rays will incident almost parallel to principal axis. After reflection all the rays will converge and meet at principal focus.

So, focal length is 20 cm.

- Q. 16. A student obtains a blurred image of a distant object on a screen using a convex lens. To obtain a distinct image on the screen he should move the lens
- away from the screen
  - towards the screen
  - to a position very far away from the screen
  - either towards or away from the screen depending upon the position of the object [CBSE Board, All India Region, 2017]

Ans. Option (D) is correct.

**Explanation:** The incident rays coming from the distant object will be parallel to the principal axis and as we know the rays parallel to the principal axis, after refraction by convex lens, will pass through the principal focus. Hence, a distinct image will be obtained immediately when distance between screen and lens is equal to focal length, so option (D) is correct choice.

- Q. 17. A student very cautiously traces the path of a ray through a glass slab for different values of the angle of incidence ( $\angle i$ ). He then measures the corresponding values of the angle of refraction ( $\angle r$ ) and the angle of emergence ( $\angle e$ ) for every value of the angle of incidence. On analyzing these measurements of angles, his conclusion would be
- $\angle i > \angle r > \angle e$
  - $\angle i = \angle e > \angle r$
  - $\angle i < \angle r < \angle e$
  - $\angle i = \angle e < \angle r$  [CBSE Board, All India Region, 2017]

Ans. Option (B) is correct.

**Explanation:** (Angle of incidence)  $\angle i = \angle e$  (angle of emergence) because the direction of incident ray and emergent ray is parallel to each other.

$\angle e > \angle r$  (angle of refraction) because at point of emergence light is entering into optically rarer medium (air) from optically denser medium (glass), so light will bend away from the normal making the angle bigger.

- Q. 18. An optical device has been given to a student and he determines its focal length by focusing the image of the sun on a screen placed 24 cm from the device



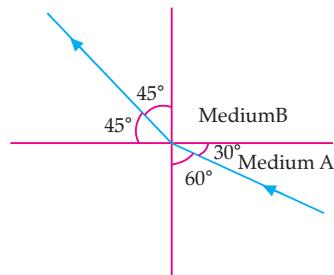
- (C) A convex lens of focal length 5 cm  
 (D) A concave lens of focal length 5 cm

**Ans. Option (C) is correct.**

**Explanation:** A magnified image of an object will be obtained when it is placed between the optical centre and focus of a convex lens.

Magnification is also higher for convex lenses having shorter focal length. Therefore, for reading small letters, a convex lens of focal length 5 cm should be used.

- Q. 26.** Figure shows a ray of light as it travels from medium A to medium B. Refractive index of the medium B relative to medium A is



(A)  $\frac{\sqrt{3}}{\sqrt{2}}$

(B)  $\frac{\sqrt{2}}{\sqrt{3}}$

(C)  $\frac{1}{\sqrt{2}}$

(D)  $\sqrt{2}$

[AE]

**Ans. Option (A) is correct.**

**Explanation:** Here, angle of incidence =  $60^\circ$

Angle of refraction =  $r = 45^\circ$

Refractive index of the medium B relative to medium A

$$= n_{BA} = \frac{\sin i}{\sin r} = \frac{\sin 60^\circ}{\sin 45^\circ}$$

$$= \frac{\frac{\sqrt{3}}{2}}{\left(\frac{1}{\sqrt{2}}\right)} = \frac{\sqrt{3}}{\sqrt{2}}$$



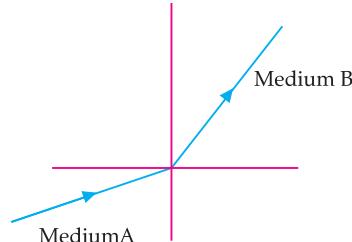
## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

- (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 true but R is false.  
 (D) A is false and R is True.

**Q. 1. Assertion (A):** Plane mirror may form real image.

- Q. 27.** A light ray enters from medium A to medium B as shown in the figure. The refractive index of medium B relative to A will be



[U]

- (A) Greater than unity (B) Less than unity  
 (C) Equal to unity (D) Zero

**Ans. Option (A) is correct.**

**Explanation:** Since, light rays in medium B go towards normal, so it has greater refractive index and lesser velocity of light with respect to medium A. So refractive index of medium B with respect to medium A is greater than unity.

- Q. 28.** Which of the following statements is true?

- (A) A convex lens has 4 dioptre power having a focal length 0.25 m  
 (B) A convex lens has - 4 dioptre power having a focal length 0.25 m  
 (C) A concave lens has 4 dioptre power having a focal length 0.25 m  
 (D) A concave lens has - 4 dioptre power having a focal length 0.25 m

**Ans. Option (A) is correct.**

**Explanation:** The power ( $P$ ) of a lens of focal length ( $f$ ) is given by  $P = 1/f$  where  $f$  is the focal length meter and power in dioptre.

