

CBSE
New Pattern

Science

Class 10 (Term I)

- Multiple Choice Questions
- Assertion-Reasoning MCQs
- Case Based MCQs



3 Practice Papers
On Latest Term I Syllabus

Including Chapterwise
Quick Revision Notes



Science

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- Multiple Choice Questions
- Assertion-Reasoning MCQs
- Case Based Questions

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ARIHANT PRAKASHAN (School Division Series)



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Syllabus

(Term I)

Units		Marks
Unit I	Chemical Substances-Nature and Behaviour	16
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	Chapter-3: Metals and Non-metals	
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	Chapter-6: Life Processes	
Unit III	Natural Phenomena	14
	Chapter-10: Light : Reflection and Refraction	
	Chapter-11: Human Eye and Colourful World	

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, neutralisation, 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), importance 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 Non-metals : 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.



CBSE Circular

Acad - 51/2021, 05 July 2021

About Latest Exam Scheme Term I & II



केन्द्रीय माध्यमिक शिक्षा बोर्ड

(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संगठन)

CENTRAL BOARD OF SECONDARY EDUCATION

(An Autonomous Organisation under the Ministry of Education, Govt. of India)

CBSE/DIR (ACAD)/2021

Date: July 05, 2021

Circular No: Acad-51/2021

All the Heads of Schools affiliated to CBSE

Subject: Special Scheme of Assessment for Board Examination Classes X and XII for the Session 2021-22

COVID 19 pandemic caused almost all CBSE schools to function in a virtual mode for most part of the academic session of 2020-21. Due to the extreme risk associated with the conduct of Board examinations during the second wave in April 2021, CBSE had to cancel both its class X and XII Board examinations of the year 2021 and results are to be declared on the basis of a credible, reliable, flexible and valid alternative assessment policy. This, in turn, also necessitated deliberations over alternative ways to look at the learning objectives as well as the conduct of the Board Examinations for the academic session 2021-22 in case the situation remains unfeasible.

CBSE has also held stake holder consultations with Government schools as well as private independent schools from across the country especially schools from the remote rural areas and a majority of them have requested for the rationalization of the syllabus, similar to last year in view of reduced time permitted for organizing online classes. The Board has also considered the concerns regarding differential availability of electronic gadgets, connectivity and effectiveness of online teaching and other socio-economic issues specially with respect to students from economically weaker section and those residing in far flung areas of the country. In a survey conducted by CBSE, it was revealed that the rationalized syllabus notified for the session 2020-21 was effective for schools in covering the syllabus and helped learners in achieving learning objectives in a less stressful manner.

In the above backdrop and in line with the Board's continued focus on assessing stipulated learning outcomes by making the examinations competencies and core concepts based, student-centric, transparent, technology-driven, and having advance provision of alternatives for different future scenarios, the following schemes are introduced for the Academic Session for Class X and Class XII 2021-22.



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2. Special Scheme for 2021-22

A. Academic session to be divided into 2 Terms with approximately 50% syllabus in each term:

The syllabus for the Academic session 2021-22 will be divided into 2 terms by following a systematic approach by looking into the interconnectivity of concepts and topics by the Subject Experts and the Board will conduct examinations at the end of each term on the basis of the bifurcated syllabus. This is done to increase the probability of having a Board conducted classes X and XII examinations at the end of the academic session.

B. The syllabus for the Board examination 2021-22 will be rationalized

similar to that of the last academic session to be notified in July 2021. For academic transactions, however, schools will follow the curriculum and syllabus released by the Board vide Circular no. F.1001/CBSE-Acad/Curriculum/2021 dated 31 March 2021. Schools will also use alternative academic calendar and inputs from the NCERT on transacting the curriculum.

C. Efforts will be made to make Internal Assessment/ Practical/ Project work more credible and valid as per the guidelines and Moderation Policy to be announced by the Board to ensure fair distribution of marks.

3. Details of Curriculum Transaction

- Schools will continue teaching in distance mode till the authorities permit in-person mode of teaching in schools.
- Classes IX-X: Internal Assessment** (throughout the year irrespective of Term I and II) would include the 3 periodic tests, student enrichment, portfolio and practical work/ speaking listening activities/ project.
- Classes XI-XII: Internal Assessment** (throughout the year irrespective of Term I and II) would include end of topic or unit tests/ exploratory activities/ practicals/ projects.
- Schools would create a student profile for all assessment undertaken over the year and retain the evidences in digital format.
- CBSE will facilitate schools to upload marks of Internal Assessment on the CBSE IT platform.
- Guidelines for Internal Assessment for all subjects will also be released along with the rationalized term wise divided syllabus for the session 2021-22. The Board would also provide additional resources like sample assessments, question banks, teacher training etc. for more reliable and valid internal assessments.



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4. Term I Examinations:

- At the end of the first term, the Board will organize **Term I Examination** in a flexible schedule to be conducted between November-December 2021 with a window period of 4-8 weeks for schools situated in different parts of country and abroad. Dates for conduct of examinations will be notified subsequently.
- The Question Paper will have Multiple Choice Questions (MCQ) including case-based MCQs and MCQs on assertion-reasoning type. Duration of test will be **90 minutes** and it will cover only the rationalized syllabus of **Term I only** (i.e. approx. 50% of the entire syllabus).
- Question Papers will be sent by the CBSE to schools along with marking scheme.
- The exams will be conducted under the supervision of the External Center Superintendents and Observers appointed by CBSE.
- The responses of students will be captured on OMR sheets which, after scanning may be directly uploaded at CBSE portal or alternatively may be evaluated and marks obtained will be uploaded by the school on the very same day. The final direction in this regard will be conveyed to schools by the Examination Unit of the Board.
- Marks of the **Term I** Examination will contribute to the final overall score of students.

5. Term II Examination/ Year-end Examination:

- At the end of the second term, the Board would organize **Term II or Year-end Examination** based on the rationalized syllabus of Term II only (i.e. approximately 50% of the entire syllabus).
- This examination would be held around **March-April 2022** at the examination centres fixed by the Board.
- The paper will be of **2 hours duration** and have questions of different formats (case-based/ situation based, open ended- short answer/ long answer type).
- In case the situation is not conducive for normal descriptive examination a **90 minute MCQ** based exam will be conducted at the end of the Term II also.
- Marks of the Term II Examination would contribute to the final overall score.



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6. Assessment / Examination as per different situations

- A. In case the situation of the pandemic improves and students are able to come to schools or centres for taking the exams.**

Board would conduct Term I and Term II examinations at schools/centres and the theory marks will be distributed equally between the two exams.

- B. In case the situation of the pandemic forces complete closure of schools during November-December 2021, but Term II exams are held at schools or centres.**

Term I MCQ based examination would be done by students online/offline from home - in this case, the weightage of this exam for the final score would be reduced, and weightage of Term II exams will be increased for declaration of final result.

- C. In case the situation of the pandemic forces complete closure of schools during March-April 2022, but Term I exams are held at schools or centres.**

Results would be based on the performance of students on Term I MCQ based examination and internal assessments. The weightage of marks of Term I examination conducted by the Board will be increased to provide year end results of candidates.

- D. In case the situation of the pandemic forces complete closure of schools and Board conducted Term I and II exams are taken by the candidates from home in the session 2021-22.**

Results would be computed on the basis of the Internal Assessment/Practical/Project Work and Theory marks of Term-I and II exams taken by the candidate from home in Class X / XII subject to the moderation or other measures to ensure validity and reliability of the assessment.

In all the above cases, data analysis of marks of students will be undertaken to ensure the integrity of internal assessments and home based exams.

Dr. Joseph Emmanuel
Director (Academics)



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01

Chemical Reactions and Equations

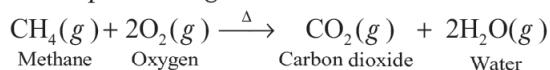
Quick Revision

1. Chemical Reactions

- A chemical reaction is a change in which one or more substance(s) or reactant(s) react to form new substance(s) or product(s) with entirely different properties.
 - The reacting species are known as **reactants** (the substances that undergo chemical change in the chemical reaction) and the new species formed as a result of the reaction are called **products**.
 - A chemical reaction can be identified either by (i) change in state or colour (ii) evolution of gas (iii) change in temperature (iv) formation of a precipitate.

2. Chemical Equations

A chemical equation is the symbolic representation of a chemical reaction. Symbols and formulae of the reactants and products are used to write chemical equation. e.g.



3. Balanced Chemical Equations

A balanced chemical equation is that in which the total number of atoms of each element are equal on both sides of the equation.

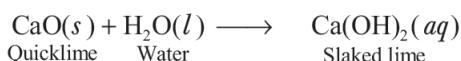
4. Types of Chemical Reactions

The chemical reactions are classified into different types depending upon the chemical changes taking place.

- (i) **Combination Reaction** A reaction in which two or more reactants react together to form a single product, is called a combination reaction.

e.g. When calcium oxide (quick lime) is dissolved in water, it forms calcium hydroxide (slaked lime).

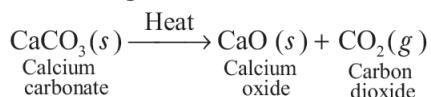
The reaction is highly exothermic, i.e. a lot of heat is produced during the reaction.



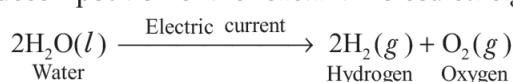
- (ii) **Decomposition Reaction** A reaction in which a single reactant breaks down to form two or more products, is known as decomposition reaction.

On the basis of the form of energy required for the reaction, these reactions are of three types

- **Thermal Decomposition** These reactions involve the use of energy in the form of heat for decomposition of the reactant. e.g.



- **Electrolysis** These reactions involve the use of electrical energy required for the decomposition of the reactant molecules, e.g.

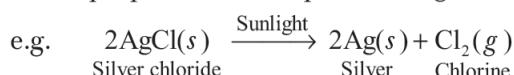


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- Photolysis or Photochemical Decomposition

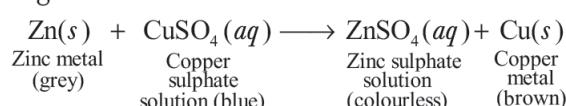
These reactions involve the use of light energy for the purpose of decomposition. e.g.



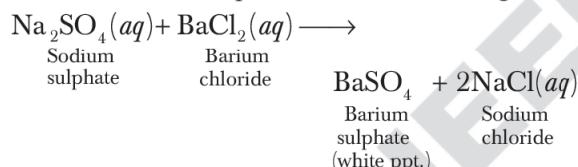
(iii) **Displacement Reaction** This reaction is of two types :

- **Single Displacement Reaction** A reaction in which a more reactive element displaces a less reactive element from the solution of its compound, is called single displacement or displacement reaction.

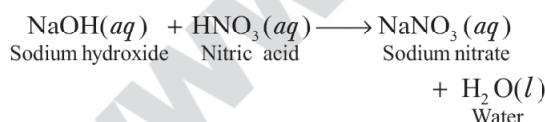
e.g.



- **Double Displacement Reaction** The reaction in which two different ions in the reactant molecules are displaced by each other, is called double displacement reaction. e.g.

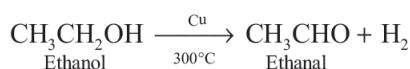
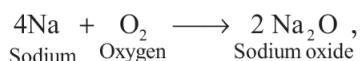


(iv) **Neutralisation Reaction** The reaction in which an acid reacts with a base to give salt and water is called neutralisation reaction, e.g.

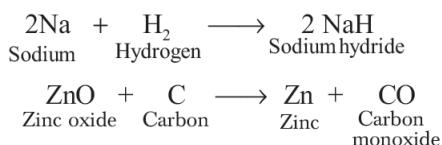


(v) Oxidation and Reduction Reactions

- **Oxidation** The process in which oxygen is added to a substance or the process in which hydrogen is removed from a substance is called oxidation.

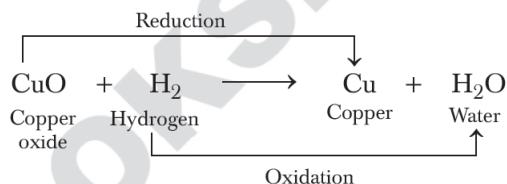


- **Reduction** The process in which hydrogen is added to a substance or the process in which oxygen is removed from a substance is called reduction.



- **Redox Reactions** Those reactions in which oxidation and reduction take place simultaneously are called redox reactions. In this reaction, the copper (II) oxide is losing oxygen and is being reduced.

Hydrogen is gaining oxygen and is being oxidised.

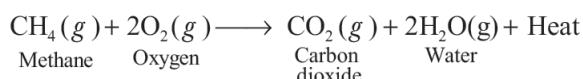


- **Oxidising Agent** A substance which helps in the oxidation of another substance, is called oxidising agent. It is always to be remembered that oxidising agent itself gets reduced.

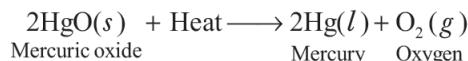
- **Reducing Agent** A substance that helps in the reduction of another substance, is called reducing agent. It is always to be remembered that reducing agent itself gets oxidised.

(vi) Exothermic and Endothermic Reactions

- **Exothermic reactions** The reactions which are accompanied by the evolution of heat, are called exothermic reactions. e.g.



- **Endothermic reactions** The reactions which occur by the absorption of heat/energy are called endothermic reactions. e.g.

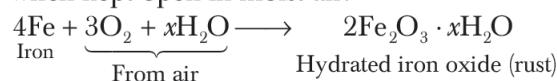


5. Corrosion

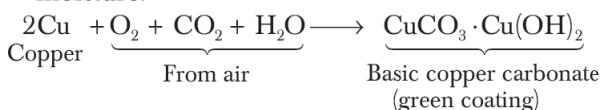
The phenomenon due to which metals are slowly eaten away by the reaction of air, water and chemicals present in atmosphere, is called corrosion.



- Rusting of Iron** Corrosion of iron is called **rusting**. Iron forms hydrated iron oxide (rust) when kept open in moist air.



- Formation of a Green Layer Over Copper** New copper (brown in colour) vessel forms a green layer of basic copper carbonate after some time due to the reaction of air and moisture.



- Corrosion causes damage to car bodies, bridges, iron railing, ships and all objects made

of metals, specially those which are made of iron.

- Corrosion is a wasteful process in most of cases. Every year, a lot of tones of various metals especially iron get wasted in the country. Hence, it is quite necessary to prevent corrosion.

6. Rancidity

- It is the process of slow oxidation of oils and fats present in the food materials resulting in the production of foul odour and taste in them.
- Anti-oxidants are added to foods containing fats and oils in order to prevent their oxidation.

Objective Questions

Multiple Choice Questions

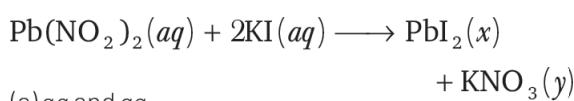
- 01.** Which one of the following processes involve chemical reactions?

- Storing of oxygen gas under pressure in a gas cylinder
- Liquefaction of air
- Keeping petrol in a China dish in the open
- Heating copper wire in the presence of air at high temperature

- 02.** The number of atoms of each element is conserved in any chemical reaction.

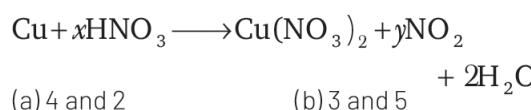
- True
- False
- Can't say
- Partially true/false

- 03.** Complete the missing variables given as 'x' and 'y' in the following reaction:



- aq and aq
- s and s
- aq and s
- s and aq

- 04.** Identify x and y in the following reaction



- 4 and 2
- 3 and 5
- 2 and 3
- 4 and 4

- 05.** The following reaction is an example of
- $$\text{CaO}(s) + \text{H}_2\text{O}(l) \longrightarrow \text{Ca}(\text{OH})_2(aq)$$

- Displacement reaction
 - Combination reaction
 - Decomposition reaction
 - Exothermic reaction
- Only (III)
 - (I) and (III)
 - (II) and (IV)
 - Only (I)

- 06.** Ferrous sulphate crystals lose water when heated. How many molecules of water are lost?

- 5
- 7
- 2
- 4

- 07.** Heating of limestone produces

- slaked lime
- quick lime
- lime water
- caustic soda



08. Carbon dioxide gas burns with a pop sound when a burning candle is brought near it.

- (a) True
- (b) False
- (c) Can't say
- (d) Partially true/false

09. The formation of quick lime and carbon dioxide from calcium carbonate is an example of

- (a) photochemical decomposition reaction
- (b) thermal decomposition reaction
- (c) oxidation reaction
- (d) displacement reaction

10. Electrolysis of water is a decomposition reaction. The mole ratio of hydrogen and oxygen gases liberated during electrolysis of water is

- | | |
|---------|---------|
| (a) 1:1 | (b) 2:1 |
| (c) 4:1 | (d) 1:2 |

11. Which of the following can be decomposed by the action of sunlight?

- (a) KBr
- (b) AgBr
- (c) MgO
- (d) NaCl

12. What will happen, when silver chloride is placed in sunlight for sometime?

- (a) White silver chloride changes into grey coloured compound
- (b) Decomposition takes place
- (c) Both (a) and (b) takes place
- (d) Nothing will happen

13. The heating of lead nitrate produces brown fumes of 'X' gas. Identify 'X' from the following.

- (a) Lead oxide
- (b) Oxygen
- (c) Nitrogen dioxide
- (d) Dinitrogen oxide

14. The carbonate of metal lead is a white solid. It decomposes when heated to form carbon dioxide and a yellow solid oxide 'X'. What is X?

- | | |
|------------------|---------------------|
| (a) Zinc oxide | (b) Lead oxide |
| (c) Silver oxide | (d) Magnesium oxide |

15. Which of the following is exothermic reaction?

- (a) Dissolution of sodium hydroxide in water
- (b) Evaporation of water
- (c) Sublimation of silver chloride
- (d) Dissolution of salt in water

16. Identify the endothermic process from the following:

- (a) $\text{H}_2\text{O(l)} \rightarrow \text{H}_2\text{O(g)}$
- (b) $\text{CaO(s)} + \text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(aq)}$
- (c) Combustion of methane
- (d) Addition of conc. HCl to water.