Now,  $P = 1/f$

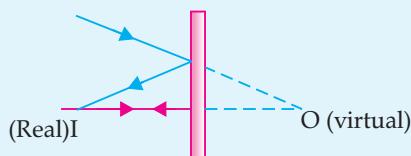
or,  $4 = \frac{1}{f}$

or  $f = \frac{1}{4} \text{ m} = 0.25 \text{ m.}$

**Reason (R):** Plane mirror forms virtual image, if object is real.

**Ans. Option (B) is correct.**

**Explanation:** Plane mirror may form real image, if object is virtual.



**Q. 2. Assertion (A):** The focal length of the convex mirror will increase, if the mirror is placed in water.

**Reason (R):** The focal length of a convex mirror of radius  $R$  is equal to,  $f = \frac{R}{2}$ .

**Ans. Option (D) is correct.**

**Explanation:** Focal length of the spherical mirror does not depend on the medium in which it is placed.

**Q. 3. Assertion (A):** The image formed by a concave mirror is certainly real if the object is virtual.

**Reason (R):** The image formed by a concave mirror is certainly virtual if the object is real.

**Ans. Option (C) is correct.**

**Explanation:** The image of real object may be real in case of concave mirror.

**Q. 4. Assertion (A):** An object is placed at a distance of  $f$  from a convex mirror of focal length  $f$ , its image will form at infinity.

**Reason (R):** The distance of image in convex mirror can never be infinity.

**Ans. Option (D) is correct.**

**Explanation:** The distance of image in convex mirror is always finite.

**Q. 5. Assertion (A):** If the rays are diverging after emerging from a lens; the lens must be concave.

**Reason (R):** The convex lens can give diverging rays.

**Ans. Option (D) is correct.**

**Explanation:** If the rays cross focal point of convex lens, they become diverging.

**Q. 6. Assertion (A):** Refractive index of glass with respect to air is different for red light and violet light.

**Reason (R):** Refractive index of a pair of media depends on the wavelength of light used.

**Ans. Option (A) is correct.**

**Explanation:** Refractive index of any pair of media is inversely proportional to wavelength of light.

$$\text{Hence, } \lambda_v < \lambda_r$$

$$\text{so, } \mu_r < \mu_v$$

where,  $\lambda_v$  and  $\lambda_r$  are the wavelengths of violet and red light.  $\mu_v$  and  $\mu_r$  are refractive index of violet and red light.

**Q. 7. Assertion (A):** The refractive index of diamond is  $\sqrt{6}$  and refractive index of a liquid is  $\sqrt{3}$ . If the light travels from diamond to the liquid, it will be initially reflected when the angle of incidence is  $30^\circ$ .

**Reason (R):**  $\mu = \frac{1}{\sin C}$ , where  $\mu$  is the refractive index of diamond with respect to liquid.

**Ans. Option (A) is correct.**

**Explanation:** Refractive index of diamond w.r.t. liquid

$${}^d\mu_l = \frac{1}{\sin C} = \frac{\mu_d}{\mu_l} \Rightarrow \frac{\sqrt{6}}{\sqrt{3}} = \frac{1}{\sin C}$$

$$\Rightarrow \sin C = \frac{1}{\sqrt{2}} = \sin 45^\circ$$

$$\therefore C = 45^\circ.$$

**Q. 8. Assertion:** Light travels faster in glass than in air.

**Reason:** Glass is denser than air.

**Ans. Option (D) is correct.**

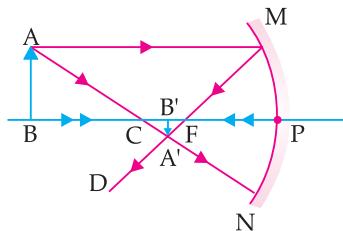
**Explanation:** Light travels faster in air than in glass, because glass is denser than air.



## CASE-BASED MCQs

**Attempt any 4 sub-parts from each question.  
Each sub-part carries 1 mark.**

- I. Following figure illustrates the ray diagram for the formation of image by a concave mirror. The position of the object is beyond the centre of curvature of the concave mirror. On the basis of given diagram answer any four questions from Q.1. to Q.5.



**Q. 1.** If the focal length of the concave mirror is 10 cm, the image formed will be at a distance \_\_\_\_\_.

- (A) Between 10cm and 15cm
- (B) Between 10cm and 20cm
- (C) Beyond 20cm
- (D) At 20 cm

**Ans. Option (B) is correct.**

**Explanation:** If the focal length of the concave mirror is 10 cm, the image formed will be at a distance between 10 cm and 15 cm.

**Q. 2.** In case of concave mirror, the image distance is \_\_\_\_\_ when image is formed in front of the mirror and \_\_\_\_\_ when the image is formed behind the mirror.

- (A) positive, negative

- (B) negative, negative  
 (C) negative, positive  
 (D) positive, positive

**Ans. Option (C) is correct.**

*Explanation:* If an image formed behind the concave mirror, the object distance is positive but if an image is formed in front of the mirror, the image distance is negative.

- Q. 3.** If the size of the object in the given figure is 5 cm and the magnification produced is  $-0.5$ . The size of the image is (in cm) \_\_\_\_\_  
 (A) -2.5                               (B) -0.1  
 (C) 2.5                                   (D) 0.1

**Ans. Option (A) is correct.**

*Explanation:* As we know, magnification,

$$m = \frac{h_2}{h_1}$$

$$h_2 = \frac{-(0.5 \times 5)}{10}$$

$$h_2 = -2.5$$

- Q. 4.** A negative sign in the magnification value indicate that the image is \_\_\_\_\_  
 (A) Real and inverted  
 (B) Real and erect  
 (C) Virtual and erect  
 (D) Virtual and inverted

**Ans. Option (A) is correct.**

*Explanation:* A negative sign in the magnification value indicate that the image is real and inverted.

- Q. 5.** An image formed by concave mirror is virtual, when the object is placed:  
 (A) at infinity                           (B) at C  
 (C) Between C and F                   (D) Between P and F

**Ans. Option (D) is correct.**

*Explanation:* An image formed by concave mirror is virtual, when the object is placed between P and F.