17. When zinc granules are reacted with dilute sulphuric acid, then which of the following gas is evolved?

- (a) Oxygen gas
- (b) Sulphur dioxide gas
- (c) Hydrogen gas
- (d) Hydrogen sulphide gas

18. Which of the following gives reddish-brown precipitate on mixing?

- | | |
|--|--|
| (a) $\text{FeCl}_3 + \text{NH}_4\text{OH}$ | (b) $\text{NaCl} + \text{H}_2\text{O}$ |
| (c) $\text{AgNO}_3 + \text{NH}_4\text{OH}$ | (d) $\text{CuSO}_4 + \text{H}_2\text{S}$ |

19. The following reaction is an example of



- (a) thermal decomposition reaction
- (b) displacement reaction
- (c) double displacement reaction
- (d) neutralisation reaction

20. Which of the following is incorrect statement?

- (a) Mg is more reactive than H
- (b) Fe is less reactive than Zn
- (c) Cu is more reactive than Al
- (d) Ag is less reactive than Cu



- 36.** 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) KMnO_4 is an oxidising agent, it oxidises FeSO_4
 - (b) FeSO_4 acts as an oxidising agent and oxidises KMnO_4
 - (c) The colour disappears due to dilution, no reaction is involved
 - (d) KMnO_4 is an unstable compound and decomposes in the presence of FeSO_4 to a colourless compound

37. Identify the reducing agent in the following reaction:

- 39.** Match chemical reactions given in the Column I with the type of chemical reactions given in the Column II and select the correct answer using the options given below:

Column I (Chemical reactions)	Column II (Types of chemical reactions)
A. Formation of NH_3 from N_2 and H_2	1. Decomposition
B. Calcination of zinc carbonate	2. Double displacement
C. Rusting of iron	3. Combination
D. Reaction of aqueous BaCl_2 solution with dil. H_2SO_4	4. Redox



Codes

A	B	C	D
(a) 3	1	4	2
(b) 3	4	2	1
(c) 1	4	3	2
(d) 4	3	2	1

40. Gold is a metal which does not corrode when exposed to the atmosphere.

- (a) True
- (b) False
- (c) Can't say
- (d) Partially true/false

41. The iron rod is covered with reddish-brown layer which damages the surface of rod. Which of the following method can be used to prevent its damage?

- (a) By covered it with layer of base
- (b) By covered it with thin layer of zinc
- (c) By covered it with layer of dilute acid
- (d) By covered its with layer of copper

42. Chemically, rust is

- (a) hydrated ferrous oxide
- (b) only ferric oxide
- (c) hydrated ferric oxide
- (d) None of the above

43. Food items made up of oils and fats are flushed with nitrogen gas

- I. to protect them from being rancid.
- II. to protect their taste.
- III. to maintain the weight of food.
- IV. to enhance their flavour.

The correct statements are

- (a) (I), (II) and (III)
- (b) (II) and (IV)
- (c) (I) and (II)
- (d) All of the above

44. are used to prevent rancidity of food.

- | | |
|-------------------------|---------------------|
| (a) Acids | (b) Anti-oxidants |
| (c) Galvanisation items | (d) Anti-reductants |

45. Which of the following gases can be used for storage of fresh sample of an oil for a long time?

- (a) Carbon dioxide or oxygen
- (b) Nitrogen or oxygen
- (c) Carbon dioxide or helium
- (d) Helium or nitrogen

46. Match the chemical reactions given in the Column I with the gas evolved given in the Column II and select the correct answer using the options given below:

Column I (Reactions)	Column II (Gas evolved)
A. Zinc granules are treated with dilute H_2SO_4 .	1. O_2
B. Calcium carbonate on reacting with HCl.	2. CO_2
C. Lead nitrate is heated strongly in a hard glass test tube.	3. H_2
D. Decomposition of $KClO_3$	4. NO_2

Codes

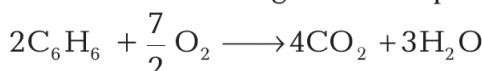
A	B	C	D
(a) 3	4	2	1
(b) 3	2	4	3
(c) 1	3	4	2
(d) 3	2	4	1

Assertion-Reasoning MCQs

Direction (Q.Nos. 47-54) For question numbers two statements are given—one labeled **Assertion** (A) and the other labelled **Reason** (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is correct explanation of the A.
- (b) Both A and R are true but R is not the correct explanation of the A.
- (c) A is true but R is false.
- (d) A is false but R is true.

47. Assertion The following chemical equation,



is a balanced chemical equation.

Reason In a balanced chemical equation, the total number of atoms of each element is equal on both side of the equation.

48. Assertion $\text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2$

Reason Photochemical decomposition occurs in the presence of sunlight.

49. Assertion Quicklime reacts vigorously with water releasing a large amount of heat.

Reason The above chemical reaction is an exothermic reaction.

50. Assertion Photosynthesis is considered as an endothermic reaction.

Reason Energy gets released in the process of photosynthesis.

51. Assertion $\text{Fe}_2\text{O}_3 + 2\text{Al} \longrightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$

The above chemical equation is an example of displacement reaction.

Reason Aluminium being more reactive than iron, displaces Fe from its oxide.

52. Assertion Reaction between silver nitrate and potassium chloride is a precipitation reaction.

Reason Precipitation reaction produces insoluble salt.

53. Assertion In the following chemical equation,



Zinc is getting oxidised and copper oxide 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.

54. Assertion Corrosion involves the damage or deterioration of metal components.

Reason The reduction reaction occurs between metal and atmospheric gases.

Case Based MCQs

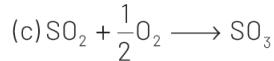
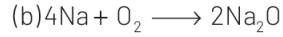
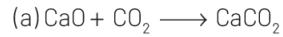
55. Read the following and answer questions from (i) to (v).

Chemical reactions involve the breaking and making of bonds between atoms to produce new substances. During a chemical reaction atoms of one element do not change into those of another element. Nor do, atoms disappear from the mixture or appear from elsewhere. There are certain types of reactions. Reactions in which a single product is formed from two or more reactants is known as a combination reactions.

Decomposition reactions are the reaction in which a compound breaks down into simpler compounds.

Displacement and double displacement reactions are one in which an atom or group of atom is replaced by another. A double displacement reaction usually occurs in solution and one of products, being insoluble, precipitate out (separate as a solid). Another of reaction is redox reactions in which simultaneous oxidation and reduction takes place.

(i) Which of the following reactions involved the combination of two element?



(ii) Consider the reaction



The above reaction is an example of

(a) combination reaction

(b) double displacement reaction

(c) decomposition reaction

(d) simple displacement reaction

(iii) The equation,



represents

- I. decomposition reaction
 - II. displacement reaction
 - III. combination reaction
 - IV. double displacement reaction
 - V. redox reaction
 - (a) I and II
 - (b) III and IV
 - (c) II and V
 - (d) IV and V

(iv) Which of the following is a decomposition reaction?

 - (a) $2\text{HgO} \xrightarrow{\text{Heat}} 2\text{Hg} + \text{O}_2$
 - (b) $\text{CaCO}_3 \xrightarrow{\text{Heat}} \text{CaO} + \text{CO}_2$
 - (c) $2\text{HgO} \xrightarrow{\text{Electrolysis}} \text{H}_2 + \text{O}_2$
 - (d) All of the above

(v) $\text{CuO} + \text{H}_2 \longrightarrow \text{H}_2\text{O} + \text{Cu}$ reaction is an example of

 - (a) redox reaction
 - (b) synthesis Reaction
 - (c) neutralisation
 - (d) analysis reaction

56. Read the following and answer question from (i) to (v).

A magnesium ribbon 'X' was taken by four students P, Q, R and S and they cleaned it by sand paper. 2 cm 'X' and a piece of coat 'Y' were taken in a watch glass by four students. On burning 'X' and 'Y' by using burner following observation were recorded in the form of table as given below:

Observations by	Item	Flame's colour	Residue obtained
P	X	Dazzling white	Greyish ash
	Y	Yellowish	Black ash
Q	X	Dazzling white	White powder
	Y	Sooty	Blackish grey
R	X	White flame	Grey powder
	Y	White flame	Black coke
S	X	Yellowish	Greyish ash
	Y	Sooty	Black ash

- (i) The correct observation was made by the student
(a) P (b) Q (c) R (d) S

(ii) When magnesium ribbon burnt it produces
(a) magnesium hydroxide
(b) magnesium oxide
(c) magnesium chloride
(d) magnesium carbonate

(iii) The magnesium ribbon must be cleaned before burning in air so as to
(a) remove the layer of MgO
(b) remove the layer of $Mg(OH)_2$
(c) remove the dirt
(d) remove the layer of rust

(iv) The type of reaction involved in this experiment is
(a) decomposition reaction
(b) displacement reaction
(c) combination reaction
(d) combustion reaction

(v) The yellow flame indicates
(a) the complete combustion
(b) the flame is not very hot
(c) an incomplete combustion
(d) oxygen supply is high

57. Read the following and answer questions from (i) to (v).

Oxidation has damaging effect on metals as well as on food.

The damaging effect of oxidation is studied as corrosion and that on food is studied as rancidity.

Corrosion causes damage to car bodies, bridges, iron railings, ships and all objects made of metals, specially those of iron, present in the atmosphere. Every year an enormous amount of money is spent to replace and prevent the damaged iron.

Some metals also get tarnished in this manner. The change in colour and the coating of layer indicates the corrosion. When metals are new, they are lustrous and shiny. But their appearance becomes



dull after sometime. These all are the signs of corrosion of metals.

58. Read the following and answer questions from (i) to (v).

Rancid fats are formed in human diet in places such as cooking oils and fats, deep fried foods and some ethnic foods that are purposely made rancid. However, any fat, given the right conditions and amount of time, can go rancid. It means that any food containing fat can become rancid.

For instance, India, 1992, a group of 45 childrens were hospitalised with vomiting, abdominal pain and diarrhoea, which prompted an investigation.

The investigation turned up a total of 71 childrens and 9 adults who were affected by eating rancid cream-filled biscuits which the children had found in the street and shared with their families. Most children ate 0.5 to 2 biscuits and were discharged from the hospitals within 24 hours, one girl ate 12 biscuits and remained in the hospital for 7 days. All the hospitalised children were treated successfully and the researchers decided that the cause of illness was the oxidative rancidity of the cream inside the biscuits. Presence of antioxidants is an antidote for rancidity.

- (i) Which of the following food items become oxidised if placed for a few hours in open?

(a) Dark green vegetables (b) Biscuits
(c) Oil (d) Potato

(ii) The following steps are taken to protect yourself from the effect of rancid fats.

I. Store oils and fats correctly.
II. Avoid food which contains fats or stale smell.
III. Consume antioxidants containing foods such as dark green vegetables.

The correct steps, mentioned above are

(a) I, II (b) II, III
(c) Only III (d) All of these

(iii) The fresh food become stale and tasteless when exposed to air due to

(a) reduction of fats and oils takes place
(b) oxidation of fats and oil takes place
(c) corrosion of food
(d) reaction between carbon dioxide and fats and oils present in food.

(iv) Which of the following is used to prevent rancidity of food?

(a) Species (b) Vinegar
(c) Antioxidants (d) All of these

(v) The packed food items like potato chips are flushed with which gas?

(a) CO_2 (b) O_2
(c) H_2 (d) N_2



ANSWERS

Multiple Choice Questions

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (d) | 2. (a) | 3. (d) | 4. (a) | 5. (c) | 6. (b) | 7. (b) | 8. (b) | 9. (b) | 10. (b) |
| 11. (b) | 12. (c) | 13. (c) | 14. (b) | 15. (a) | 16. (a) | 17. (c) | 18. (a) | 19. (b) | 20. (c) |
| 21. (d) | 22. (a) | 23. (d) | 24. (d) | 25. (b) | 26. (b) | 27. (d) | 28. (a) | 29. (a) | 30. (b) |
| 31. (c) | 32. (a) | 33. (c) | 34. (a) | 35. (a) | 36. (a) | 37. (a) | 38. (c) | 39. (a) | 40. (a) |
| 41. (b) | 42. (c) | 43. (c) | 44. (b) | 45. (d) | 46. (d) | | | | |

Assertion-Reasoning MCQs

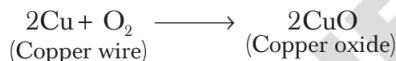
47. (d) 48. (b) 49. (a) 50. (c) 51. (a) 52. (a) 53. (a) 54. (c)

Case Based MCQs

55. (i)-(b), (ii)-(d), (iii)-(c), (iv)-(d), (v)-(a)
 56. (i)-(b), (ii)-(b), (iii)-(a), (iv)-(d), (v)-(c)
 57. (i)-(c), (ii)-(d), (iii)-(c), (iv)-(d), (v)-(a)
 58. (i)-(b), (ii)-(d), (iii)-(b), (iv)-(c), (v)-(d)

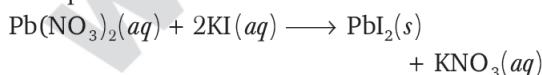
EXPLANATIONS

1. A chemical reaction is a change in which one or more substance(s) or reactant(s) react to form new substance(s) with entirely different properties. Heating of copper wire in presence of air at high temperature gives copper oxide.



- 2.** According to law of conservation of mass, the mass of reactants must be equal to mass of products. In other words, the number of atoms of each element is same, before and after the chemical reaction.

3. When lead nitrate reacts with potassium iodide solution, then insoluble solid precipitates of lead iodide are formed along with potassium nitrate solution.



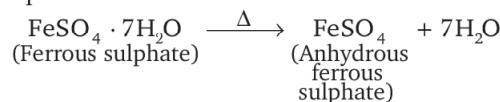
4. By equating the number of atoms both sides, the balanced equation will be



5. The given reaction is an example of both combination and exothermic reaction because calcium oxide and water are combined together to form single product, i.e. calcium hydroxide and produces heat during reaction.

Hence, it is exothermic and combination reaction

6. When blue crystals of ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) are heated, then 7 water molecules are lost and anhydrous ferrous sulphate is formed.

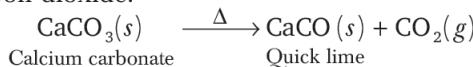


7. When lime stone (also called calcium carbonate) is heated, then it decomposes into calcium oxide and carbon dioxide. Calcium oxide is also known as quick lime.

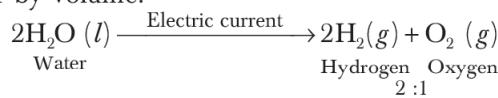


8. The carbon dioxide gas which is evolved in the reaction can be detected by lime water test. The burning candle test is used for the detection of hydrogen gas. So, the given statement is false.

9. The given reaction is a type of thermal decomposition because heat is required for the breakdown of a reactant, i.e. calcium carbonate decomposes into quick lime and carbon dioxide.

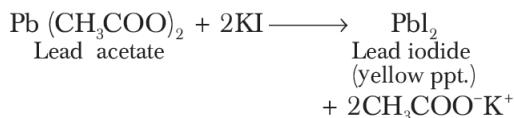


- 10.** The water decomposes during electrolysis to form hydrogen and oxygen gases in the ratio 2:1 by volume.



- 26.** Lead acetate can be used in place of lead nitrate because like lead nitrate, it is also a soluble salt in water.

The reaction is



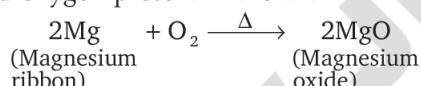
Lead sulphate is insoluble in water, so it cannot be used.

- 27.** In double displacement reaction, two different ions in reactant molecules are displaced or exchanged by each other and precipitate of insoluble salt is produced.

- 28.** The respiration involves the following reaction:

$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \longrightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}$
This reaction is a type of oxidation reaction in which addition of oxygen takes place and energy is released in this reaction, therefore, it is an exothermic reaction too.

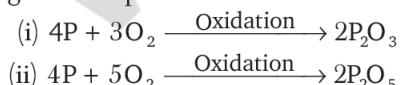
- 29.** Magnesium burns with a dazzling white flame and changes into a white powder. This powder is magnesium oxide (MgO) which is formed due to the reaction of magnesium and oxygen present in the air.



This is a type of oxidation reaction.

- 30.** Fire flies have a special kind of substance (protein), i.e. luciferin that undergoes oxidation (by atmospheric oxygen) in the presence of an enzyme. This reaction is accompanied by emission of light.

- 31.** The addition of phosphorus and oxygen can give two products in different ratio.



In both reactions, oxidation takes place.

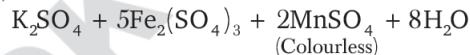
- 32.** In the given reaction, KClO_3 loses its oxygen and becomes KCl . So, there is removal of oxygen in this reaction and hence, it is an example of reduction reaction.

- 33.** Fe is gaining oxygen to give Fe_3O_4 . H_2O is losing oxygen to give H_2 . The substance which oxidises the other substance in a chemical reaction is known as an oxidising agent. So, water is acting as oxidising agent.

- 34.** In the given reaction, the substance that reduced is MnO_2 . It acts as an oxidising agent because it helps hydrogen to get oxidised and itself get reduced.

- 35.** In the given reaction, HCl has been oxidised to Cl_2 (removal of H) and Pb_3O_4 has been reduced to PbCl_2 (removal of O). Hence, Pb_3O_4 acts as an oxidising agent.

- 36.** KMnO_4 in the presence of dil. H_2SO_4 , i.e. in acidic medium, acts as strong reducing agent. In acidic medium, KMnO_4 oxidises ferrous sulphate to ferric sulphate.



- 37.** H_2O is the reducing agent because of the addition of electronegative F, it gets oxidised to HOF . It reduces F_2 to HF (by addition of hydrogen).

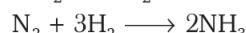
- 38.** In the following reaction,



PbO is losing oxygen and thus, being reduced and the hydrogen is gaining oxygen and thus being oxidised. Oxidation and reduction both occurs simultaneously.

Hence, it is a type of redox reaction.

- 39.** (A) The chemical reaction for the formation of NH_3 from N_2 and H_2 is



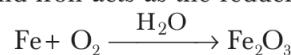
This reaction is combination reaction as N_2 and H_2 are combined together to form NH_3 .

- (B) The calcination of zinc carbonate is a type of decomposition reaction. The chemical reaction involves:

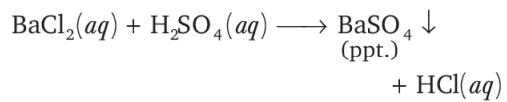


Since, ZnCO_3 decomposes into ZnO and CO_2 , therefore, it is decomposition reaction.

- (C) Rusting of iron is a redox reaction in which oxygen acts as the oxidising agent and iron acts as the reducing agent.



- (D) When dilute sulphuric acid is added to barium chloride solution, then barium sulphate and hydrogen chloride solution are formed.



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This reaction is a type of double displacement reaction because two compounds exchange their ions form two new products.