**II. Read the following passage and answer any four questions from Q.1. to Q.5.**

A student wants to project the image of a candle flame on the walls of the school laboratory by using a mirror.

- Q. 1.** Which type of mirror should he use and why? U  
 (A) Convex mirror, it forms virtual image  
 (B) Concave mirror, it forms virtual image  
 (C) Concave mirror, it forms real image  
 (D) Convex mirror, it forms real image

**Ans. Option (C) is correct.**

*Explanation:* He should use a concave mirror as it forms real images.

- Q. 2.** At what distance, in terms of focal length ' $f$ ' of the mirror, should he place the candle flame to get the magnified image on the wall? C

- (A) At F                                   (B) Between F and C  
 (C) At C                                   (D) At infinity

**Ans. Option (B) is correct.**

*Explanation:* He should place the candle flame between the focus and centre of curvature of the mirror to get the magnified image on the wall.

- Q. 3.** To get the diminished image of the candle flame, the object must be placed at: U  
 (A) infinity                              (B) at C  
 (C) between F and C                   (D) At F

**Ans. Option (A) is correct.**

*Explanation:* To get the diminished image of the candle flame, the object must be placed at infinity.

- Q. 4.** If the image formed by this mirror is inverted and real, the magnification will be: A  
 (A) Positive                              (B) Negative  
 (C) Either of them                      (D) None of the above

**Ans. Option (B) is correct.**

*Explanation:* If the image formed by this mirror is inverted and real, the magnification will be negative.

- Q. 5.** A virtual image formed by concave mirror is: C  
 (A) erect and enlarged  
 (B) erect and diminished  
 (C) inverted and diminished  
 (D) inverted and enlarged

**Ans. Option (A) is correct.**

*Explanation:* A virtual image formed by concave mirror is erect and enlarged.

AT **III. Read the following passage and answer any four questions from Q.1. to Q.5.**

A student wants to project the image of a candle flame on a screen 60 cm in front of a mirror by keeping the flame at a distance of 15 cm from its pole.

- Q. 1.** Suggest the type of mirror he should use:

- (A) convex mirror                      (B) plane mirror  
 (C) concave mirror                    (D) none of the above

**Ans. Option (C) is correct.**

*Explanation:* He should use a concave mirror, as it forms a real image on the same side of the mirror.

- Q. 2.** Find the linear magnification of the image produced.  
 (A) -4                                    (B) + 4  
 (C) -900                               (D) + 900

**Ans. Option (A) is correct.**

**Explanation:** Object distance,  $u = -15 \text{ cm}$

Image distance,  $v = -60 \text{ cm}$

$$\text{Magnification, } m = \frac{-v}{u} = \frac{-(-60)}{(-15)} = -4,$$

The minus sign in magnification shows that the image formed is real and inverted.

- Q. 3.** When object distance is less than focal length the image is \_\_\_\_\_ and when object distance is more than focal length the image is \_\_\_\_\_.  
 (A) real in both case    (B) virtual in both case  
 (C) real, virtual    (D) virtual, real

**Ans. Option (D) is correct.**

**Explanation:** When object distance is less than focal length the image is virtual and when object distance is more than focal length the image is real.

- Q. 4.** What is the distance between the object and its image ?  
 (A) 45 cm    (B) 35 cm  
 (C) 75 cm    (D) 0 cm

**Ans. Option (A) is correct.**

**Explanation:** The image is formed at a distance of 45 cm from the object.

- Q. 5.** The image formed in the above case is:  
 (A) virtual, inverted and magnified.  
 (B) real, erect and magnified  
 (C) real, inverted and magnified  
 (D) real, erect and diminished

**Ans. Option (C) is correct.**

**Explanation:** In this case, the image is formed beyond the centre of curvature. This image is real, inverted and enlarged.

**IV. Read the following passage and answer the following questions from Q.1. to Q.4.**

A student focuses the image of a candle flame, placed at about 2 m from a convex lens of focal length 10 cm, on a screen. After that he moves gradually the flame towards the lens and each time focuses its image on the screen. U

- Q. 1.** In which direction does he move the lens to focus the flame on the screen ?  
 (A) away from screen  
 (B) towards the screen  
 (C) should not move the screen  
 (D) toward the candle

**Ans. Option (D) is correct.**

**Explanation:** Let us assume the screen to lens distance is greater than 20 cm. Since it is required to get image beyond 2F,

the object should be F and 2F on other side of the lens. Hence student will move the lens towards candle.

(F means a location at a distance from lens that equals the focal length of lens. 2F means distance that equals twice the focal length).

- Q. 2.** What happens to the size of the image of the flame formed on the screen?  
 (A) size of image will decrease  
 (B) size of image will increase  
 (C) remains unchanged  
 (D) size will become too small

**Ans. Option (B) is correct.**

**Explanation:** Size of the image of the flame increases when object is moving towards lens, from a distance beyond 2F, then 2F, then less than 2F.

- Q. 3.** What difference is seen in the intensity (brightness) of the image of the flame on the screen ?  
 (A) intensity of image increases  
 (B) intensity of image remains same  
 (C) intensity of image reduces  
 (D) the image disappears

**Ans. Option (A) is correct.**

**Explanation:** As the object (candle) is moved towards lens more light intensity is collected by lens, hence brightness of the image increase.

- Q. 4.** What is seen on the screen when the flame is very close (at about 5 cm) to the lens ?  
 (A) a bright image    (B) a magnified image  
 (C) diminished image    (D) no image

**Ans. Option (D) is correct.**

**Explanation:** When the candle is very close about 5 cm, focussing the flame is not possible. Hence student will not get any image on the screen.