40. In the reactivity series, gold is present at the bottom as it is highly unreactive metal. Hence, it does not react with oxygen present in atmosphere. So, the given statement is true.
41. The iron rod can be protected from corrosion (or rust) by coating a thin layer of zinc metal. The process of coating zinc over iron is called galvanisation.
42. Iron reacts with oxygen from the air in the presence of moisture and rust gets formed. The formula of rust is $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, where x is a variable. So, rust is the hydrated form of ferric oxide.
43. Rancidity spoils the taste and odour of the food. To prevent rancidity, food items made of oils and fats are flushed with nitrogen gas so that the taste and odour of food do not change.
44. Anti-oxidants are used to prevent the oxidation of oils and fats present in food and rancidity can be prevented.
45. Helium and nitrogen both gases are inert in nature. When the packed food is surrounded by unreactive gas, there is no oxygen to cause its oxidation and make it rancid.
46. (A) When zinc granules are treated with dil. H_2SO_4 , it will give hydrogen gas and zinc sulphate.

$$\text{Zn}(s) + \text{H}_2\text{SO}_4(aq) \longrightarrow \text{ZnSO}_4(aq) + \text{H}_2(g)$$
- (B) On reacting with HCl, calcium carbonate gives calcium chloride, water and carbon dioxide.

$$\text{CaCO}_3(s) + 2\text{HCl}(aq) \longrightarrow \text{CaCl}_2(aq) + \text{CO}_2(aq) + \text{H}_2\text{O}(l)$$
- (C) When lead nitrate is heated strongly in a hard glass test tube, then lead oxide is formed along with nitrogen dioxide and oxygen gas.

$$2\text{Pb}(\text{NO}_3)_2 \xrightarrow{\Delta} 2\text{PbO} + 4\text{NO}_2 + \text{O}_2$$
- (D) On decomposition of KClO_3 , two products are formed, that are potassium chloride and oxygen gas.

$$2\text{KClO}_3 \xrightarrow{\Delta} 2\text{KCl} + 3\text{O}_2$$

47. A is false but R is true. In a balanced chemical equation, the total number of atoms of each element are equal on both sides of the equation.

Moreover, the correct balanced chemical equation is,



48. Both A and R are true but R is not the correct explanation of A. The given reaction is thermal decomposition reaction not a photochemical decomposition reaction.

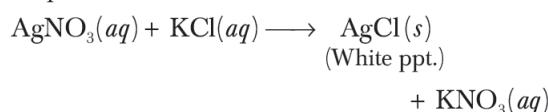
49. Both A and R are true and R is the correct explanation of A. In exothermic reactions, heat is released alongwith the formation of products.

50. A is true but Reason is false. Photosynthesis is considered as an endothermic reaction because energy in the form of sunlight is absorbed by the green plants.

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

$\text{Fe}_2\text{O}_3 + 2\text{Al} \longrightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$
is a displacement reaction. Here, a highly reactive element (Al) displaces Fe from Fe_2O_3 .

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



The white precipitate formed is insoluble salt of AgCl.

53. Both A and R are true and R is the correct explanation of A. The reaction involves both oxidation and reduction in which, CuO is reduced to Cu and Zn is oxidised to ZnO.

54. A is true but R is false. The oxidation reaction occurs between the metal and atmospheric gases such as O_2 , CO_2 , SO_2 etc., and results in corrosion.

55. (i) $4\text{Na} + \text{O}_2 \longrightarrow 2\text{Na}_2\text{O}$

In this reaction, two elements sodium and oxygen participate and form sodium oxide. However in other reactions, the compounds are combined together and form a single product.

- (ii) The given reaction is an example of simple displacement reaction because Al being more reactive than Fe, replace iron from its oxide and forms aluminium oxide.
- (iii) $Mg(s) + CuO(s) \longrightarrow MgO(s) + Cu(s)$
In this reaction, Mg displaces Cu from its oxide and form magnesium oxide. Also, Mg is being oxidised (addition of oxygen) and Cu is being reduced (removed of oxygen). Therefore, this reaction is a redox reaction and displacement reaction.
- (iv) All the given reactions are decomposition reaction because in all reactions, single compound decomposes into two products.
- (v) $CuO + H_2 \longrightarrow H_2O + Cu$
This reaction is an example of redox reaction in which reduction and oxidation both takes place. CuO is being reduced to Cu and H₂ is being oxidised to H₂O.
- 56.**
- (i) Magnesium ribbon burns with dazzling white flame and sooty fumes. The correct observation was made by the student Q.
 - (ii) When magnesium ribbon burnt, it reacts with oxygen present in the air and form a powdery ash called magnesium oxide (MgO).
 - (iii) Magnesium ribbon must be cleaned before burning in the air so as to remove the layer of MgO formed due to reaction between magnesium and air.
 - (iv) Combustion reaction is involved in this experiment which is as follows:
 $Mg(s) + H_2SO_4(aq) \longrightarrow MgO(s) + H_2(g)\uparrow$
 - (v) The yellow flame indicates the incomplete combustion of gas because of insufficient supply of oxygen.

- 57.**
- (i) The iron articles when coated with reddish brown powder on the exposure to air and moisture, that coating is known as rusting. The process of corrosion of iron is rusting.
 - (ii) The atmosphere contains gases like oxygen, carbon dioxide, sulphur dioxide; moisture and heat which are responsible for the corrosion of metal. Moreover, presence of acid in the atmosphere can easily cause corrosion.
 - (iii) When silver articles exposed to air, then silver reacts with hydrogen sulphide present in air and becomes black. This process is called tarnishing of silver.
 - (iv) The rusting of iron is a redox reaction in which oxygen acts as the oxidising agent and iron acts as the reducing agent.
 - (v) Painting, galvanising and electroplating are some methods which are used to prevent corrosion. By using anti-oxidants, rancidity of food is prevented.
- 58.**
- (i) Biscuits will become oxidised and inedible if it is placed for a few hours in open.
 - (ii) All of the given steps are correct and can be helpful to protect yourself from effect of rancid fats.
 - (iii) The fats and oils present in food items are oxidised by air and make them rancid. This rancidity responsible for stale and tasteless food.
 - (iv) Antioxidants are the additives capable of preventing rancidity of food due to oxidation.
 - (v) Being unreactive, N₂ gas is flushed to packing food like potato chips to prevent oxidation or rancidity.

02

Acids, Bases and Salts

Quick Revision

1. Acids

- Acids are those chemical substances which have a sour taste and turn blue litmus solution red.
- According to **Arrhenius concept**, substances that furnish H^+ ions in an aqueous solution are called acids.
e.g. $H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$
- Acids may be **strong** (which completely dissociates) or **weak** (which partially dissociates).

2. Chemical Properties of Acids

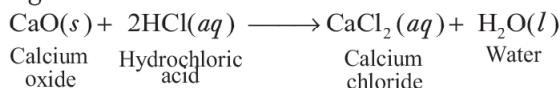
- **Reaction with Metals** Dilute acids (e.g. HCl and H_2SO_4 , not HNO_3) react with certain active metals like zinc (Zn), iron (Fe), etc., to evolve H_2 gas.

e.g.

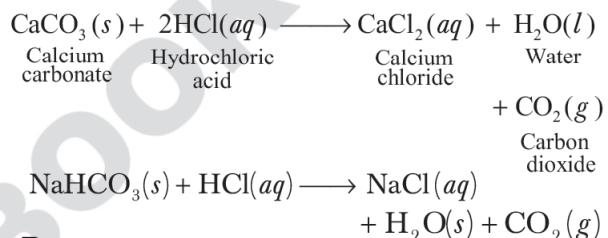


- **Reaction with Metal Oxides** Acids react with certain metal oxides (basic oxides) to form salt and water.

e.g.



- **Reaction with Metal Carbonate and Hydrogen Carbonate** Acids react with metal carbonates and hydrogen carbonates to produce carbon dioxide gas. e.g.

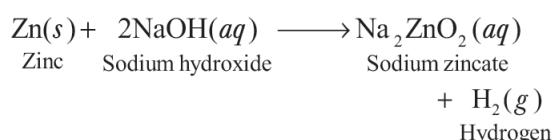


3. Bases

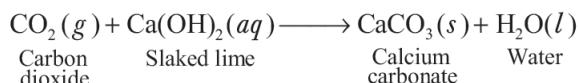
- Substances that furnish hydroxide ions (OH^-) in aqueous solution are called bases. e.g. Caustic soda or sodium hydroxide, $NaOH$.
- **Strong Bases** The substances/bases which ionise completely to furnish OH^- ions are called strong bases. e.g. KOH (caustic potash).
- **Weak Bases** The bases which ionise only partially are called weak bases. e.g. Calcium hydroxide $[Ca(OH)_2]$.
- **Alkali** Water soluble base is called alkali. e.g. $NaOH$. All alkalies are base, but all base are not alkalies.
- Bases have bitter taste, turn red litmus to blue and soapy to touch.

4. Chemical Properties of Bases

- **Reaction with Metals** Strong bases react with active metals to produce hydrogen gas. e.g.



- Reaction with Non-metallic Oxide Bases** react with non-metallic oxides (acidic oxides) to produce salt and water. This reaction proves that non-metallic oxides are acidic in nature. e.g.

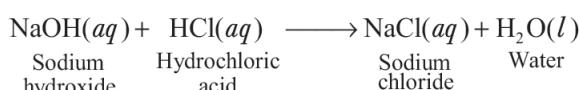


5. Reaction Between Acids and Bases

- Acids react with bases to produce salt and water. In this reaction, acid neutralises a base, i.e. reduce its effect or *vice-versa*, thus the reaction is known as **neutralisation reaction**.
- In general, neutralisation reaction can be written as



e.g.



6. Effect of Dilution on an Acid or Base

- Mixing of an acid or base with water is called **dilution**. It results in decrease in the concentration of ions (H_3O^+ / OH^-) per unit volume and the acid or base is said to be **diluted**.
- The process of diluting an acid or base is a highly exothermic process. The acid must be added slowly to water with constant stirring.
- If water is added to a concentrated acid, the heat generated may cause the mixture to splash out and cause burns.

7. Indicators

Indicators are the substances that change their colour or odour when added into an acid or alkaline solution. Indicators can be classified as natural, synthetic indicators, olfactory indicators and universal indicators.

- (i) Natural Indicators** These indicators are found in nature in the plants. e.g. Litmus solution is a purple colour dye extracted from the lichen plant.
- (ii) Synthetic Indicators** The indicators which are synthesised in the laboratory or industry are known as synthetic indicators. e.g. Methyl orange, phenolphthalein.

Indicator	pH-range	Colour	
		(In Acidic Medium)	(In Basic Medium)
(i) Natural Indicators			
Litmus	-	Red	Blue
Turmeric	-	Yellow	Red
Red cabbage juice (from leaves)	-	Red	Green
(ii) Synthetic indicators			
Phenolphthalein	8.4-10.00	Colourless	Pink (Red)
Methyl orange	3.1-4.4	Red	Yellow
(iii) Olfactory Indicators Those substances whose odour changes in acidic or basic medium are called olfactory indicators. e.g. Vanilla extract and onion.			
(iv) Universal Indicators To judge how strong a given acid or base is, a universal indicator is used which is a mixture of several indicators. It shows different colours at different concentrations of hydrogen ion in a solution.			
8. Strength of an Acid or Base			
<ul style="list-style-type: none"> Strength of an acid or base depends on the number of H^+ ions or OH^- ions produced by them respectively. Larger the number of H^+ ions produced by an acid, stronger is the acid. Similarly, larger the number of the OH^- ions produced by a base, stronger is the base. 			
9. pH Scale			
<ul style="list-style-type: none"> It is a scale used for measuring hydrogen ion concentration. The <i>p</i> in the pH stands for potenz which means power in German. It has values ranging from 0 (very acidic) to 14 (very alkaline). Thus, pH is a number which indicates the acidic or basic nature of a solution. According to Danish chemist Sorenson, pH is the negative of logarithm to the base 10 of hydrogen ion concentration present per litre of solution. 			

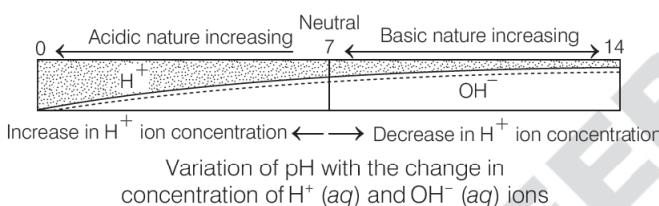
- In other words, value of pH is equal to the logarithm to the base 10, inverse of hydrogen ion concentration.

$$\Rightarrow \text{pH} = -\log_{10} [\text{H}^+] \\ = \log_{10} \frac{1}{[\text{H}^+]} \Rightarrow [\text{H}^+] = 10^{-\text{pH}}$$

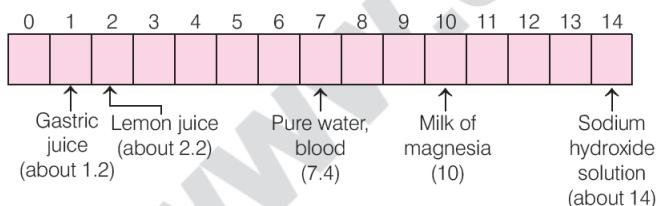
Similarly, $\text{pOH} = -\log [\text{OH}^-] = \log \frac{1}{[\text{OH}^-]}$

and $\text{pH} + \text{pOH} = \text{p}K_w = 14$

- Higher the hydronium ion concentration present in the solution, lower is its pH value [pH means power of hydrogen ions].
 - If $\text{pH} > 7$, solution is basic.
 - If $\text{pH} < 7$, solution is acidic.
 - If $\text{pH} = 7$, solution is neutral.



- Pure water is neutral because of the absence of free ions. A paper impregnated with the universal indicator is used for measuring pH.



10. Importance of pH in Everyday Life

Following are the examples showing importance of pH in everyday life

- Plants and Animals are pH Sensitive** Our body works normally within a pH range of 7.0 to 7.8. When pH of rain water goes below 5.6, it is called acid rain. It lowers the pH of the river water and makes survival of aquatic life difficult.
- pH of the Soil** Nature of soil is known by testing its pH and then a particular crop is grown in it by selecting fertilizer.

(iii) **pH in Our Digestive System** During indigestion the stomach produces too much acid, it causes pain and irritation. To correct the disturbed pH range, milk of magnesia (a mild base) is used as a medicine, which is also called **antacid**.

(iv) **pH Change Leads to Tooth Decay** If the pH inside the mouth decreases below 5.5 (acidic), the decay of tooth enamel begins. The bacteria present in the mouth degrades the sugar and left over food particles and produce acids that remains in the mouth after eating.

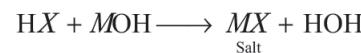
To prevent tooth decay, toothpastes (basic) are used which neutralise the excess acid.

(v) **Self Defence by Animals and Plants through Chemical Warfare** When insects like honeybee, ant, etc., bite, they inject an acid into the skin, that causes pain and irritation. If a mild base like baking soda is applied on the affected area, it gives relief.

(vi) **pH in Plants** Stinging hair of nettle leaves injects methanoic acid in the skin which causes burning pain. It is cured by rubbing with leaves of dock plant.

11. Salts

- These are produced by the **neutralisation reaction** between acid and base.



Here, X is non-metal and M is metal.

- Salts of strong acid and strong base are neutral ($\text{pH}=7$). Salts of strong acid and weak base are acidic [$\text{pH} < 7$] and salts of strong base and weak acid are basic in nature ($\text{pH} > 7$).

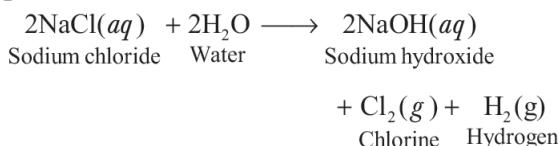
12. Common Salt : Sodium Chloride

Common salt is formed by the combination of hydrochloric acid and sodium hydroxide solution. It is the salt that we use in food.

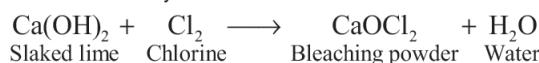
(i) **Caustic Soda** (Sodium Hydroxide [NaOH])

When electricity is passed through an aqueous solution of sodium chloride (called brine), it decomposes to form sodium hydroxide.

The process is called the **chlor-alkali process**.

(ii) **Bleaching Powder** (Calcium Oxychloride [CaOCl₂])

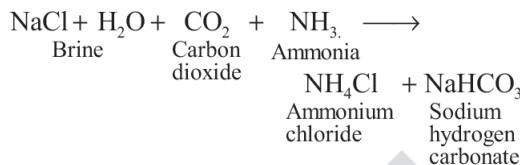
It is produced by the action of chlorine on dry slaked lime.

(iii) **Baking Soda** (Sodium Hydrogen Carbonate or Sodium Bicarbonate [NaHCO₃])

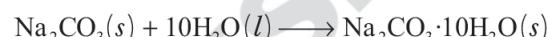
The soda commonly used in the kitchen for making tasty crispy pakoras is baking soda.

It is the major constituent of baking powder. It is produced by using sodium chloride as one of the raw materials.

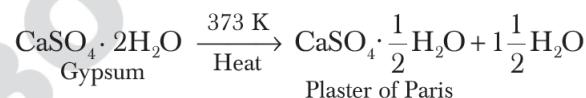
Manufacture of baking soda is shown in reaction below

(iv) **Washing Soda** (Sodium Carbonate [Na₂CO₃ · 10H₂O])

Sodium carbonate can be obtained by heating baking soda; recrystallisation of anhyd. sodium carbonate gives washing soda. It is also a basic salt.

(v) **Plaster of Paris** (Calcium Sulphate Hemihydrate [CaSO₄ · 1/2 H₂O])

It is obtained by heating gypsum (CaSO₄ · 2H₂O) at 373 K. At this temperature, gypsum loses water molecules and forms plaster of Paris.

**13. Water of Crystallisation**

It is the fixed number of water molecules present in one formula unit of a salt. e.g. Hydrated copper sulphate, CuSO₄ · 5H₂O contains five molecules of crystallisation.

Objective Questions

Multiple Choice Questions

01. Which of the following is the mineral acid?

- (a) Hydrochloric acid
- (b) Citric acid
- (c) Acetic acid
- (d) Lactic acid

02. Which of the following statements is incorrect about acids?

- (a) Acids conduct electricity
- (b) Acids do not corrode metals
- (c) Acids give hydrogen ions after dissociation
- (d) All of the above are correct

03. Which of the following acids is present in sour milk? (NCERT Exemplar)

- | | |
|-------------------|-----------------|
| (a) Glycolic acid | (b) Oxalic acid |
| (c) Lactic acid | (d) Citric acid |

04. Which of the following is acidic in nature?

- | | |
|----------------|-----------------|
| (a) Lime juice | (b) Human blood |
| (c) Lime water | (d) Antacid |

05. Select the acid which contains four hydrogen atoms in it.

- | | |
|-----------------|--------------------|
| (a) Formic acid | (b) Sulphuric acid |
| (c) Nitric acid | (d) Acetic acid |

- 06.** Match the acids given in Column I with their correct source given in Column II and select the correct answer using the options given below:

Column I	Column II
A. Lactic acid	1. Tomato
B. Citric acid	2. Curd
C. Acetic acid	3. Oranges
D. Oxalic acid	4. Vinegar

Codes

A	B	C	D
(a) 1	3	2	4
(b) 3	1	4	2
(c) 4	2	1	3
(d) 2	3	4	1

- 07.** Which of the following statements is not correct? *(NCERT Exemplar)*

- (a) All metal carbonates react with acid to give a salt, water and carbon dioxide
- (b) All metal oxides react with water to give salt and acid
- (c) Some metals react with acids to give salt and hydrogen
- (d) Some non-metal oxides react with water to form an acid

- 08.** Which gas is evolved, when hydrochloric acid is added in first test tube containing small pieces of marble and then in second test tube containing zinc granules?

- (a) H₂ is first test tube, O₂ in second test tube
- (b) CO₂ in first test tube, H₂ in second test tube
- (c) O₂ in first test tube, Cl₂ in second test tube
- (d) Cl₂ in first test tube, CO₂ in second test tube

- 09.** When dilute sulphuric acid reacts with iron sulphide, the gas evolved is

- (a) hydrogen sulphide
- (b) sulphur dioxide
- (c) sulphur trioxide
- (d) vapour of sulphuric acid

- 10.** Which of the following gives OH⁻ ions on dissociation in water?

- (a) Calcium carbonate
- (b) Iron sulphide
- (c) Calcium oxide
- (d) All of these

- 11.** Which of the following hydroxides is not an alkali?

- (a) Ammonium hydroxide
- (b) Calcium hydroxide
- (c) Copper hydroxide
- (d) Sodium hydroxide

- 12.** Sodium hydroxide and potassium hydroxide are used as electrolytes.

- (a) True
- (b) False
- (c) Can't say
- (d) Partially true/false

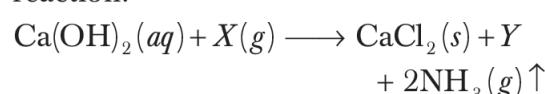
- 13.** Which of the following statements is incorrect about bases?

- (a) Bases are bitter in taste
- (b) They are soapy to touch
- (c) They are corrosive in nature
- (d) All bases are alkali

- 14.** Which of the following combination justify that lime water is basic in nature?

- (a) Ca(OH)₂ + CO₂(g)
- (b) Ca(OH)₂ + NaOH
- (c) Ca(OH)₂ + NaCl
- (d) Both (b) and (c)

- 15.** Identify 'X' and 'Y' in the following reaction:



- (a) X = NH₄Cl, Y = O₂
- (b) X = NH₄Cl, Y = H₂O
- (c) X = (NH₄)₂SO₄, Y = SO₂
- (d) X = NH₄OH, Y = O₂

- 16.** An acid when dissolved in water gives ions.

- (a) hydroxide
- (b) negative
- (c) hydronium
- (d) All of these

- 17.** What happens, when sodium hydroxide is mixed in water?

- I. Hydronium ions will be produced.
- II. Heat is released during dissolution.
- III. The process is endothermic.

IV. Hydroxide ions will be produced

Choose the correct option.

- | | |
|-------------------|-------------------|
| (a) (I) and (II) | (b) (II) and (IV) |
| (c) (I) and (III) | (d) (IV) only |

18. The aqueous solution of sulphur dioxide is

- | | |
|-------------|----------------|
| (a) acidic | (b) basic |
| (c) neutral | (d) amphoteric |

19. When a small amount of acid is added to water, the phenomena which occur are

(CBSE 2020)

- I. Dilution
 - II. Neutralisation
 - III. Formation of H_3O^+ ions
 - IV. Salt formation
- | | |
|---------------|---------------|
| (a) I and III | (b) II and IV |
| (c) I and II | (d) II and IV |

20. Sodium hydrogen carbonate when added to acetic acid evolves a gas. Which of the following statements are true about the gas evolved?

- I. It turns lime water milky.
 - II. It extinguishes a burning splinter.
 - III. It dissolves in a solution of sodium hydroxide.
 - IV. It has a pungent odour.
- (NCERT Exemplar)
- | | |
|--------------------|-------------------|
| (a) I and II | (b) I, II and III |
| (c) II, III and IV | (d) I and IV |

21. When metal carbonate reacts with acid like HCl in aqueous solution, then which gas will evolved?

- | | | | |
|------------------|-------------------|------------------|-------------------|
| (a) H_2 | (b) CO_2 | (c) O_2 | (d) NO_2 |
|------------------|-------------------|------------------|-------------------|

22. Mixing of an acid or base with water results in in the concentration of ions per unit volume. (NCERT Exemplar)

- | | |
|---------------|--------------------|
| (a) decrease | (b) increase |
| (c) no change | (d) reverse change |

23. When a metallic oxide is dissolved in water, the solution formed has a high concentration of which ions

- | | |
|-------------------|--|
| (a) H^+ | (b) H_3O^+ |
| (c) OH^- | (d) M^+ ($\text{M} = \text{metal}$) |

24. Which one of the following can be used as an acid-base indicator by a visually impaired student? (NCERT Exemplar)

- | | |
|---------------------|--------------------|
| (a) Litmus | (b) Turmeric |
| (c) Vanilla essence | (d) Petunia leaves |

25. The correct statement regarding universal indicator is

- | |
|---|
| (a) it is an indicator having $\text{pH} = 7$ |
| (b) it gives blue colour at $\text{pH} = 3$ |
| (c) it becomes colourless at $\text{pH} = 7$ |
| (d) it gives red colour at $\text{pH} = 3$ |

26. A blue litmus paper was first dipped in dil. HCl and then in dil. NaOH solution. The colour of the litmus paper will be

- | |
|---|
| (a) changed first to red and then to blue |
| (b) changed first to blue and then colourless |
| (c) remains blue in both times |
| (d) changed to red |

27. The turmeric solution will turn red by an aqueous solution of

- | | |
|------------------------------|---------------------|
| (a) CH_3COOK | (b) CuSO_4 |
| (c) Na_2SO_4 | (d) FeCl_3 |

28. Which of the following is not a natural indicator? (NCERT Exemplar)

- | |
|--------------------------------|
| (a) Red cabbage juice |
| (b) Turmeric juice |
| (c) Flowers of hydrangea plant |
| (d) None of the above |

29. An aqueous solution turns red litmus solution blue. Excess addition of which of the following solution would reverse the change? (NCERT Exemplar)

- | |
|---------------------------------|
| (a) Baking powder |
| (b) Lime |
| (c) Ammonium hydroxide solution |
| (d) Hydrochloric acid |

30. Methyl orange and phenolphthalein are used for purposes.

- | | |
|-----------------|--------------------|
| (a) titration | (b) cooking |
| (c) dissolution | (d) neutralisation |



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- 31.** Match the indicators given in the Column I with its colour transition on reacting with base in Column II and select the correct answer using the options given below.

Column I (Indicators)	Column II (Change in colour in basic medium)
A. Red litmus	1. Yellow
B. Methyl orange	2. Blue
C. Phenolphthalein	3. No change
D. Blue litmus	4. Pink

Codes

A	B	C	D
(a) 2	3	1	4
(b) 3	1	4	2
(c) 2	1	4	3
(d) 3	2	4	1

- 32.** What is pH?

- (a) The positive logarithm of the hydroxide ion concentration
- (b) The positive logarithm of the hydrogen ion concentration
- (c) The negative logarithm of the hydroxide ion concentration
- (d) The negative logarithm of the hydrogen ion concentration

- 33.** Which of the following statements is correct about an aqueous solution of an acid and a base?

- I. Higher the pH, stronger the acid.
- II. Higher the pH, weaker the acid.
- III. Lower the pH, stronger the base.
- IV. Lower the pH, weaker the base.

(NCERT Exemplar)

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

- 34.** When the pH increases, the acidity decreases.

- (a) True
- (b) False
- (c) Can't say
- (d) Partially true/false

- 35.** A solution turns red litmus blue, its pH is likely to be

- (a) 1
- (b) 4
- (c) 5
- (d) 10

- 36.** Which of the following statement is correct?

- (a) pH of acid rain is 7–7.8
- (b) Acid rain makes survival of aquatic life difficult
- (c) Acid rain clear the marble buildings
- (d) All of the above

- 37.** A sample of soil is mixed with water and allowed to settle. The clear supernatant solution turns the pH paper yellowish-orange. Which of the following would change the colour of this pH paper to greenish-blue?

- (a) Lemon juice
- (b) Vinegar
- (c) Common salt
- (d) An antacid

- 38.** Calcium phosphate is present in tooth enamel. Its nature is

- (a) basic
- (b) acidic
- (c) neutral
- (d) amphoteric

- 39.** Antacids contain

- (a) weak base
- (b) weak acid
- (c) strong base
- (d) strong acid

- 40.** Which of the following substances can be used to get relief from bee sting?

- (a) Vinegar
- (b) Baking soda
- (c) Formic acid
- (d) Alcohol

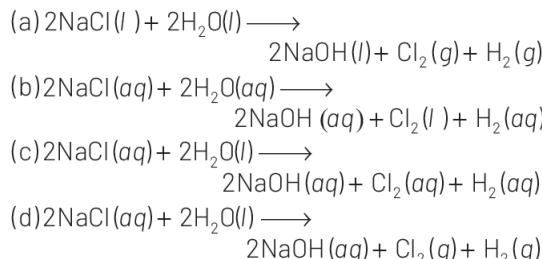
- 41.** Useful substance for disinfecting water is

- (a) washing soda
- (b) common alum
- (c) baking soda
- (d) bleaching powder

- 42.** The chemical formula of washing soda is

- (a) NaHCO_3
- (b) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- (c) CaOCl_2
- (d) NaOH

- 43.** Identify the correct representation of reaction occurring during chloralkali process. *(NCERT Exemplar)*



- 44.** The chemical name of bleaching powder is calcium chloride.

- (a) True
 (b) False
 (c) Can't say
 (d) Partially true/false

- 45.** Plaster of Paris can be hardened by

- (a) giving out water
 (b) combining with water
 (c) changing into CaCO_3
 (d) giving off CO_2

- 46.** Match the chemical substances given in Column I with their appropriate application given in Column II.

Column I	Column II
A. Bleaching powder	1. Preparation of glass
B. Baking soda	2. Production of H_2 and Cl_2
C. Washing soda	3. Decolourisation
D. Sodium chloride	4. Antacid

Codes *(NCERT Exemplar)*

- | | | | |
|---|---|---|---|
| A | B | C | D |
|---|---|---|---|
- (a) 2 1 4 3
 (b) 3 2 4 1
 (c) 3 4 1 2
 (d) 2 4 1 3

- 47.** Which of the following salts does not contain water of crystallisation?

- (a) Blue vitriol
 (b) Baking soda
 (c) Washing soda
 (d) Gypsum

- 48.** 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.

(NCERT Exemplar)

- (a) Only I
 (b) I and III
 (c) II and III
 (d) I and IV

- 49.** Baking soda is a mixture of *(CBSE 2020)*

- (a) sodium carbonate and acetic acid
 (b) sodium carbonate and tartaric acid
 (c) sodium hydrogen carbonate and tartaric acid
 (d) sodium hydrogen carbonate and acetic acid

Assertion-Reasoning MCQs

Direction (Q.Nos. 50-57) For question numbers 50 to 57 two statements are given—one labeled **Assertion (A)** and the other labeled **Reason (R)**. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is correct explanation of the A.
 (b) Both A and R are true but R is not the correct explanation of the A.
 (c) A is true but R is false.
 (d) A is false but R is true.

- 50. Assertion** Lemon juice is sour in taste.

Reason Lemon juice is acidic in nature.

- 51. Assertion** Sodium hydrogen carbonate is used in fire extinguisher.

Reason Sodium hydrogen carbonate is a mild base.

- 52. Assertion** HCl produces hydronium ions (H_3O^+) and chloride ions (Cl^-) in aqueous solution.

Reason In presence of water, base gives H^+ ions.

53. Assertion Sodium carbonate is an acidic salt.

Reason Sodium carbonate is salt of weak acid and strong base.

54. Assertion Phenolphthalein gives pink colour in basic solution.

Reason Phenolphthalein is a natural indicator.

55. Assertion If the pH inside the mouth decreases below 5.5, the decay of tooth enamel begins.

Reason The bacteria present in mouth degrades the sugar and left over food particles and produce acids that remains in the mouth after eating.

56. Assertion Aqueous solution of ammonium nitrate turns the blue litmus into red.

Reason Ammonium nitrate is a salt of strong acid and strong base.

57. Assertion Magnesium hydroxide is used as an antacid.

Reason Magnesium hydroxide is a strong base.

Cased Based MCQs

58. Read the following and answer questions from (i) to (v).

Acids produce hydrogen ions, $H^+(aq)$, in solution, which are responsible for their acidic properties. Hydrogen ions cannot exist alone, but they exist after combining with water molecules.

Bases generate hydroxide (OH^-) ions in water. Bases which are soluble in water are called **alkalis**, that all acids generate $H^+(aq)$ and all bases generate $OH^-(aq)$,



The acidic behaviour of acids is due to the presence of hydrogen (H^+) ions in them. They produce hydrogen ions in the presence of water.

Water is a polar solvent and this property of water helps in weakening the bond between the ions and makes them soluble. Hence, acids and bases produce ions in aqueous solutions.

(i) Ammonium hydroxide is a weak base because

- (a) it has low vapour pressure
- (b) it is only slightly ionised
- (c) it is not a hydroxide of any metal
- (d) it has low density

(ii) The poisonous effect of acid present in stings of bees and ants can be neutralised by use of a solution that contains

- (a) acetic acid
- (b) formic acid
- (c) sodium hydroxide
- (d) sodium chloride

(iii) Which of the following is an alkali?

- (a) $Ca(OH)_2$
- (b) KOH
- (c) $Mg(OH)_2$
- (d) $CaCO_3$

(iv) Acids and bases are important because of

- (a) their use in industry
- (b) their effects on human health
- (c) their effect on farmer's crop
- (d) All the above are correct

(v) Which of following compound is alkaline in aqueous medium?

- | | |
|----------------|--------------|
| (a) Na_2CO_3 | (b) NaCl |
| (c) H_2CO_3 | (d) $CuSO_4$ |

59. Read the following and answer questions from (i) to (v).

Sodium is a very important element. Many of its compound are widely used by us, even in our food as well as for washing clothes.

Sodium carbonate decahydrate

$(\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O})$ is called washing soda and is widely used for washing clothes. When it is saturated with dioxide of carbon in moist environment, it gives a product called baking soda.



Baking soda is used in small amount in making bread and cake. It helps to make these soft and spongy. An aqueous solution of baking soda turns red litmus blue. It is also used in soda-acid fire extinguisher.

Bleaching powder is also known as chloride of lime. It is solid and yellowish white in colour. Bleaching powder can be easily identified by the strong smell of chlorine. When calcium hydroxide (slaked lime) reacts with chlorine, it gives calcium oxychloride (bleaching powder) and water.

Aqueous solution of bleaching powder is basic in nature.

- (i) Baking powder helps in making cakes and bread soft and spongy by
 - (a) providing hydrogen gas
 - (b) releasing carbon monoxide gas
 - (c) releasing carbon dioxide gas
 - (d) reacting dough of cakes and bread

- (ii) Which reaction is used in soda-acid fire extinguishers ?
 - (a) $\text{NaHCO}_3 \xrightarrow{\Delta} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$
 - (b) $\text{NaHCO}_3 + \text{H}^+ \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$
+ Sodium salt of acid
 - (c) Both (a) and (b)
 - (d) None of the above

- (iii) The approximate pH value of bleaching powder solution is
 - (a) 4
 - (b) 7
 - (c) 9
 - (d) 5.5

- (iv) How many water of crystallisation present in washing soda?
 - (a) 2
 - (b) 5
 - (c) 6
 - (d) 10

- (v) Which of the following statement is correct about heating washing soda?

- (a) Washing soda will give pungent smell
- (b) Washing soda will lose its water of crystallisation
- (c) The colour of washing soda will change into black
- (d) All are correct

60. Read the following and answer questions from (i) to (v).

The strength of a base depends on the concentration of the hydroxyl ions present in a solution. Greater the number of hydroxyl ion present, greater is the strength of base. However, some bases do not dissociate to any appreciable extent in water, e.g. NH_4OH . Some bases dissolve in water to form alkali. Examples of such bases are sodium hydroxide and potassium hydroxide.

Strong alkalis like sodium hydroxide and potassium hydroxide are highly corrosive or caustic in nature. Sodium hydroxide and potassium hydroxide are commonly called caustic soda and caustic potash respectively.

- (i) Which of the following is the characteristics of a base?
 - (a) Turns blue litmus to red
 - (b) Turns phenolphthalein pink from colourless
 - (c) Decomposes carbonates
 - (d) Gives H^+ ions on dissociation

- (ii) Strength of base can be explained on the basis of
 - (a) its concentration in solution
 - (b) its degree of ionisation
 - (c) both (a) and (b) required
 - (d) it is an inherent property of acid.

- (iii) The acidity of barium hydroxide is
 - (a) 1
 - (b) 2
 - (c) 3
 - (d) 4

- (iv) Which of the following is not an alkali?
 - (a) NaOH
 - (b) KOH
 - (c) $\text{Cu}(\text{OH})_2$
 - (d) LiOH



(v) Which is the strongest base among the following?

- | | |
|----------------------------|-------------------|
| (a) NH_4OH | (b) NH_3 |
| (c) H_2O | (d) NaOH |

61. Read the following and answer questions from (i) to (v).

The pH scale can be used to determine the strength of acid solutions as well as basic solutions by making use of hydrogen ion concentrations in them. The 'p' in pH stands for potenz which means power in German. It ranges from 0 to 14. Now-a-days, pH meter is used to measure the value of pH, however in previous years, pH papers were used to measure range of pH.

The negative logarithm is used because most of the pH values are positive numbers. A change of one pH unit represents a ten-fold change in the concentration of hydronium ions and hydroxide ions. Thus, pH equal to 2 is ten times as acidic as pH equal to 3.

Consider two solutions *A* and *B* having pH values 3 and 9.5 respectively.

(i) Which solution will turn phenolphthalein from colourless to pink?

- | | |
|----------------------|-------------------|
| (a) Solution A | (b) Solution B |
| (c) Both (a) and (b) | (d) None of these |

(ii) Which of the following substances would have pH less than 7?

- | | |
|-------------|-----------|
| (a) Antacid | (b) Soap |
| (c) Vinegar | (d) Water |

(iii) What effect does the concentration of H^+ ions have on the nature of the solution?