He will get diffused light on the screen.

- AI V.** Read the passage and note the following observations. Answer any four questions from Q.1. to Q.5.

A student focussed the image of a candle flame on a white screen by placing the flame at various distances from a convex lens. He noted his observations as:

S. No.	Distance of flame from the lens (cm)	Distance of the screen from the lens (cm)
(a)	60	20
(b)	40	24
(c)	30	30
(d)	24	40
(e)	15	70

- Q. 1.** From the above table, find the focal length of lens without using lens formula: [AE]

(A) 15cm    (B) 30cm



Ans. Option (C) is correct.

(C) Glass (D) diamond

*Explanation:* Refractive index being a ratio of two similar quantities hence has no unit.

Ans. Option (B) is correct.

*Explanation:* Light waves travel fastest through a vacuum and air, and slower through other materials such as glass or water.

Q. 5. Light travel fastest in:

R

- (A) Air (B) Vacuum

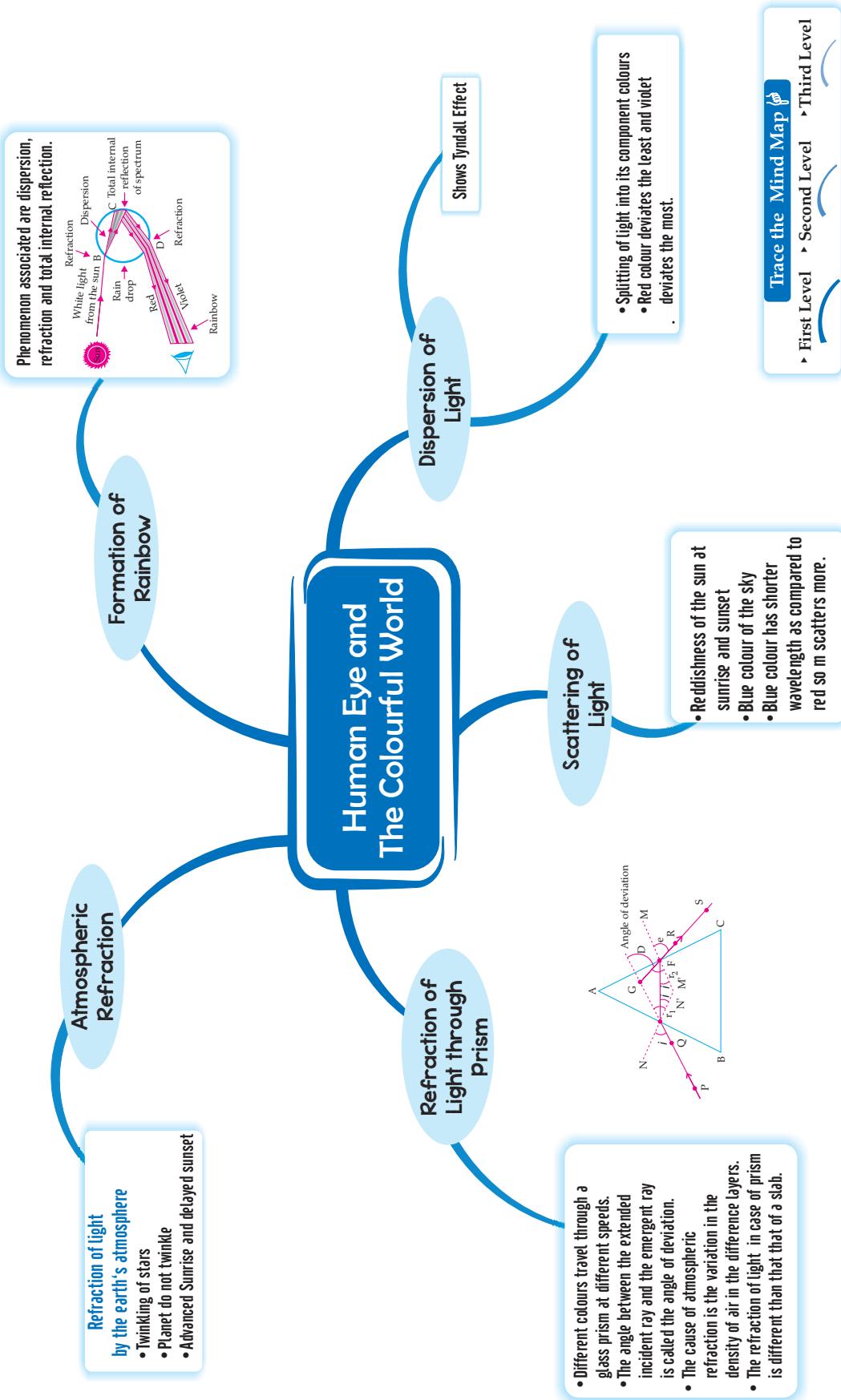


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## CHAPTER

# 6

# HUMAN EYE AND THE COLOURFUL WORLD

## Syllabus

- *Refraction of light through a prism, dispersion of light, scattering of light, applications in daily life.*



## Revision Notes

### Refraction of Light through prism, Dispersion of Light and Scattering of Light

- The phenomenon of splitting of white light into its constituent colours on passing through a glass prism is called **dispersion of light**.  
**Concept Name:** Spectrum
- Different colours undergo different deviations on passing through prism.
- If a second identical prism is placed in an inverted position with respect to the first prism, all the colours recombine to form white light.
- **Atmospheric refraction** is the phenomenon of bending of light on passing through earth's atmosphere.  
➤ As we move above the surface of earth, density of air goes on decreasing.  
➤ Light travelling from rarer to denser layers always bends towards the normal.  
➤ Stars twinkle on account of atmospheric refraction.  
➤ Sun appears to rise 2 minutes earlier and set 2 minutes later due to atmospheric refraction.
- The phenomenon in which a part of the light incident on a particle is redirected in different directions is called **scattering of light**.  
➤ Very small particles scatter light of shorter wavelengths better than longer wavelengths.  
➤ The scattering of longer wavelengths of light increases as the size of the particle increases.  
➤ Larger particles scatter light of all wavelengths equally well.

Scan to know more about this topic



Dispersion by prism

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Rainbow formation

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Scattering of Light



## Mnemonics

## Concept: Complete Phenomenon of light

Mnemonics: VIBGYOR

## Interpretation:

**V** - **Violet****I** - **Indigo****B** - **Blue****G** - **Green****Y** - **Yellow****O** - **Orange****R** - **Red**

A prism causes dispersion,  
 Stars twinkle due to refraction,  
 Scattering causes redirection,  
 All have their own attraction.

## Know the Terms

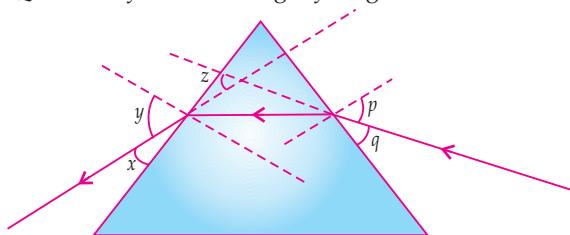
- **Prism:** Prism is a homogenous, transparent, refracting material, such as glass, enclosed by two inclined plane refracting surfaces, at some fixed angle, called refracting angle or angle of prism. It has two triangular bases and three rectangular lateral surfaces which are inclined to each other.
- **Angle of Refraction:** The angle between the refracted ray and the normal is called angle of refraction ( $\angle r$ ).
- **Angle of Emergence:** The angle between the emergent ray and normal at the second refracting face of the prism is called angle of emergence ( $\angle e$ ).
- **Angle of Deviation:** The angle formed between the incident ray produced in the forward direction and emergent ray produced in the backward direction in the refraction through the prism is called angle of deviation ( $\angle \delta$ ).
- **Tyndall effect:** The phenomenon of scattering of light by the colloidal particles is known as tyndall effect.



## STAND ALONE MCQs

(1 Mark each)

Q. 1. Study the following ray diagram :



In this diagram, the angle of incidence, the angle of emergence and the angle of deviation respectively have been represented by

- (A)  $y, p$  and  $z$       (B)  $x, q$  and  $z$   
 (C)  $p, y$  and  $z$       (D)  $p, z$  and  $y$

[CBSE Board, All India Region, 2017]

Ans. Option (C) is correct.

**Explanation:** Angle  $p$  is the angle of incidence as this angle is formed between the incident ray and the normal.

Angle  $y$  is angle of emergence as it is formed between emergent ray and the normal and angle  $z$  is the angle of deviation as it is formed between the emergent ray and the incident ray. Hence, the correct answer is  $p, y, z$ .

Q. 2. Which of the following phenomena of light are involved in the formation of a rainbow?

- (A) Reflection, refraction and dispersion  
 (B) Refraction, dispersion and total internal reflection  
 (C) Refraction, dispersion and internal reflection  
 (D) Dispersion, scattering and total internal reflection

Ans. Option (C) is correct.

**Explanation:** Dispersion means white light getting segregated into its component colours. Refraction bends the incident light to an angle that causes internal reflection and finally rainbow is formed.

Q. 3. Twinkling of stars is due to atmospheric

- (A) dispersion of light by water droplets
- (B) refraction of light by different layers of varying refractive indices
- (C) scattering of light by dust particles
- (D) internal reflection of light by clouds

**Ans. Option (B) is correct.**

**Explanation:** Due to refraction of light by different layers of varying refractive indices, the apparent position of source of light keeps on changing. So stars appear to twinkle.

**Q. 4.** At noon the sun appears white as

- (A) light is least scattered.
- (B) all the colours of the white light are scattered away.
- (C) blue colour is scattered the most.
- (D) red colour is scattered the most.

**Ans. Option (A) is correct.**

**Explanation:** Sun is directly over the head and sunlight travel relatively shorter distance causing only little of the blue and violet colours to be scattered.

**Q. 5.** The clear sky appears blue because

- (A) blue light gets absorbed in the atmosphere
- (B) ultraviolet radiations are absorbed in the atmosphere
- (C) violet and blue lights get scattered more than light of all other colours by the atmosphere
- (D) light of all other colours is scattered more than the violet and blue colour light by the atmosphere

U

**Ans. Option (C) is correct.**

**Explanation:** A clear cloudless day-time sky is blue because molecules in the air scatter blue light from the sun more than they scatter red light. Rayleigh scattering is inversely proportional to the fourth power of wavelength, so that shorter wavelength violet and blue light will scatter more than the longer wavelengths (yellow and especially red light).

**Q. 6.** Which of the following statements is correct regarding the propagation of light of different colours of white light in air?