- | |
|---|
| (a) Higher the concentration of H^+ ions, greater is the acidic nature of the solution |
| (b) Higher the concentration of H^+ ions, greater is the basic nature of the solution |
| (c) Concentration of H^+ ions does not effect the nature of the solution |
| (d) None of the above |

(iv) pH of solution is defined by expression

- | | |
|-----------------------------------|--|
| (a) $\log[\text{H}^+]$ | (b) $\log \left[\frac{1}{\text{H}^+} \right]$ |
| (c) $\frac{1}{\log [\text{H}^+]}$ | (d) $\frac{1}{-\log [\text{H}^+]}$ |

(v) If water is added to solution *B*, then pH will

- | | |
|--------------|---------------|
| (a) increase | (b) decrease |
| (c) = 7 | (d) unchanged |

ANSWERS

Multiple Choice Questions

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (b) | 3. (c) | 4. (a) | 5. (d) | 6. (d) | 7. (b) | 8. (b) | 9. (a) | 10. (c) |
| 11. (c) | 12. (a) | 13. (d) | 14. (a) | 15. (b) | 16. (c) | 17. (b) | 18. (a) | 19. (a) | 20. (b) |
| 21. (b) | 22. (a) | 23. (c) | 24. (c) | 25. (d) | 26. (a) | 27. (a) | 28. (d) | 29. (d) | 30. (a) |
| 31. (c) | 32. (d) | 33. (d) | 34. (a) | 35. (d) | 36. (b) | 37. (d) | 38. (a) | 39. (a) | 40. (b) |
| 41. (d) | 42. (b) | 43. (d) | 44. (b) | 45. (b) | 46. (c) | 47. (b) | 48. (d) | 49. (c) | |

Assertion-Reasoning MCQs

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 50. (a) | 51. (b) | 52. (c) | 53. (d) | 54. (c) | 55. (a) | 56. (c) | 57. (c) |
|---------|---------|---------|---------|---------|---------|---------|---------|

Cased Based MCQs

58. (i)-(b), (ii)-(c), (iii)-(b), (iv)-(d), (v)-(a)
60. (i)-(b), (ii)-(c), (iii)-(b), (iv)-(c), (v)-(d)

59. (i)-(c), (ii)-(b), (iii)-(c), (iv)-(d), (v)-(b)
61. (i)-(b), (ii)-(c), (iii)-(a), (iv)-(b), (v)-(b)

EXPLANATIONS

1. The mineral acids are those which are obtained from minerals and do not contain carbon.
e.g. HCl , H_2SO_4 , HNO_3 , etc.
2. Strong acids are generally corrosive in nature. Acids corrode metals and release hydrogen gas on reacting.
3. Lactic acid is present in sour milk.
Glycolic acid is present in fruits and vegetables.
Oxalic acid is present in vegetable, fruits, seeds, etc.
Citric acid is present in citrus fruits like lemons, oranges, etc.
4. Lime juice is acidic in nature because it contains citric acid. Human blood is slightly basic (i.e. having pH 7.8). Lime water and antacid are basic in nature as they contain hydroxide (OH^-) ion.
5. Acetic acid has chemical formula, CH_3COOH in which four hydrogen atoms are present.
6. All organic acids have source from nature as they occur in animals, plant, vegetables, etc.
Lactic acid is present in curd. Citric acid is present in oranges. Acetic acid is present in vinegar and oxalic acid is present in tomato.
7. Most metal oxides are insoluble in water but some of these (e.g. Na_2O , CaO) dissolve in water to form alkalis, not salt and acid e.g. $\text{Na}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow 2\text{NaOH}(aq)$
8. In first test tube, the following reaction involves:

$$\text{CaCO}_3 + 2\text{HCl} \longrightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{CaCl}_2$$

CO_2 gas is evolved here.

In second test tube, the following reaction takes place:

$$\text{Zn} + 2\text{HCl} \longrightarrow \text{ZnCl}_2 + \text{H}_2$$

Here, H_2 gas is evolved.
9. When dilute sulphuric acid treated with iron sulphide, then hydrogen sulphide gas is evolved and iron sulphate is formed.

$$\text{FeS}(s) + \text{H}_2\text{SO}_4(aq) \longrightarrow \text{FeSO}_4(aq) + \text{H}_2\text{S}(g)$$

Iron sulphide	Sulphuric acid	Iron (II) sulphate	Hydrogen sulphide
---------------	----------------	--------------------	-------------------
10. Calcium oxide dissolves in water to form calcium hydroxide which further ionises to give hydroxyl ion (OH^-).

$$\text{CaO} + 2\text{H}_2\text{O} \rightleftharpoons \text{Ca}(\text{OH})_2 \rightleftharpoons \text{Ca}^{2+} + 2\text{OH}^-$$
11. Copper hydroxide is not an alkali because it is insoluble in water. Hence, it is a base but not an alkali.
12. Sodium hydroxide and potassium hydroxide both are bases and bases are good conductor of electricity. Therefore, these bases are used as electrolytes.
13. Alkali is basic in nature and all alkalies are bases.
But all bases are not alkali because all bases are not soluble in water whereas an alkali is soluble in water.
14. $\because \text{CO}_2$ is an acidic oxide, thus when it reacts with a base $[\text{Ca}(\text{OH})_2](aq)$, i.e. lime water, it gives salt and water.

$$\text{Ca}(\text{OH})_2 + \text{CO}_2(g) \longrightarrow \text{CaCO}_3(s) + \text{H}_2\text{O}(l)$$

(Salt)

The above reaction proves that $\text{Ca}(\text{OH})_2(aq)$ is basic in nature.
15. When base $\text{Ca}(\text{OH})_2$ combines with ammonium salt, NH_4Cl , then it liberates ammonia gas and forms calcium chloride, CaCl_2 and water.

$$\text{Ca}(\text{OH})_2(aq) + 2\text{NH}_4\text{Cl}(g) \longrightarrow \text{CaCl}_2(s) + 2\text{H}_2\text{O}(l) + 2\text{NH}_3(g) \uparrow$$

So, $X = \text{NH}_4\text{Cl}$ and $Y = \text{H}_2\text{O}$
16. When an acid is dissolved in water, then it dissociates and produce hydrogen (H^+) or hydronium ions (H_3O^+).
17. When sodium hydroxide in mixed with water, then ionisation takes place.

$$\text{NaOH} + \text{H}_2\text{O} \longrightarrow \text{Na}^+ + \text{OH}^- + \text{H}_2\text{O}$$

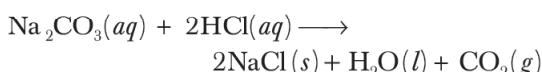
Hydroxide ions are formed and a lot of heat is generated or released during dissolution.
18. The sulphur dioxide in aqueous solution is acidic because it shows blue litmus paper test.
19. When a small amount of acid is added to water, the process is called dilution and it results in the formation of H_3O^+ ions.

- 20.** When sodium hydrogen carbonate is added to acetic acid then odourless carbon dioxide (CO_2) gas is evolved.



CO_2 turns lime water milky. It is a non-supporter of combustion and is absorbed by strong alkalies like NaOH .

- 21.** The reaction between metal carbonate and an acid is an example of acid and base reaction because metal carbonate is basic in nature. Thus, the reaction will produce salt, water and carbon dioxide. Let metal carbonate be sodium carbonate.



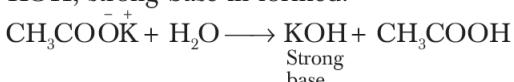
- 22.** During the dilution of an acid or base, the concentration of ions per unit volume decreases. Dilution causes lowering of concentration of hydronium ions and hydroxide ions of acids and bases respectively.
- 23.** Metallic oxides are basic in nature. So, on dissolution of water, the concentration of hydroxide ions is highest.

- 24.** Vanilla essence is an olfactory indicator. So, its smell is different in acid and basic media which can be detected easily by a visually air student. Vanilla extract has a characteristic pleasant smell.

If a basic solution like sodium hydroxide solution is added to vanilla extract then we cannot detect the characteristic smell of vanilla extract. An acidic solution like hydrochloric acid, however, does not destroy the smell of vanilla extract.

- 25.** Universal indicator is a mixture of many indicators. Its colour is red at $\text{pH} = 3$.
- 26.** In acid, blue litmus changes to red and in basic solution, red litmus changes to blue. Hence, blue litmus first changes its colour to red and then to blue.

- 27.** When CH_3COOK is treated with water, then KOH , strong base is formed.



The solution will be basic in nature. So, it turns turmeric to red.

- 28.** The given three indicators are natural indicators which show characteristics colours in acidic as well as in basic medium.

- 29.** Since, the aqueous solution turns red litmus solution blue. So, it is a basic compound. An acid solution (HCl) would reverse the change. That is HCl would turn blue litmus solution to red.

Other options baking powder, lime and ammonium hydroxide solution are basic compounds.

So, the blue litmus solution would not change the colour by adding these compounds.

- 30.** Methyl orange and phenolphthalein are the indicators which are used in laboratory for titrations of strong acids with strong bases.

- 31.** In basic medium,
- Red litmus turns blue.
 - Methyl orange turns into yellow in colour.
 - Phenolphthalein turns pink in colour.
 - Blue litmus remains blue in colour.

- 32.** pH is calculated by using the expression:

$$\text{pH} = -\log[\text{H}_3\text{O}^+] \text{ or } -\log[\text{H}^+]$$

So, pH is the negative logarithm of the hydrogen ion concentration.

- 33.** As the pH of solution decreases from 7 to 0, the hydrogen ion concentration in the solution goes on increasing and hence the strength of acid goes on increasing.

As the pH of solution increases from 7 to 14, the hydroxide ion concentration in the solution goes on increasing, due to which the strength of base also goes on increasing.

It depends on the solution, i.e. higher the pH, weaker the acid and lower the pH, weaker the base.

- 34.** The value of pH for acids ranges from 0 to 7. If pH increases, the value of basicity increases because more the value of pH, more will be the basicity.

- 35.** If a solution turns red litmus blue, then a solution is basic in nature and its pH value is likely to be greater than 7.

- 36.** pH of acid rain is below 5.6 and it have a corrosive effect on marble buildings or sculptures.



- 37.** As pH paper turns greenish blue for weakly basic compound and antacids contain weak base like $Mg(OH)_2$. So, an antacid would change the colour of this pH paper to greenish-blue. Other options (a) and (b) contain acids and option (c) is a neutral salt.
- 38.** $3Ca(OH)_2 + 2H_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 6H_2O$
- | | | |
|-----------|------------|-----------|
| Calcium | Phosphoric | Calcium |
| hydroxide | acid | phosphate |
- Calcium phosphate $Ca_3(PO_4)_2$ is basic salt, as it is a salt of weak acid (phosphoric acid) and slightly stronger base (calcium hydroxide) (though both are weak).
- Also when pH of our mouth falls below 5.5 due to eating of sweets etc., i.e. mouth is acidic, the dissolution of enamel (calcium phosphate) starts which shows that calcium phosphate is basic in nature.
- 39.** Antacids are weak bases which are given to the patients who are suffering from acidity. They are given to patient so that they get relief.
- 40.** The bee sting is slightly acidic with pH of 4.5–5.5. So, to neutralise the effect of sting, a basic substance can be used such as baking soda.
- 41.** Bleaching powder has ability to kill off the germs because of chlorine. When bleaching powder exposed to moisture, chlorine releases and disinfects the area.
- 42.** $Na_2CO_3 \cdot 10H_2O$ is the formula of washing soda. It contains 10 molecules of water.
- 43.** $2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$
(because state of Cl_2 and H_2 is gaseous, H_2O is liquid and that of $NaCl$ and $NaOH$ is aqueous).
- 44.** Chemical name of bleaching powder is calcium hypochlorite (calcium oxychloride).
- 45.** The hardening of the plaster of Paris can be done by mixing it with water and it converts into hard material called gypsum.
- 46.** Bleaching powder bleaches the clothes and other coloured substances, baking soda is a constituent of antacid, washing soda is used in the preparation of glass and sodium chloride when subjected to electrolysis gives H_2 and Cl_2 gases.

- 47.** Chemical formula of baking soda is $NaHCO_3$ (sodium hydrogen carbonate). Chemical formulae of blue vitriol is $CuSO_4 \cdot 5H_2O$, washing soda is $Na_2CO_3 \cdot 10H_2O$ and gypsum is $CaSO_4 \cdot 2H_2O$. So, baking powder does not contain water of crystallisation.
- 48.** When an acid reacts with a base, neutralisation reaction takes place to form salt and water and it is an exothermic reaction. So, the temperature of the solution increases.
- 49.** Sodium hydrogen carbonate and tartaric acid are mixed together and forms baking soda.
- 50.** Both A and R are true and R is the correct explanation of A. Lemon juice is sour in taste as it is an acid and sour taste is one of the characteristics of acid. Therefore, lemon juice is acidic in nature.
- 51.** Both A and R are correct but R is not the correct explanation of R. Sodium hydrogen carbonate react with acid present in fire extinguisher to produce carbon dioxide.
- 52.** A is true but R is false.
HCl produces H^+ ions in aqueous solution because in presence of water, acids give H^+ ions. As H^+ ions cannot exist alone so it combines with water molecules and form H_3O^+ .
- 53.** A is false but R is true. Sodium carbonate (Na_2CO_3) is the salt of weak acid carbonic acid (H_2CO_3) and a strong base, sodium hydroxide ($NaOH$).

$$2NaOH + H_2CO_3 \longrightarrow Na_2CO_3 + 2H_2O$$

Sodium	Carbonic	Sodium carbonate	Water
hydroxide	acid	(salt)	
- 54.** A is true but R is false. Phenolphthalein is a synthetic indicator. It is used in titrations of acid and base. It will appear pink in basic solution and clear in acidic solution.
- 55.** Both A and R are true and R is the correct explanation of A. Tooth enamel is calcium phosphate, which gets affected when pH of our mouth falls below 5.5. It happens because the bacteria present in our mouth breakdown sugar and food particles into acids which damage our teeth by corroding them.

- 56.** A is true but R is false because ammonium nitrate is a salt of strong acid and weak base.
- 57.** A is true but R is false because magnesium hydroxide is a mild base and neutralises the excess acid present in a stomach.
- 58.** (i) Ammonium hydroxide (NH_4OH) is a weak base because it does not ionise completely in given aqueous solution.
(ii) NaOH, sodium hydroxide, being a base can neutralise the effect of acid.
(iii) An alkali is a base which is water soluble and KOH is soluble in water whereas $\text{Ca}(\text{OH})_2$ and $\text{Mg}(\text{OH})_2$ are slightly soluble in water and CaCO_3 is insoluble in water.
(iv) Acids and bases are important because of their various uses and impacts. They are used in industry. They have impact on human health and farmer's crop.
(v) Na_2CO_3 , sodium carbonate is alkaline in aqueous medium because it is formed from NaOH and H_2CO_3 , i.e. strong base and weak acid.
- 59.** (i) $\text{NaHCO}_3 \xrightarrow{\Delta} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$
 $\text{NaHCO}_3 + \text{H}^+ \longrightarrow \text{CO}_2 + \text{H}_2\text{O} +$
Sodium salt of acid
Both the above reactions take place on adding baking powder while making cakes or bread.
The released CO_2 gas makes the cakes or bread soft and spongy.
(ii) In soda-acid fire extinguishers, CO_2 is released by the reaction of sodium bicarbonate with acid.
(iii) Bleaching powder is basic nature, so its pH value must be greater than 7.
(iv) Washing soda has chemical formula, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. So, it has 10 water of crystallisation.

- (v) When we heat washing soda, the water of crystallisation will be lost (efflorescent occurs) and become anhydrous.
- 60.** (i) A base can turn phenolphthalein pink from colourless. Phenolphthalein is used as indicator in acid-base titration and it shows pink in basic solution.
(ii) Since, for strong base which is completely ionised, only concentration is the measure of strength, but for weak base which is incompletely ionised, both degree of ionisation and concentration will be required.
(iii) Barium hydroxide is $\text{Ba}(\text{OH})_2$. It can give two hydroxyl group. So, its acidity is two.
(iv) NaOH, KOH and LiOH are called as alkali because these bases are soluble in water whereas $\text{Cu}(\text{OH})_2$ is not alkali because it is insoluble in water.
(v) NaOH is the strongest base among the other compounds because it dissociates completely into ions.
- 61.** (i) Solution B will turn phenolphthalein from colourless to pink as it is basic in nature according to its pH.
(ii) Acidic substances have pH value less, than 7. Among the given substances, vinegar would have pH less than 7 as it is an aqueous solution of acetic acid.
(iii) Higher the concentration of H^+ ions greater is the acidic nature of the solution because H^+ ions comes from acid.
(iv) pH is defined as negative logarithm of concentration of H^+ ions.
So, expression of pH = $\log \left[\frac{1}{\text{H}^+} \right]$
or $= -\log [\text{H}^+]$
(v) When base is diluted with water, the concentration of base decrease and this causes the pH of alkali to fall towards 7. So, the pH will decrease.

03

Metals and Non-metals

Quick Revision

1. Metals

Elements that are electropositive in nature are called metals, e.g. copper.

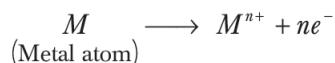
2. Physical Properties of Metals

- (i) **Malleability** It is the property of metals due to which they can be beaten into thin sheets. Most of the metals are malleable.
- (ii) **Ductility** It is the property due to which a metals can be drawn into wires. Metals are generally ductile. Gold is the most ductile metal.
- (iii) **Hardness** Most of the metals are hard. But some alkali metals like sodium and potassium are so soft that they can be cut easily with knife.
- (iv) **Metallic Lustre** Metals in their pure state have bright shining surfaces. This property is called metallic lustre.
- (v) **Electrical Conductivity** Most of the metals are good conductors of electricity.
- (vi) **Thermal Conductivity** Generally metals are good conductors of heat, except lead and mercury, which are poor conductors of heat. The best conductors of heat are copper and silver among all metals.
- (vii) **Melting and Boiling Points** Metals generally have high melting and boiling point, except mercury, gallium and alkali metals. Tungsten has the highest melting point among metals while mercury has the lowest.
- (viii) **Sonority** When metals are struck with a hard substance, they produce sound. This property is called **sonority** and the metals are said to be

sonorous. Bells are made up of metals due to this property.

3. Chemical Properties of Metals

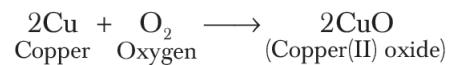
Most of the chemical properties of metals are due to their electropositive nature. It means metal atom loses electrons to form cations.



- **Reactions of Metals with Oxygen in Air**
(Formation of oxides)

- (i) Almost all the Metals react with Oxygen (or air) to form Metal Oxides

Metal + Oxygen \longrightarrow Metal Oxide
e.g. When copper is heated in air, it combines with oxygen to form copper (II) oxide, a black oxide.



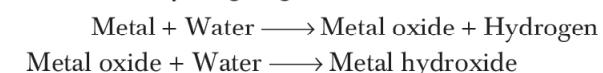
- (ii) **Order of Reactivity with Oxygen**
Different metals react with oxygen at different rates. e.g. sodium (Na) and potassium (K) catch fire, when placed in the open.

Hence, these are most reactive metals.
The order of reactivity of metals with oxygen is



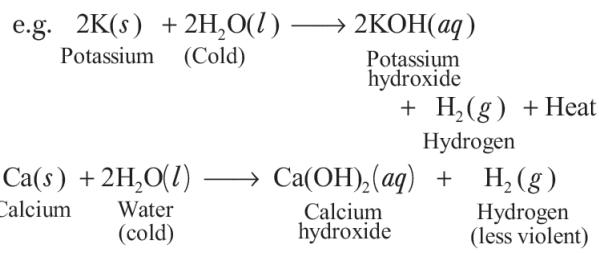
- **Reactions of Metals with Water**

Metals react with water and produce a metal oxide and hydrogen gas.