- (A) Red light moves fastest
- (B) Blue light moves faster than green light
- (C) All the colours of the white light move with the same speed
- (D) Yellow light moves with the mean speed as that of the red and the violet light

**Ans. Option (C) is correct.**

**Explanation:** Speed of light is a constant value regardless of its colour.

**Q. 7.** Which of the following phenomena contributes significantly to the reddish appearance of the sun at sunrise or sunset?

- (A) Dispersion of light
- (B) Scattering of light
- (C) Total internal reflection of light
- (D) Reflection of light from the earth

**Ans. Option (B) is correct.**

**Explanation:** Red colour scatters the least so that it travels the farthest. During sunset or sunrise, light has to travel a longer distance to reach us. Hence, only red light reaches to us and the sky appears reddish.

**Q. 8.** In an experiment to trace the path of a ray of light through a triangular glass prism, a student would observe that the emergent ray

- (A) is parallel to the incident ray.
- (B) is along the same direction of incident ray.
- (C) gets deviated and bends towards the thinner part of the prism.
- (D) gets deviated and bends towards the thicker part (base) of the prism.

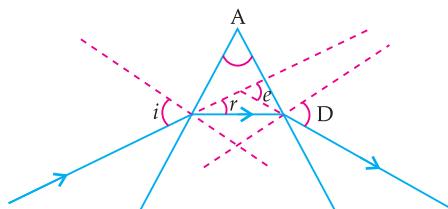
[CBSE Board, Foreign Scheme, 2016]

**Ans. Option (D) is correct.**

**Explanation:** As ray emerges out of the prism, it moves from a denser to a rarer medium, and therefore, bends away from the normal. So, bends towards the thicker part (base) of the prism.

**Q. 9.** Study the following figure in which a student has marked the angle of incidence ( $\angle i$ ), angle of refraction ( $\angle r$ ), angle of emergence ( $\angle e$ ), angle of prism ( $\angle A$ ) and the angle of deviation ( $\angle D$ ). The correctly marked angles are:

U [CBSE, Delhi-2016, Set-I]



- (A)  $\angle A$  and  $\angle i$
- (B)  $\angle A$ ,  $\angle i$  and  $\angle r$
- (C)  $\angle A$ ,  $\angle i$ ,  $\angle e$  and  $\angle D$
- (D)  $\angle A$ ,  $\angle i$ ,  $\angle r$  and  $\angle D$

**Ans. Option (A) is correct.**

**Explanation:** The correctly marked angles are of  $\angle A$  and  $\angle i$ .



## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

- (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 true but R is false.
- (D) A is false and R is true.

**Q. 1. Assertion (A):** Eye lens has the ability to focus clearly on the retina by adjusting its focal length.

**Reason (R):** This phenomenon is known as power of accommodation.

**Ans. Option (B) is correct.**

**Explanation:** The ability of the eye lens to focus clearly on the retina by adjusting its focal length is known as the power of accommodation.

**Q. 2. Assertion (A):** A hypermetropic person prefers to remove his spectacles, while driving.

**Reason (R):** When a hypermetropic person wearing the spectacles looks at a distant object, the parallel rays from the distant object get converged in front of the retina. The image thus appears blurred.

**Ans. Option (A) is correct.**

**Explanation:** When a hypermetropic person wearing the spectacles looks at a distant object, the parallel rays from the distant object get converged in front of the retina. The image appears blurred, in order to avoid this, the person prefers to remove his spectacles.

**Q. 3. Assertion (A):** Concave lens is used to correct myopia or short-sightedness.

**Reason (R):** A concave lens of suitable focal length diverges the parallel rays from the distant objects as if they are coming from the far point of the myopic eye. This helps the eye lens to form a clear image at the retina.

**Ans. Option (A) is correct.**

**Explanation:** A concave lens of suitable focal length diverges the parallel rays from the distant objects as if they are coming from the far point of the myopic eye. This helps the eye lens to form a clear image at the retina. So, a concave lens used to correct myopia or short-sightedness.

**Q. 4. Assertion (A):** Light from a distant object arriving at the eye lens may get converged at a point in front of the retina.

**Reason (R):** The eye is producing too much divergence in the incident beam.

**Ans. Option (C) is correct.**

**Explanation:** The light from a distant object arriving at the eye lens may get converged at a point in front of the retina. This type of defect is called near-sightedness or myopia. This means that the eye is producing too much convergence in the incident beam.

**Q. 5. Assertion (A):** A white light on passing through prism splits into its component colours as such that the red light emerges nearest to the base of the prism.

**Reason (R):** Wavelength of red light is more than other component colours and hence, red light deviates least.

**Ans. Option (D) is correct.**

**Explanation:** Dispersion takes place because the refractive index of medium for different wavelengths (colours) is different. The refractive index is inversely proportional to  $\lambda$ . Since  $\lambda_{\text{red}}$  is more than other colours wavelength. So, deviation is least for red and it appears farthest from the base of the prism.

**Q. 6. Assertion (A):** Sunlight reaches us without dispersion in the form of white light and not as its components.

**Reason (R):** Dispersion takes place due to variation of refractive index for different wavelength but in vacuum the speed of light is independent of wavelength and hence vacuum is a non-dispersive medium.

**Ans. Option (A) is correct.**

**Explanation:** In vacuum speed of light is independent of wavelength. Hence, no dispersion takes places in vacuum. Thus, vacuum is a non-dispersive medium in which all colours travel with the same speed.