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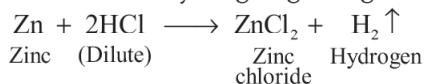
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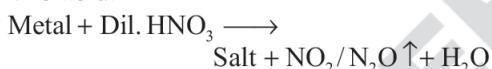
- **Reactions of Metals with Dilute Acids**

- Reaction of Metals with Dilute HCl and Dilute H_2SO_4**

Except a few less reactive metals (Cu, Hg, Ag, Au, Pt, etc) all metals react with dilute sulphuric acid and hydrochloric acid to produce salt and hydrogen gas. e.g.



- Reaction of Metals with Dil. HNO_3** Except magnesium and manganese, metals do not give H_2 gas on reaction with dilute nitric acid. This is due to the oxidising nature of nitric acid.



Exceptional Case (for Mn and Mg only)



Aqua-regia

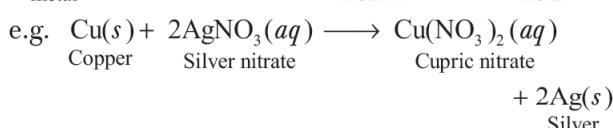
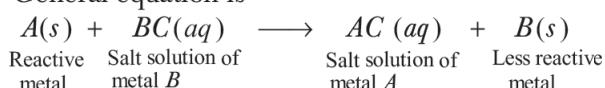
It is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in ratio of 3 : 1.

It can dissolve gold, even though neither of these acids can do so alone. *Aqua-regia* is highly corrosive, fuming fluid.

- **Reaction of Metals with Solution of Other Metal Salts**

A **reactive metal** can displace a comparatively **less reactive** metal from their compounds in aqueous solution or in molten state.

General equation is



4. Reactivity Series or Electrochemical Series of Metals

The series obtained by placing the metals in order of their decreasing reactivity is called electrochemical series or reactivity series. In other words, the series obtained by placing the metals in increasing order of their standard reduction potential is called electrochemical series or reactivity series.

The series is as follows:

K (most reactive) > Ba > Sr > Ca > Na > Mg > Al > Zn > Fe > Cd > Ni > Sn > H > Cu > Hg > Ag > Pt > Au (least reactive)

5. Non-metals

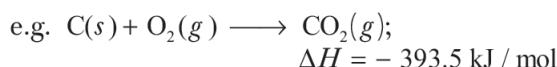
Elements that are **electronegative** in nature are called non-metals. It means non-metals gain electrons to form negative ions, e.g. iodine.

6. Physical Properties of Non-metals

- Brittleness** Non-metals are neither malleable nor ductile but they are brittle in nature.
- Physical State** Most of the non-metals are soft (if solid). Only diamond, a form of carbon is the hardest known substance. Other non-metals are gases except bromine which is a liquid.
- Metallic Lustre** The non-metals do not have lustre, i.e. shining surface. However, diamond, graphite (forms of carbon) and iodine have lustre, even they are non-metals.
- Electrical and Thermal Conductivity** Non-metals are generally poor conductors of heat and electricity.
- Melting and Boiling Points** Generally, non-metals have low melting and boiling points. But non-metals that are solids have comparatively higher boiling points (e.g. B, Si, C, etc.).

7. Chemical Properties of Non-metals

- Reaction with Oxygen** Non-metals react with oxygen to form oxides. These oxides are generally acidic. Only some of the non-metallic oxides are neutral. Acidic oxides are CO_2 , SO_2 , P_2O_5 , etc.

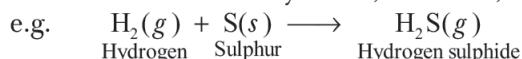


- (ii) **Reaction with Water** Non-metals do not react with water or steam to evolve hydrogen gas. This is because non-metals cannot give electrons to hydrogen in water therefore, hydrogen gas cannot be released.]
 - (iii) **Reaction with Acids** Non-metals do not react with acids to release hydrogen gas. Reason is being non-metal is an electron acceptor, it cannot supply electrons to the H^+ ions of acids to reduce than to hydrogen gas.
 - (iv) **Displacement Reaction** Non-metals also show displacement reaction like metals. e.g.



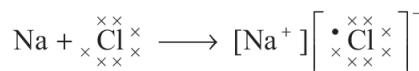
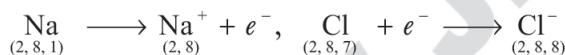
(v) Formation of Covalent Compounds

Non-metals form covalent compounds with other non-metals like hydrides, chlorides, etc.



8. Ionic Compounds

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



- The strong electrostatic forces of attraction which helps to bind Na^+ and Cl^- ions together is called **ionic bond** or **electrovalent bond**.

9. Properties of Ionic Compounds

- (i) **Physical Nature** Ionic compounds are solids due to the presence of strong forces of attraction between the positive and negative ions. These compounds are generally brittle.
 - (ii) **Melting and Boiling Points** Ionic compounds have high melting and boiling points because a large amount of energy is required to break the strong inter-ionic attraction.
 - (iii) **Solubility** Ionic compounds are generally soluble in water and insoluble in solvents like petrol, kerosene.
 - (iv) **Conduction of Electricity** Ionic compounds conduct electricity in the molten state only because the electrostatic forces of attraction between the oppositely charged ions are overcome due to heat and thus, the ions move freely and conduct electricity.
They do not conduct electricity in the solid state due to the absence of free ions.

Objective Questions

Multiple Choice Questions

- 01.** Which of the following statement is correct about metals?

- (a) Metals form positive ions by losing electrons
 - (b) Metals form negative ions by losing electrons
 - (c) Metals form positive ions by gaining electrons
 - (d) Metals form negative ions by gaining electrons

- 02.** Which of the following is a characteristic of metals?

- (a) They have one to three valence electrons
(b) They have 4 to 8 valence electrons
(c) They are brittle
(d) They are capable to form anions easily

- 03.** Gold is used for making jewellery.
What are the properties of gold make it a suitable metal for making jewellery?





- 16.** Which of the following pairs will give displacement reactions?
- Zinc sulphate solution and aluminium metal
 - Ferrous sulphate solution and silver metal
 - Magnesium chloride solution and aluminium metal
 - Silver nitrate solution and copper metal.
- 17.** Which of the following metal will not give $H_2(g)$ with H_2O ?
- $Na(s) + 2H_2O \longrightarrow$
 - $Mg(s) + H_2O \longrightarrow$
 - $Zn(s) + H_2O \longrightarrow$
 - $Cu + H_2O \longrightarrow$
- 18.** Few particles of Zn are dropped in the $CuSO_4$ solution, the correct observation is
- blue colour of $CuSO_4$ solution fades
 - solution changes to red colour
 - solution becomes black
 - solution becomes silvery white
- 19.** An aluminium strip is kept immersed in freshly prepared ferrous sulphate ($FeSO_4$) solution taken in test tube, the change obtained is that
- light green solution changes to blue
 - green solution slowly turns brown
 - lower end of test tube become slightly warm
 - colourless gas with the smell of burning sulphur is observed
- 20.** Copper sulphate solution can be safely kept in a container made of silver and lead.
- True
 - False
 - Can't say
 - Partially true/false
- 21.** Non-metals are electropositive in nature.
- True
 - False
 - Can't say
 - Partially true/false
- 22.** Which of the following is not a property of non-metals?
- They are neither malleable nor ductile
 - They are brittle

- They are sonorous
 - They are poor conductor of heat and electricity (except graphite)
- 23.** Generally, non-metals are not conductors of electricity. Which of the following is a good conductor of electricity?
- Diamond
 - Graphite
 - Sulphur
 - Fullerene
- 24.** Which of the following non-metal is liquid at room temperature?
- Mercury
 - Carbon
 - Phosphorus
 - Bromine
- 25.** Generally, non-metals are not lustrous. Which of the following non-metals is lustrous?
- Sulphur
 - Oxygen
 - Nitrogen
 - Iodine
- 26.** Match the elements given in Column I with their state/property given in Column II and select the correct answer using the options given below:
- | Column I
(Elements) | Column II
(State/Property) |
|------------------------|-------------------------------|
| A. Iodine | 1. Liquid metal |
| B. Mercury | 2. Liquid non-metal |
| C. Bromine | 3. Lustrous |
| D. Diamond | 4. Hardest substance |
- Codes**
- | A | B | C | D |
|-------|---|---|---|
| (a) 1 | 3 | 4 | 2 |
| (b) 3 | 1 | 2 | 4 |
| (c) 2 | 4 | 3 | 1 |
| (d) 4 | 1 | 3 | 2 |
- 27.** Non-metals oxides react with water to form
- salts
 - bases
 - acids
 - hydrogen
- 28.** The combination of carbon monoxide and hydrogen is known as
- carbon gas
 - coal gas
 - carbonic gas
 - water gas

29. When sulphur reacts with conc. nitric acid, then which gas is evolved?

- | | |
|-------------------|-------------------|
| (a) CO_2 | (b) NO_2 |
| (c) O_2 | (d) H_2 |

30. Chlorine can displace Br and I from solutions of their respective salts.

- | | |
|---------------|--------------------------|
| (a) True | (b) False |
| (c) Can't say | (d) Partially true/false |

31. An element can react with oxygen to give a compound with high melting point. This compound is also water soluble. The element is likely to be

- | | |
|-------------|------------|
| (a) Calcium | (b) Carbon |
| (c) Silicon | (d) Iron |

32. A metal M of moderate reactivity is present as sulphide X on heating in air, X converts in its oxide Y and a gas evolves. On heating Y and X together, the metal M is produced. X and Y respectively are

- | |
|---|
| (a) X-cuprous sulphide, Y-cuprous oxide |
| (b) X-cuprous sulphide, Y-cupric oxide |
| (c) X-sodium sulphide, Y-sodium oxide |
| (d) X-calcium sulphide, Y-calcium oxide |

33. The following observations are given for four metal

- I. Metal H does not react with dilute HCl.
- II. Metal K reacts with warm water.
- III. Metal L does not react with water but displs metal H from its aqueous salt solution.
- IV. Metal M reacts with cold water.

Choose the correct decreasing order of reactivity of these metals among the following.

- | | |
|---------------------|---------------------|
| (a) $M > L > H > K$ | (b) $K > M > H > L$ |
| (c) $M > K > L > H$ | (d) $L > H > K > M$ |

34. gas is evolved when Mn react with very dilute HNO_3 .

- | | |
|--------------------------|------------------|
| (a) NO_2 | (b) H_2 |
| (c) N_2O | (d) NO |

35. Aqueous solution of CsO_2 is

- | | |
|------------|----------------|
| (a) Basic | (b) Neutral |
| (c) Acidic | (d) Amphoteric |

36. Match the oxides given in Column I with their nature given in Column II and select the correct option given below:

Column I (Oxides)	Column II (Nature of oxides)
A. SO_2	1. Basic oxide
B. H_2O	2. Acidic oxide
C. Al_2O_3	3. Neutral oxide
D. CaO	4. Amphoteric oxide

Codes

A	B	C	D
(a) 2	3	4	1
(b) 1	4	2	3
(c) 2	3	4	1
(d) 3	2	4	1

37. Which of the following electronic configuration shows that the given element is a metalloid?

- | | |
|-------------|-----------------|
| (a) 2, 8, 4 | (b) 2, 8, 18, 8 |
| (c) 2, 4 | (d) 2, 6 |

38. Which elements among the following can be considered as a metal and non-metal both?

- | | |
|--------------|-------------|
| (a) Nitrogen | (b) Sulphur |
| (c) Silicon | (d) Mercury |

39. Which of the following are not ionic compounds? (NCERT Exemplar)

- | | |
|---------------------|-------------------|
| I. KCl | II. HCl |
| III. CCl_4 | IV. NaCl |
| (a) I and II | (b) II and III |
| (c) III and IV | (d) I and III |

40. Which one of the following properties is not generally exhibited by ionic compounds? (NCERT Exemplar)

- | |
|---|
| (a) Solubility in water |
| (b) Electrical conductivity in solid state |
| (c) High melting and boiling points |
| (d) Electrical conductivity in molten state |



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Assertion-Reasoning MCQs

Direction (Q.Nos. 46-54) For question numbers 1 to 8, two statements are given—one labeled **Assertion (A)** and the other labeled **Reason (R)**. Select the correct answer to these questions from the codes (i), (ii), (iii) and (iv) as given below.

- (a) Both A and R are true and R is correct explanation of the A.
 - (b) Both A and R are true but R is not the correct explanation of the A.
 - (c) A is true but R is false.
 - (d) A is false but R is true.

- 46. Assertion** Electrical wires are made by sodium.

Reason Sodium is a bad conductor of electricity.

47. Assertion When zinc is added to a solution of iron (II) sulphate, no change is observed.

Reason Zinc is more reactive than iron.

48. Assertion Food cans are coated with tin and not with zinc.

Reason Zinc is more reactive than tin.

49. Assertion Carbon reacts with oxygen to form carbon dioxide which is acidic oxide.

Reason Non-metals form acidic oxides.

50. Assertion Ionic compounds have high melting and boiling points.

Reason Ionic compounds are compounds consisting of ions.

51. Assertion At higher temperatures, metal wires have a greater chance of short circuiting.

Reason Both resistivity and resistance of a material vary with temperature.
(CBSE 2020)

52. Assertion Platinium, gold and silver are used to make jewellery.

Reason Platinum, gold and silver are least reactive metals.

53. Assertion Electrical wires are made up of copper.

Reason Copper is a bad conductor of electricity.

54. Assertion The electrical conductivity of an alloy is less than that of pure metals.

Reason An alloy is prepared by mixing the metals in molten form.



Case Based MCQs

55. Read the following and answer any four questions from (i) to (v).

On the basis of reactivity of different metals with oxygen, water and acids as well as displacement reactions, the metal have been arranged in the decreasing order of their reactivities. This arrangement is known as activity series or reactivity series of metals.

From the position of the aluminium (Al) metal in the activity series, it seems to be quite reactive. However, it is not so reactive.

Actually, when the metal is kept in air or oxygen for sometime, it is converted into its oxide called aluminium oxide (Al_2O_3). This gets deposited as the surface of the metal as a thin coating. It is rather passive which means that it is not reactive. Therefore, the metal is used for packing food articles which do not get spoiled under the foil.

- (i) Which is the correct order of reactivity series?

(a) Mg < Ca < Na < K (b) K < Na < Ca < Mg
(c) K < Mg < Na < Ca (d) Mg < Ca < Na < K

- (ii) Choose the correct match from the following:

A. Sodium	1. Quick lime
B. Aluminium	2. Keep in kerosene
C. Calcium	3. Wrapping food

Codes

A	B	C	A	B	C
(a) 1	2	3	(b) 2	3	1
(c) 3	1	2	(d) 2	1	3

- (iii) What is the reaction of quick lime into slaked lime?

- (a) $\text{CaO} + \text{CO}_2 \xrightarrow{\Delta} \text{CaCO}_3$
 (b) $\text{Ca(OH)}_2 \xrightarrow{\Delta} \text{CaO} + \text{H}_2\text{O}$
 (c) $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + \Delta$
 (d) $\text{C} + \text{O}_2 \xrightarrow{\Delta} \text{CO}_2$

- (iv) Why we wear ornaments of gold and silver?

- (a) They are expensive, to look rich
 - (b) They are most reactive
 - (c) They are least reactive
 - (d) None of the above

- 56.** Read the following and answer questions from (i) to (v).

An element is a pure substance made up of same kind of atoms. At present, nearly 118 elements are known but all of them do not occur free in nature, some of them have been synthesised by artificial methods. Based on their properties, they are mainly classified as metal and non-metals.

The easiest way to start grouping substances is by comparing their physical properties. Metals, in their pure state, have a shining surface. This property is called metallic luster. metals are generally hard. The hardness varies from metal to metal. some metals are used for making cooking vessels.

- (i) Metals generally are

 - (a) reducing agents
 - (b) oxidising agent
 - (c) both oxidising and reducing agents
 - (d) None of the above

(ii) The most abundant metal in the earth's crust is

 - (a) iron
 - (b) copper
 - (c) aluminium
 - (d) mercury

(iii) The metal that reacts with cold water is

 - (a) mercury
 - (b) sodium
 - (c) zinc
 - (d) tungsten

(iv) Metal present in chlorophyll is

 - (a) iron
 - (b) copper
 - (c) magnesium
 - (d) cobalt

(v) Which of the following metal(s) catch fire on reaction with water?

 - (a) Sodium
 - (b) Potassium
 - (c) Magnesium
 - (d) Both (a) and (b)



- 57.** Read the following and answer questions from (i) to (v).

The arrangement of metals in a vertical column in the decreasing order of their reactivities is called the reactivity series or activity series of metals. The most reactive metal is at the top position of reactivity series and the least reactive metal is at bottom of the reactivity series.

An element placed above in the activity series will replace the element placed below it from its aqueous solution. Reactivity of metals towards other elements decreases as you go down the series. The stability of their compounds also decreases.

Any metal above hydrogen reacts with acids, replaces hydrogen from acids.

The more active a metal, the more strongly it holds on to oxygen in an oxide and therefore, the more strongly the oxide resists decomposition into its elements upon heating.

- (i) Copper displaces which of the following metals from its salt solution?
 - (a) Zinc
 - (b) Iron
 - (c) Silver
 - (d) Nickel

- (ii) Which of the following oxides can be decomposed with difficulty?
 - (a) CuO
 - (b) ZnO
 - (c) Ag₂O
 - (d) CrO

- (iii) Which of the following statement is correct?
 - (a) Elements near the top of the series are never found free in nature
 - (b) Elements near the bottom of the series are often found free in nature
 - (c) Elements near the top of the series are found free in nature
 - (d) Both (a) and (b)

- (iv) Which of the following metals can react with steam but not with hot water.
 - (a) Iron
 - (b) Calcium
 - (c) Sodium
 - (d) Potassium

- (v) The method which is used to extract metal present at the top of the series will be
 - (a) electrolytic refining
 - (b) calcination
 - (c) electrolytic reduction
 - (d) Roasting

- 58.** Read the following and answer questions from (i) to (v).

Metals are electropositive elements. They can easily lose electrons to form ions: Metals show, distinguished physical as well as chemical properties.

Generally most of the metals are ductile and malleable with exception such as mercury. These properties make them valuable for commercial as well as domestic uses. Reaction of a metal with water is one of important chemical property.

Metals like sodium and potassium reacts with cold water while magnesium reacts with hot water. Metals like aluminium, zinc do not react with hot/cold water but they easily react with steam.

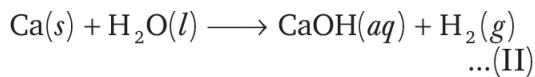
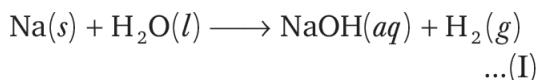
When a metal react with hot/cold water the products are metal hydroxide and hydrogen, and when it react with steam, the product are metal oxide and hydrogen. Some metals like sodium, potassium react violently with water.

- (i) When zinc reacts with steam it produces
 - (a) Zn(OH)₂
 - (b) ZnO
 - (c) O₂
 - (d) ZnO₂

- (ii) Most ductile metal among the following is
 - (a) Au
 - (b) Ag
 - (c) Cu
 - (d) Al

- (iii) During the reaction of calcium with water, pieces of metal start floating due to the formation of
 - (a) Ca(OH)₂
 - (b) CO₂
 - (c) H₂
 - (d) None of these

(iv) Consider the reactions:



- (a) Reaction I is endothermic reaction
- (b) Reaction II is endothermic reaction
- (c) Reaction II is more exothermic than reaction I
- (d) Reaction I is more exothermic than reaction II

(v) Metals can be converted into thin sheet by hammering. This property is known as

- (a) ductility
- (b) sonorous
- (c) malleability
- (d) Both (a) and (c)

59. Read the following and answer questions from (i) to (v).

Metallic Character

The ability of an atom to donate electrons and form positive ion (cation) is known as electropositivity or metallic character.

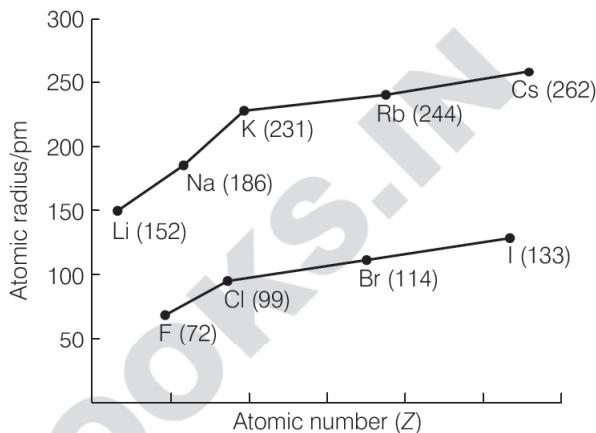
Down the group, metallic character increases due to increase in atomic size and across the period, from left to right electropositivity decreases due to decrease in atomic size.

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 electronegativity increases due to decrease in atomic size.



(CBSE Sample Paper 2021)

- (i) Which of the following correctly represents the decreasing order of metallic character of alkali metals plotted in the graph?
 - (a) Cs > Rb > Li > Na > K
 - (b) K > Rb > Li > Na > Cs
 - (c) Cs > Rb > K > Na > Li
 - (d) Cs > K > Rb > Na > Li
- (ii) Hydrogen is placed along with alkali metals in the modern periodic table though it shows non-metallic character
 - (a) as hydrogen has one electron and 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
- (iii) Which of the following has highest electronegativity?
 - (a) F
 - (b) Cl
 - (c) Br
 - (d) I



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- (iv) 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 and valence electrons
- (v) Which of the following reason correctly justifies that “fluorine (72 pm) has smaller atomic radius than lithium (152 pm)”?
- 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.

ANSWERS

Multiple Choice Questions

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (a) | 3. (d) | 4. (d) | 5. (d) | 6. (c) | 7. (d) | 8. (c) | 9. (d) | 10. (a) |
| 11. (c) | 12. (b) | 13. (b) | 14. (a) | 15. (d) | 16. (d) | 17. (d) | 18. (a) | 19. (b) | 20. (d) |
| 21. (b) | 22. (c) | 23. (b) | 24. (d) | 25. (d) | 26. (b) | 27. (c) | 28. (d) | 29. (b) | 30. (a) |
| 31. (a) | 32. (a) | 33. (c) | 34. (b) | 35. (a) | 36. (c) | 37. (a) | 38. (c) | 39. (b) | 40. (b) |
| 41. (b) | 42. (c) | 43. (b) | 44. (c) | 45. (c) | | | | | |

Assertion-Reasoning MCQs

46. (b) 47. (d) 48. (a) 49. (a) 50. (b) 51. (a) 52. (a) 53. (c) 54. (b)

Case Based MCQs

55. (i)-(a), (ii)-(b), (iii)-(c) (iv)-(c) (v)-(a)
 57. (i)-(c), (ii)-(b), (iii)-(d), (iv)-(a), (v)-(c)
 59. (i)-(c), (ii)-(b), (iii)-(a), (iv)-(c), (v)-(d)

56. (i)-(a), (ii)-(c), (iii)-(b), (iv)-(c), (v)-(d)
 58. (i)-(b), (ii)-(a), (iii)-(c), (iv)-(d), (v)-(c)

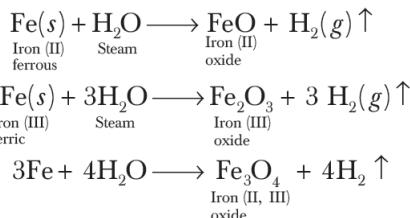
EXPLANATIONS

- Those elements which form positive ions by losing electrons are called metals. So, option (a) is correct.
- Metal can easily give up their electrons and form electropositive ions. They have one to three valence electrons in their valence shell. They are not brittle and do not form anions.
- Gold has all given properties which make it suitable for making jewellery. Gold is ductile, malleable and lustrous. It can be drawn into thin sheets, wires and has shiny appearance.
- Good thermal conductivity, malleability, light weight and high melting point are the

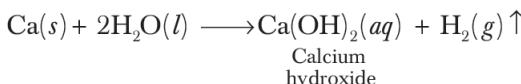
properties of aluminium due to which it is used for making cooking utensils.

- Tungsten has the highest melting point among the metals because it is one of the hardest metal present on earth surface.
- The metal with the lowest melting point is mercury. Hence, it is liquid at room temperature.
- Metals when react with the oxygen, give basic-oxides/amphoteric oxide. ZnO is an amphoteric oxide.
 Option (b) and (c) indicates that, ZnO react with the acid (H_2SO_4) as well as with the base (NaOH).
 Hence, (b) and (c) together gives the nature of oxide.

8. Reactions of iron metal with water



9. Calcium reacts less violently with water and the bubbles of hydrogen gas produced stick to the surface of calcium. Due to which it floats over water surface.

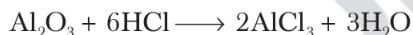


Much less heat is produced in this reaction due to which hydrogen gas formed does not catch fire.

10. Nitric acid (HNO_3) on reacting with metals (except Mn and Mg) does not give hydrogen gas.

Because it is a strong oxidising agent so, as soon as hydrogen gas is formed in the reaction between metal and dil. HNO_3 , the nitric acid oxidises this hydrogen to water.

11. When aluminium oxide reacts with acid, HCl then aluminium chloride and water get formed.



12. Magnesium metal does not react with cold water.

Mg reacts with hot water and steam both, to give magnesium hydroxide and hydrogen.

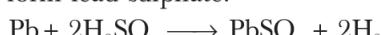


13. A mixture of conc. HCl and conc. HNO_3 in the ratio of 3 : 1 is known as *aqua-regia*. Gold (Au) dissolve only in *aqua-regia*.

14. According to the reactivity series of metal, $\text{Fe} < \text{Zn} < \text{Mg} < \text{K}$.

Potassium is highly reactive and iron is least reactive among them.

15. Lead reacts with concentrated sulphuric acid and form lead sulphate.



But lead does not react with ferrous sulphate as Pb is less reactive than Fe.

16. As copper is more reactive than silver, so, it will displace silver from silver nitrate solution.

17. Metals placed below the hydrogen in reactivity series, will not give $\text{H}_2(g)$ with water (H_2O).

Decreasing order of reactivity of metals is
 $\text{Na} > \text{Mg} > \text{Zn} > \text{Cu}$

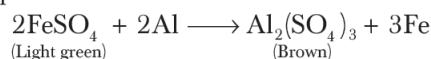
18. Since, zinc (Zn) is more reactive than copper (Cu), it will displace the Cu^{2+} ions from the CuSO_4 solution.

Hence, the blue colour of solution fades.



19. When an aluminium strip is kept immersed in freshly prepared ferrous sulphate (FeSO_4), the change in colour is observed.

The green solution slowly turns into brown. Because Al is more reactive than Fe, it displaces iron from its sulphate solution and form aluminium sulphate which is responsible for brown colour.



20. Copper sulphate solution can be safely kept in silver container but not in lead container because lead is more reactive than copper, hence it can displace copper from copper sulphate solution.

21. Non-metals are electronegative elements because they can form negative ions by gaining electrons. Metals are electropositive.

22. Almost all the non-metals produce no metallic sound on hitting. Thus, they are not sonorous.

23. Carbon is a non-metal and it has two allotropes diamond and graphite, out of them graphite has free electrons in its crystal due to which it conducts electricity.

24. Most of the non-metals are gases and a few are solids and bromine is the only non-metal which is liquid at room temperature.

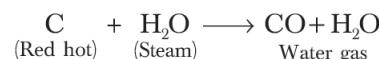
25. Iodine is a non-metal having lustrous appearance. It has a shining surface like metals.



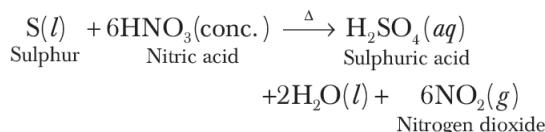
- 26.** Iodine is a lustrous non-metal and mercury is a liquid metal.
Bromine is a non-metal which is liquid at room temperature.
Diamond is the hardest substance.

27. The non-metals oxides react with water to form sulphuric acid and hence, these oxides are acidic in nature.

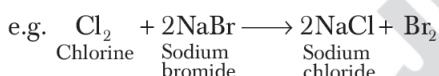
28. The gaseous mixture of carbon monoxide and hydrogen is known as water gas.



- 29.** The sulphur reacts with conc. nitric acid, to form sulphuric acid along with water and evolution of nitrogen dioxide gas.



- 30.** Just like metals, non metals are also differ in their reactivities. The order of reactivity of given halogens is $\text{Cl} > \text{Br} > \text{I}$. Therefore, chlorine can displace Br and I from their solution of salts.



- 31.** Calcium (Ca) combines with oxygen to form calcium oxide (CaO) which has a high melting point and dissolved in water to form $\text{Ca}(\text{OH})_2$.



X = Cuprous sulphide

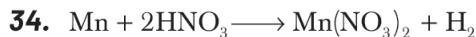
$Y = \text{Cuprous oxide}$

- 33.** Metals below hydrogen in a reactivity series does not react with dilute HCl. Medium reactive metals react with warm water and highly reactive metals react with cold water.

As per the given information H, K, L and M can be identified as Cu, Mg, Pb and K / Na respectively.

So, their reactivity order will be

$M > K > L > H$, i.e. $K > Mg > Pb > Cu$.



Hydrogen gas is evolved when Mn reacts with very dilute HNO_3 .

- 35.** $2\text{CsO}_2 + 2\text{H}_2\text{O} \longrightarrow 2\text{CsOH} + \text{H}_2\text{O}_2 + \text{O}_2$
 CsO_2 is the oxide of alkali metal. It is a basic oxide. Due to formation of CsOH its aqueous solution is basic.

36. (A) SO_2 is acidic oxide because non-metals form acidic oxides.
(B) H_2O is a neutral oxide.
(C) Al_2O_3 is an amphoteric oxide which behaves as acid as well as base.
(D) CaO is basic oxide because metals form basic oxides and Ca is a metal.

37. Generally, metalloids are present in p -block, i.e. on the right side of the periodic table.
The element with electronic configuration 2, 8, 4 is silicon. It is a metalloid. It can react with both acids as well as bases.
(i) $\text{Si} + 4\text{HCl} \xrightarrow[\text{(Acid)}]{} \text{SiCl}_4 + 2\text{H}_2(g)$
(ii) $2\text{Si} + 2\text{NaOH} \xrightarrow[\text{(Base)}]{} 2\text{Na}_2\text{SiO}_3 + 5\text{H}_2(g)$

38. Silicon is a metalloid, as it can react with an acid and base both.

39. Ionic compounds are the result of electron transfer. HCl is a polar covalent compound while CCl_4 is a non-polar covalent compound because both are formed by sharing of electrons.
 KCl and NaCl are formed by the transfer of electrons and are ionic compounds.

40. Ionic compounds can conduct electricity in molten or aqueous state only. In solid state, these are non-conductors of electricity because of the absence of free ions.
In the solid ionic compounds, the ions are held together in fixed position by strong electrostatic force and cannot move freely. So, electrical conductivity in solid state is not generally exhibited by ionic compounds.

41. Metals and non-metals combine by the transfer of electrons from metals to non-metals to form ionic bonds. Therefore, the given statement is false.

42. Ionic compounds are generally soluble in water (polar solvent) and insoluble in solvents such as kerosene, petrol, etc., (non-polar solvents).





- (iii) Both (a) and (b) are correct. Elements like Na, K etc., which are at top of the series never found free in nature they are high reactive while elements like gold, platinum, etc., are found free in nature because they are least reactive and placed at bottom of the series.
- (iv) Iron reacts with steam and do not reacts with cold or hot water. It reacts with steam to form metal oxide and hydrogen.
- (v) Due to high affinity with oxygen, electrolytic reduction is employed for metals, like Na, Mg, Ca, etc.
- 58.** (i) When zinc reacts with steam, it gives zinc oxide, ZnO and hydrogen gas, H_2 .
- (ii) Gold and platinum are the most ductile metals and here, among the given metals, Au is the most ductile metal. Hence, it is used in jewellery.
- (iii) During the reaction of calcium with water, pieces of calcium starts floating because the bubbles of hydrogen gas formed stick to the surface of the water.
- (iv) Both given reactions are exothermic but reaction (I) is more exothermic because when sodium reacts with water, it reacts violently and catches fire while in reaction (II), heat is evolved in less amount. The solution gets warm only in reaction (II).
- (v) Malleability is the characteristic of metal in which metal can be converted into thin sheet by hammering.
- 59.** (i) $Cs > Rb > K > Na > Li$ represents the decreasing order of metallic character of alkali metals. Down the group metallic character increases due to increase in atomic size.
- (ii) As hydrogen can easily lose one electron like alkali metals to from positive ion. That's why hydrogen is placed along with alkali metals in the modern periodic table though it shows non-metallic character.
- (iii) Fluorine has the highest electronegativity. As fluorine is the smallest and first element of its group. So, down the group electronegativity decreases due to increase in atomic size.
- (iv) In halogens, the electronegativity decreases down the group due to increase in atomic radius and decrease in tendency to gain electron.
- (v) Fluorine (72 pm) has smallest atomic radius than lithium (152 pm) because atomic radius/size decreases from left to right in a period. As F and Li are in the same period.



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04(a)

Life Processes I : Nutrition

Quick Revision

The process wherein an organism uses food and obtains energy from it in order to carry out its functioning is called nutrition.

Nutrients are the substances required for proper growth and maintenance of a living body.

There are two modes of nutrition:

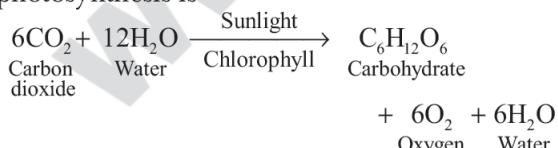
1. Autotrophic Mode of Nutrition

- Autotrophic nutrition is performed by the autotrophs that synthesise organic food in the form of carbohydrates from carbon dioxide and water in the presence of sunlight and chlorophyll to convert them into stored forms of energy.

This process of food synthesis is known as **photosynthesis**.

Examples of autotrophs are green plants (producers) and some bacteria.

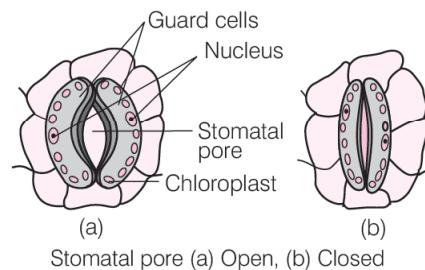
- General reaction involved in the process of photosynthesis is



- Major events occurring in photosynthesis are
 - Absorption** of light energy by chlorophyll.
 - Conversion** of light energy into chemical energy.
 - Splitting** of water molecules into hydrogen and oxygen.
 - Reduction** of carbon dioxide to carbohydrates.

- Leaves in green plants have some structures known as **chloroplasts** (containing chlorophyll) which are main site for the process of photosynthesis to occur.
- In leaf, some other structures are also present such as **stomata** (tiny pores present on the surface of the leaf) that participate in gaseous exchange during photosynthesis, but it is also responsible for large amount of water loss.

These pores close when there is no need of carbon dioxide for photosynthesis. **Guard cells** are the bean-shaped cells that frame the stomatal openings.



- Each pair of guard cells is meant to control the opening of the stomata and hence control the rate of diffusion of gases and water vapour into and out of the leaf.
- Plants require some raw materials other than water like nitrogen, phosphorus, iron and magnesium that are taken up from the soil.
- Nitrogen is an essential component for the synthesis of proteins and other compounds. It is mainly taken up in the form of inorganic nitrates or nitrites or in organic form (prepared from N₂).

2. Heterotrophic Mode of Nutrition

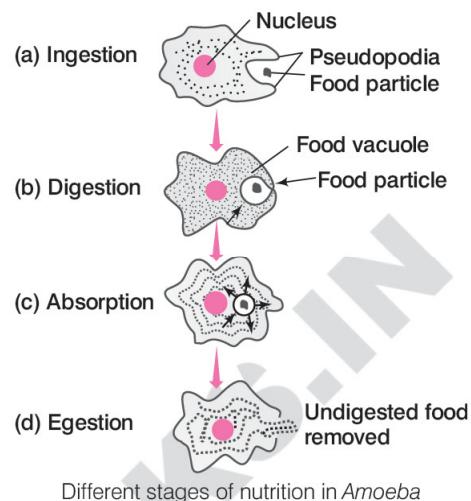
- Heterotrophic nutrition is performed by an organism that cannot make its own food and obtains it from other organisms. Thus, heterotrophs obtain carbon and energy from organic molecules already produced by the autotrophs.
e.g. Herbivores, carnivores, omnivores, saprotrophs and parasites.
- Heterotrophic mode of nutrition can be of following three types
 - Holozoic nutrition** is the mode of nutrition in which herbivores (plant-eaters), carnivores (meat-eaters) and omnivores (both plant and meat-eaters) take complex molecules which are then broken down into simpler and soluble molecules, e.g. *Amoeba*, cow, goat, dog, cat, human being, etc.
 - Saprotrophic nutrition** is the mode of nutrition in which saprotrophs (organisms that have saprotrophic nutrition) feed on dead organic matter by breaking down complex materials outside the body and then absorb it, e.g. yeast and bacteria.
 - Parasitic nutrition** is the mode of nutrition in which parasites (an organism that live either on or into the body of another organism) obtain their nutrition without killing them. e.g. *Plasmodium*, ticks, lice, leech, tapeworm, flatworm, *Cuscuta* (Amarbel), etc.

3. Process of Nutrition in Different Organisms

As the food and the way it is obtained is different for different types of organisms, so there is different digestive system in various organisms.

4. Nutrition in *Amoeba*

- Amoeba* is a unicellular organism with holozoic mode of nutrition. It takes place with the help of temporary finger-like extensions called **pseudopodia**.
- Different stages of nutrition in *Amoeba* include **ingestion**, **digestion**, **absorption** and **egestion**.



5. Nutrition in Human Beings

Digestion is a catabolic process where complex and large components of food are broken down into simpler forms with the help of hydrolytic enzymes which are absorbed by different parts of the body. The digestive system of humans constitutes a long tubular **alimentary canal** and **digestive glands**.