**Q. 7. Assertion (A):** In case of rainbow, light at the inner surface of the water drop gets internally reflected.

**Reason (R):** The angle between the refracted ray and normal to the drop surface is greater than the critical angle.

**Ans. Option (A) is correct.**

**Explanation:** The rainbow is formed when light at the inner surface of the water drop gets internally reflected. If the angle between the refracted ray and normal to the drop surface is greater than the critical angle.

**Q. 8. Assertion (A):** Scattering of light is the reflection of light from an object in all directions.

**Reason (R):** The colour of scattered light depends on the size of scattering particles and wavelength of light.

**Ans. Option (B) is correct.**

**Explanation:** The reflection of light from an object in all direction is called scattering of light. The colour of scattered light depends on the size of scattering particles and wavelength of light. Very fine particles scatter mainly blue light while particles of larger size scatter light of longer wavelength i.e. red light. If the size of the scattering particles is large enough, then the scattered light may even appear white.

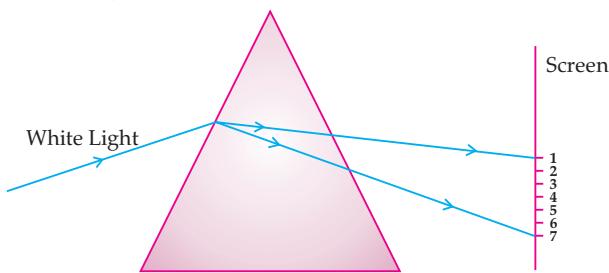


## CASE-BASED MCQs

**Attempt any 4 sub-parts from each question.**

**Each sub-part carries 1 mark.**

**I.** A narrow beam of white light is passing through a glass prism as shown in the diagram. Study the diagram and answer any four questions from Q.1. to Q.5.



**Q. 1.** The phenomenon observed in above set-up is

- (A) scattering of light
- (B) dispersion of light
- (C) reflection of light
- (D) refraction of light

**Ans. Option (B) is correct.**

**Explanation:** The phenomenon of splitting of white light into its constituent colours after passing through a prism is called as dispersion of light. When the light enters the prism, all the colours have different speeds due to which it gets split into bands.

**Q. 2.** In nature, this phenomenon is observed in

- (A) Formation of rainbow
- (B) Twinkling of stars
- (C) Blue colour of sky
- (D) Advance sunrise

**Ans. Option (A) is correct.**

**Explanation:** Rainbow is caused by dispersion of sunlight by tiny water droplets present in the atmosphere which is one of the application of dispersion of light.

**Q. 3.** Which of the following statement is correct about constituents of white light based on above observations?

- (A) White light consists of seven colours.
- (B) Violet colour suffers minimum deviation.
- (C) Red light suffers maximum deviation.
- (D) All the colours of the white light move with different speed in vacuum.

**Ans. Option (A) is correct.**

**Explanation:** When the light disperses, various bands of light are clearly visible. It is clear from the figure that the violet light suffers maximum deviation and red light suffers minimum deviation. All the colours of the white light move with the same speed in air or vacuum but with different wavelengths and frequencies.

**Q. 4.** The cause of dispersion of light is

- (A) All the colors of light travel with the speed more than the speed of light.
- (B) All the colors have different angles of deviation.
- (C) All the colors do not travel with the same speed of light.
- (D) All the colors have the same wavelength.

**Ans. Option (C) is correct.**

**Explanation:** The various colours of white light have different extent of refraction in a medium. All of colours of light do not travel with same speed in the medium which is the cause of dispersion of light.

**Q. 5.** Read the following statements carefully

- (i) The prism behaves same as that of rectangular glass slab.
- (ii) All the colours have different angles of deviation in case of dispersion through prism.
- (iii) All the colours travel with the same speed of light in glass.
- (iv) Dispersion of light is observed in case of rectangular glass slab.

Which of the above statement/s is true?

- (A) Only (ii)
- (B) (i) and (ii) only
- (C) (i), (ii) and (iv) only
- (D) All of the above

**Ans. Option (A) is correct.**

**Explanation:** A prism is made up of glass in which the faces are joined at a certain angle but in case of rectangular glass slab, the opposite faces are parallel to each other. As the light enters in the prism, all the colours travel with the different speed of light because glass is a denser medium as compared to air and dispersion of light is not observed in case of a rectangular glass slab. So, both prism and rectangular glass slab behave differently.

**AI II. Read the passage on human eye and answer any four questions from Q.1. to Q.5.**

Eye is a natural optical device by which human could see objects around him. It forms an inverted, real image on a light sensitive surface. It works on the phenomenon of refraction of light through a natural convex lens. However, Meena was unable to see clearly the words written on the black board placed at a distance of approximately 3 m from her. Her mother discussed the same with the doctor. Doctor explained her about this defect of vision and its correction.

**Q. 1.** The human eye forms the image of the object at its

- (A) Cornea
- (B) Iris
- (C) Pupil
- (D) Retina

**Ans. Option (D) is correct.**

**Explanation:** The retina in the human eye consists of contains a large number of light-sensitive cells which help in the organization of visual information. Thus, the retina helps in sending information to the brain due to which a person is able to see.

**Q. 2.** What kind of defect Meena is suffering from?

- (A) Myopia
- (B) Hypermetropia
- (C) Astigmatism
- (D) Malnutrition

**Ans. Option (A) is correct.**

**Explanation:** Meena was unable to read the words written on the blackboard i.e. she could see the nearby objects clearly but was unable to see the far off objects. Thus, she was suffering from Myopia

**Q. 3.** The possible cause this defect is

- (A) eye ball is of same size
- (B) eye ball becomes long
- (C) eye ball becomes small
- (D) None of the above

**Ans. Option (B) is correct.**

**Explanation:** The excessive curvature of eye lens becomes more converging and it results in the elongation of eye ball due to which a person suffers from Myopia.

**Q. 4.** The closest distance up to which a person can see without any strain in the eyes

- (A) 35 cm
- (B) 15 cm
- (C) 5 cm
- (D) 25 cm

**Ans. Option (D) is correct.**

**Explanation:** A normal eye is not able to see distinctly the objects placed closer than 25 cm, without putting any strain on the eye. This is because the ciliary muscles of eyes are unable to contract beyond a certain limit. If the objects are placed at a distance less than 25 cm from the eye, then the objects appear blurred because light rays coming from the object meet beyond the retina.

**Q. 5.** The defective eye of a person has near point 0.5 m and far point as 3 m. The power of both lens required for reading purpose and seeing far off objects is

- (A) 0.75 D and +4 D
- (B) +2D and -1/3 D
- (C) -2.5D and + 1/8D
- (D) 0.85 D and -2 D

**Ans. Option (B) is correct.**

**Explanation:** Let the object distance =  $u$   
image distance =  $v$   
 $u = -25 \text{ cm}$ ,  $v = 0.5 \text{ cm}$ ,  $m = -50 \text{ cm}$

Using Lens formula

$$\begin{aligned}\frac{1}{f} &= \frac{1}{v} - \frac{1}{u} \\ &= \frac{1}{-50} - \frac{1}{-25} \\ &= \frac{1}{50}\end{aligned}$$

$$\therefore P = \frac{100}{f(\text{cm})} = 100 \times \frac{1}{50} = +2\text{D}$$

If the distance objects are taken into consideration

$$u = \infty, v = -3 \text{ m}$$

Using Lens formula

$$\begin{aligned}\frac{1}{f} &= \frac{1}{v} - \frac{1}{u} \\ &= \frac{1}{-3} - \frac{1}{\infty} \\ &= -\frac{1}{3} \\ \therefore P &= \frac{1}{f(\text{m})} = -\frac{1}{3}\text{D}\end{aligned}$$

**[AI] III.** Read the given passage and answer any of the four questions from 1 to 5.

The human eyes gradually lose their power of accommodation. In such cases, the person cannot see distinctly and comfortably. There are three common eye defects, and they are myopia or near-sightedness, hypermetropia or far-sightedness, and Presbyopia. These defects are corrected by the use of suitable spherical lenses.

**Q. 1.** A person cannot read newspaper placed nearer than 50 cm from his eyes. The defect of vision he is suffering from is

- (A) Myopia                    (B) Hypermetropia  
 (C) Presbyopia                (D) None of these

**Ans. Option (B) is correct.**

**Explanation:** In hypermetropia, the affected person can see far objects clearly but cannot see nearby objects clearly. The near point of the eye moves away from 25 cm.

**Q. 2.** This defect may be corrected using

- (A) Concave lens of focal length 25 cm.  
 (B) Convex lens of focal length 50 cm.  
 (C) Concave lens of focal length 50 cm.  
 (D) Convex lens of focal length 25 cm

**Ans. Option (B) is correct.**

**Explanation:** The defect can be corrected by using the convex lens of focal length :

$$u = -25 \text{ cm}$$

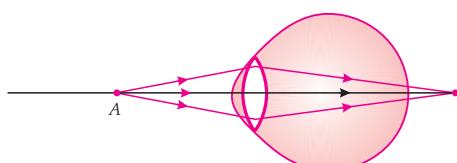
$$v = -50 \text{ cm.}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-50} - \frac{1}{-25}$$

$$(1/f) = \frac{-1+2}{50} = \frac{1}{50} \Rightarrow f = 50 \text{ cm}$$

$$\text{Now, } P = \frac{100}{f} = \frac{100}{50} = 2\text{D}$$

**Q. 3.** Observe the given diagram carefully. What could be the causes of this defect?



I. The focal length of the eye lens is too long.

II. The eyeball becomes too small.

III. The focal length of the eye lens is too small.

IV. The eyeball becomes too long

- (A) Only (I) and (II)    (B) Only (I) and (IV)  
 (C) Only (II) and (III)    (D) Only (III) and (IV)

**Ans. Option (A) is correct.**

**Explanation:** The diagram shows defect hypermetropia. This defect arises either because the focal length of the eye lens is too long or the eyeball has become too small.

**Q. 4.** An old person is unable to see clearly nearby objects as well as distant object. To correct the vision, what kind of lens will he require?

- (A) Concave lens  
 (B) Bifocal lens whose upper portion is concave lens and lower portion is convex lens.  
 (C) Convex lens  
 (D) Bifocal lens whose upper portion is convex lens and lower portion is concave lens.

**Ans. Option (B) is correct.**

**Explanation:** The upper portion (concave lens) facilitates distant vision and the lower portion (convex lens) facilitates near vision.

**Q. 5.** An optician while testing the eyes of Mr. X found the vision to be 6/9. What does it mean?

By this he means that Mr. X

- (A) Can read the letters of 6 inches from a distance 9 m.  
 (B) Can read the letters of 9 inches from 6 m.  
 (C) Can read letters from 6 m which the normal eye can read from 9 m.  
 (D) Can read letters from 9 m which the normal eye can read from 6 m

**Ans. Option (C) is correct.**

**Explanation:** The person can read letters from 6 m which the normal eye can read from 9 m. Dipsmeter is used to measure the power of a spectacle.



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