I. Alimentary Canal

It is a long tube where the entire process of digestion takes place. It is an internal coiled tube, which runs from anterior mouth to the posterior anus.

The complete process of ingestion, digestion, absorption, assimilation and egestion of food material is carried out within the alimentary canal itself. The major portions of alimentary canal are discussed below

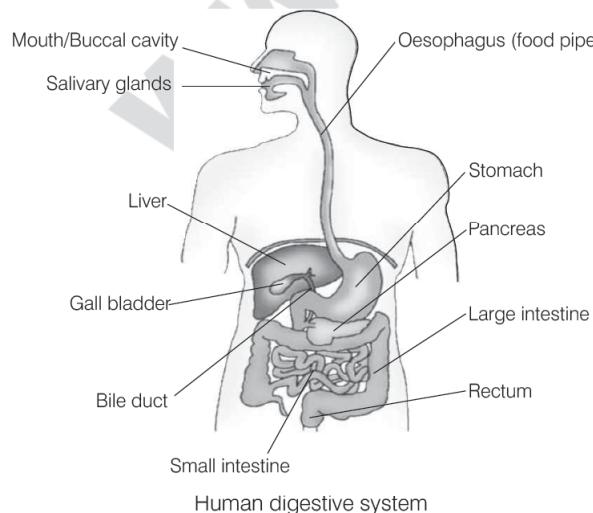
- Mouth** It acts as the first part of the digestive system from where the food enters into the alimentary canal. Mouth mainly comprised of two major parts
 - Tongue** It is a highly muscular sensory organ present at floor of buccal cavity. It bears several taste buds for basic taste such as sweet, bitter, salty, sour. Tongue also helps in mixing food with saliva.
 - Teeth** These are hard structures present on the bones of both lower and upper jaw.



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Humans have 20 milk teeth and 32 permanent teeth. Four different types of teeth, are **incisors** (for cutting the food), **canines** (for tearing of food), **premolars** and **molars** (for crushing, chewing and grinding of food).

- (ii) **Pharynx** is small and funnel-shaped. It is located behind the oral cavity. It communicates with both oesophagus and trachea.
- (iii) **Oesophagus** It is a thin, long muscular tube that leads into stomach. Its opening is covered by leaf-like cartilaginous structure called epiglottis.
- (iv) **Stomach** It is the most dilated J-shaped part of the alimentary canal. This serves as a storehouse of food where partial digestion takes place through the secretion of gastric glands.
- (v) **Small Intestine** It is the longest part of alimentary canal which is the site of complete digestion of food into different components.
 - Secretions from liver and pancreas enter the intestine to help in the digestion process.
 - Small finger-like projections called **villi** are present and help in nutrient absorption.
 - Herbivores have longer small intestine as plants have cellulose that takes time to digest.
- (vi) **Large Intestine** Although shorter, but is called large intestine because it is wider in diameter than small intestine.
- (vii) **Rectum** It is the last and broad chamber like structure to store faecal matter temporarily.
- (viii) **Anus** It helps in exit of waste material.



II. Digestive Glands

Various digestive glands are tabulated below.

Digestive Glands and their Position	Secretion	Enzyme	Digested Food
Salivary gland (Oral cavity)	Saliva	Salivary amylase	Starch (converts starch into maltose)
Gastric glands (Stomach)	Gastric juice	Pepsin, rennin and lipase	Protein, milk and lipids
Liver (above stomach)	Bile	None	Emulsify large fat droplets
Pancreas (behind stomach)	Pancreatic juice	Amylase, lipase, trypsinogen, chymotrypsinogen	Carbohydrate, fat, protein
Intestinal glands (Small intestine)	Intestinal juice	Erepsin, maltase, lactase, sucrase, lipase	<ul style="list-style-type: none"> • Breaks down protein into amino acids. • Breaks maltose into 2 molecules of glucose. • Breaks lactose into glucose and galactose. • Breaks sucrose into glucose and fructose.

6. Mechanism of Digestion of Food

Various steps involved in digestion of these nutrients are given below

- (i) **Ingestion** It is the process of food intake by mouth. Food moistened by saliva, before swallowing is masticated into smaller particles by teeth.
- (ii) **Digestion** Process of breaking down large organic molecules into smaller ones is called digestion. It is done with the help of enzymes.
- (iii) **Absorption of Food** Protein, carbohydrates, nucleic acids and nucleotides are absorbed by blood capillaries present in villi, while fats are absorbed by lymph ducts.

Digested food is absorbed by small intestine.
Lipid molecules are mainly absorbed by small intestine.

(iv) **Assimilation** It is the distribution of digested food to various cells of the body.

The food absorbed by villi reaches every cell of the body and is used to build/repair tissues.

Peristaltic movements push the undigested food forward from small to large intestine.

(v) **Egestion** It involves elimination of undigested food through anus.

The remaining material after reabsorption of water and ions is stored in rectum temporarily and is then removed *via* anus.

Objective Questions

Multiple Choice Questions

01. liberated during photosynthesis comes from water.

- | | |
|--------------------|-----------------|
| (a) Oxygen | (b) Chlorophyll |
| (c) Carbon dioxide | (d) Glucose |

02. Which of the following equations is the correct summary of photosynthesis?

- $6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$
- $6\text{CO}_2 + \text{H}_2\text{O} + \text{Sunlight} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 + 6\text{H}_2\text{O}$
- $6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$
- $6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{CO}_2 + 2\text{H}_2\text{O}$

03. From which structure, the free oxygen gas produced during photosynthesis is released?

- | | |
|---------------|----------------|
| (a) Epidermis | (b) Stomata |
| (c) Cortex | (d) Guard cell |

04. The internal (cellular) energy reserve in autotrophs is *(NCERT Exemplar)*

- | | |
|--------------|----------------|
| (a) glycogen | (b) protein |
| (c) starch | (d) fatty acid |

05. Which of the following statements about the autotrophs is incorrect? *(NCERT Exemplar)*

- 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

06. Which among the following organisms shows parasitic nutrition?

- | | |
|-------------|--------------|
| (a) Cuscuta | (b) Bacteria |
| (c) Amoeba | (d) Goat |

07. 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

08. Select the correct statement.

(NCERT Exemplar)

- 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

09. The remaining undigested food material is eliminated *via* in case of *Amoeba*.

- absorption
- digestion
- egestion
- ingestion



10. In which part of the alimentary canal, food is finally digested?

- (a) Stomach (b) Mouth cavity
 (c) Large intestine (d) Small intestine

11. Stomach serves as the storehouse of food where complete digestion takes place.

- (a) True (b) False
 (c) Can't say (d) Partially True/False

12. Match the Column I with Column II and select the most appropriate one from the options given.

Column I	Column II
A. Amoeba	1. Extensive coiling
B. Trypsin	2. Pseudopodia
C. Liver	3. Pancreatic juice
D. Small intestine	4. Bile

Codes

A	B	C	D
(a) 1	2	4	3
(b) 2	1	3	4
(c) 2	3	4	1
(d) 2	3	1	4

13. An enzyme 'X' that converts starch to simple sugars is also the first enzyme to mix with food in the digestive tract. Identify 'X'.

- (a) Pepsin (b) Amylase
 (c) Lipase (d) None of these

Assertion-Reasoning MCQs

Direction (Q.Nos. 14-18) For the following question numbers two statements are given, one labelled as Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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, but R is true

14. Assertion (A) Leaves are the major photosynthetic organs of a plant.

Reason (R) They contain chloroplasts.

15. Assertion (A) *Amoeba* follows holozoic mode of nutrition.

Reason (R) It is unicellular and omnivore.

16. Assertion (A) Walls of the intestine has numerous villi.

Reason (R) These villi increase the surface area of digestion.

17. Assertion (A) Herbivores have longer small intestine.

Reason (R) Digestion of cellulose takes time.

18. Assertion (A) Raw materials needed for photosynthesis are carbon dioxide, water and minerals.

Reason (R) Nutrients provide energy to an organism.

Case Based MCQs

19. Read the following and answer questions from (i) to (v).

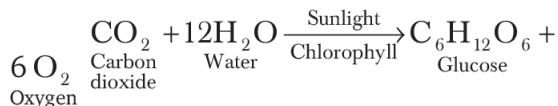
Green plants are called autotrophs, since they can photosynthesise and prepare their own food. Other organisms which depend on plants for food are heterotrophs.

Photosynthesis is the autotrophic mode of nutrition followed by green plants and some bacteria. In this process, light energy is converted into chemical energy which is later used to fuel cellular activities.

The process of photosynthesis takes place in chloroplasts through photosynthetic pigments like chlorophyll-a, chlorophyll-b, carotene and xanthophyll.



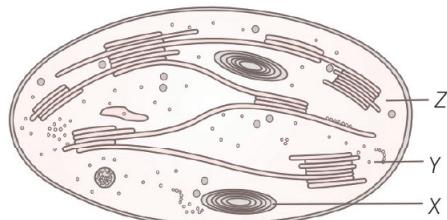
The byproduct of this physio-chemical process is oxygen and the whole reaction can be equated as



Sugars in the form of glucose and fructose are another byproduct of the process.

The first phase of the reaction is directly light driven hence called light reaction whereas the second phase is not directly light driven, but depends on the products of light reaction. This phase is called dark phase.

- (i) Which of the following is produced during light phase of photosynthesis?
- (a) ATP
 - (b) NADPH
 - (c) Carbohydrate
 - (d) Both (a) and (b)
- (ii) Given below is the diagrammatic representation of a section of chloroplast. Identify X, Y and Z in the following diagram by choosing from the options below.



X	Y	Z
(a) Dark reaction	Light reaction	Carbohydrate synthesis
(b) Light reaction	Carbohydrate synthesis	Carbohydrate storage
(c) Light reaction	Carbohydrate storage	Carbohydrate synthesis
(d) Carbohydrate synthesis	Carbohydrate storage	Cytoplasmic inheritance

- (iii) Read the following statements and choose the statement that is incorrect with regard to photosynthesis.

I. Photosynthesis occurs in all unicellular and multicellular organisms.

II. It is a reductive process.

III. Carbon dioxide is evolved as a byproduct in all the organisms capable of photosynthesising.

IV. Dark reaction occurs in the stroma of the chloroplast.

Codes

- | | |
|----------------|-------------|
| (a) II only | (b) IV only |
| (c) II and III | (d) II only |

(iv) In the overall process of photosynthesis, how many sugar molecules are produced?

- | | |
|-------|--------|
| (a) 6 | (b) 12 |
| (c) 4 | (d) 1 |

(v) The table below states few differences between light and dark reactions.

Light reaction	Dark reaction
I. It is also called biosynthetic phase	It is also called photosynthetic phase
II. Takes place in thylakoids	Takes place in stroma
III. Reaction leads to production of ATP and NADPH	Reaction consumes ATP and NADPH
IV. It depends on light	It depends only on products formed during light reaction

Which of the following is the correct group of differences?

- | | |
|-------------------|--------------------|
| (a) I, II and III | (b) II, III and IV |
| (c) II and III | (d) I and IV |

20. Read the following and answer questions from (i to v).

Food is the basic requirement of all living beings. It provides energy and organic materials for cell growth and repair. The major components of food include carbohydrates, fats, proteins, vitamins, water and minerals.



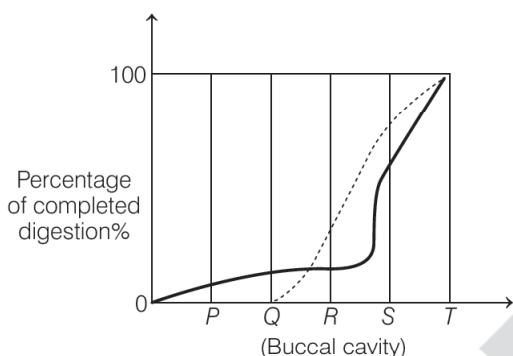
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The food that we intake is complex in nature and so, it becomes necessary to convert into simple and absorbable form. This happens by digestion.

The human digestive system consists of gastrointestinal tract plus the accessory organs of digestion. It involves breaking down of food into smaller components until they are absorbed.

Sections *P* to *T* represent different parts of the alimentary canal.



(i) Identify the part of alimentary canal that is *R* and *S*.

- (a) Stomach and gall bladder
- (b) Gall bladder and Oesophagus
- (c) Stomach and small intestine
- (d) Pancreas and stomach

(ii) The table show nutrients present in our foods.

Foods	Carbohydrates	Fat	Protein
<i>P</i>	✓	✗	✓
<i>Q</i>	✗	✗	✓
<i>R</i>	✗	✓	✗
<i>S</i>	✓	✓	✗

Which foods would both be partly digested in the stomach?

- (a) *P* and *Q*
- (b) *P* and *R*
- (c) *Q* and *S*
- (d) *R* and *S*

(iii) Only two of the following statements accurately describe what happens in the mouth?

- I. Amylase breaks down large starch molecules into smaller maltose molecules.
- II. Chewing increases the surface area of food for digestion.
- III. Saliva emulsifies fats into smaller droplets.
- IV. Teeth breakup large insoluble molecules into smaller soluble molecules.

Which statements are correct?

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

(iv) When a person eats raw egg white, protein and water enter the stomach.

Which substances are found leaving the stomach and leaving small intestine?

	Leaving the stomach	Leaving the small intestine
(a)	Amino acid and water	Amino acid and water
(b)	Fatty acid, glycerol and water	Fatty acid, glycerol and water
(c)	Protein and water	Fatty acid and glycerol
(d)	Protein, amino acid and water	Water

(v) If we take food rich in lime juice, then

- (a) action of ptyalin on starch is enhanced
- (b) action of ptyalin on starch is reduced
- (c) action of ptyalin on starch is unaffected
- (d) action of ptyalin on starch is stops

ANSWERS

Multiple Choice Questions

1. (a) 2. (c) 3. (b) 4. (c) 5. (c) 6. (a) 7. (b) 8. (a) 9. (c) 10. (d)
 11. (b) 12. (c) 13. (b)

Assertion-Reasoning MCQs

14. (a) 15. (b) 16. (c) 17. (a) 18. (b)

Case Based MCQs

19. (i)-(d), (ii)-(b), (iii)-(c), (iv)-(d), (v)-(b) 20. (i)-(c), (ii)-(a), (iii)-(a), (iv)-(d), (v)-(b)

EXPLANATIONS

- 1.** Oxygen liberated during photosynthesis comes from water. The following events occur during photosynthesis
- Absorption of light energy by chlorophyll.
 - Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.
 - Reduction of carbon dioxide to carbohydrates, which is used as food for plants.
- 2.** The correct reaction of photosynthesis is
- $$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Carbon dioxide}]{\substack{\text{Chlorophyll} \\ \text{Water}}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$$
- Sunlight
- 3.** The oxygen gas produced during photosynthesis is released into the surroundings through stomata. Stomata are also called site of gaseous exchange.
- 4.** In autotrophs, the cellular energy reserve is starch. However, carbohydrates serve as a major fuel in the cells to provide energy for life processes.
- The sugar (glucose) produced that is not used immediately gets stored in the form of starch in plants.
- In animals, food is stored in the form of glycogen. These food reserves provide energy as and when required by the organisms.
- 5.** Autotrophs can convert carbon dioxide and water into carbohydrates only in the presence of sunlight.

- 6.** *Cuscuta* is a parasitic plant that obtains its nutrition from other plants by growing on them.
- 7.** Yeast, mushroom and bread mould are fungi having heterotrophic mode of nutrition. They break down the dead organic matter in to small particles outside their body and then absorb it.
- 8.** Heterotrophs are those organisms which cannot make their own food from inorganic substances like CO_2 and water as they do not have chlorophyll to trap solar energy, e.g. all animals, most bacteria and fungi.
- They depend on other organisms for their food.
- Autotrophs synthesise their own food through photosynthesis by utilising solar energy, e.g. green plants.
- 9.** Egestion involves elimination of remaining undigested food material by rupturing of cell wall at any time.
- 10.** Small intestine is the site of complete digestion of all the nutrients present in food.
- 11.** False; stomach serves as a storehouse of food where partial digestion takes place.
- 12.** Pseudopodia are temporary extensions at the surface of *Amoeba* which facilitates movement. Trypsin is produced by the pancreas. Liver is responsible for bile production. Small intestines show extensive coiling.
- 13.** Salivary amylase is the first enzyme that mix with food and converts starch to simple sugars.

- 14.** Both A and R are true and R is the correct explanation of A.

Chloroplasts capture light energy and produce free energy as ATP and NADPH *via* photosynthesis.

- 15.** Both A and R are true, but R is not the correct explanation of A.

Amoeba does not have any specialised organ for nutrition and the entire process of digestion occurs with the help of pseudopodia.

This involves ingestion, digestion and egestion of food material.

- 16.** A is true, but R is false.

All the digested food is taken up by the walls of intestine, which has numerous villi. These increase the surface area for absorption.

- 17.** Both A and R are true and R is the correct explanation of A. Herbivores depend upon plant and grass based food that is formed of cellulose which takes time to digest.

- 18.** Both A and R are true, but R is not the correct explanation of A.

Raw materials needed for photosynthesis are carbon dioxide, water and minerals like nitrogen, phosphorus, iron and magnesium.

Nutrients are the substances required for proper growth and maintenance of a living body as they provide energy to an organism.

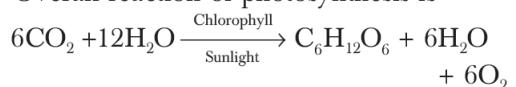
- 19.** (i) In light reaction of photosynthesis, energy rich ATP molecules and reduced coenzyme NADPH are produced.

- (ii) Light reactions of photosynthesis occurs in grana thylakoids.

Dark reaction involving carbohydrate synthesis by CO₂ fixation occur in stroma of chloroplast. Matrix of chloroplast stores starch temporarily as starch granules.

- (iii) Photosynthesis is a biochemical process with oxygen as its output or byproduct. It is the air that we breathe in and is necessary for our survival.

- (iv) Overall reaction of photosynthesis is



No. of glucose (sugar) molecules produced is 1.

- (v) Statements II, III and IV are correct, whereas I is incorrect and can be corrected as Light reaction is also called photochemical reaction whereas dark phase/reaction occurs in stroma and are called biochemical phase.

- 20.** (i) R represents stomach and S represents small intestine.

- (ii) Foods containing carbohydrate and proteins are digested partially in the stomach. However, their complete digestion occurs in small intestine.

- (iii) Statements I and II are correct, while III and IV are incorrect and can be corrected as Saliva does not emulsify fats into smaller droplets, but does play a role in converting undigested starch to sugar (maltose).

Teeth break the food into smaller pieces or help in chewing the food (mastication) and mix it with saliva in order to make it easily soluble.

- (iv) In stomach, egg white is broken down to amino acid. It contain albumin protein which is not completely broken down. Some of it, is further hydrolysed in intestine from where amino acids are absorbed by blood.

- (v) Amylase also called ptyalin breaks down starch into simpler sugars and works at a pH of 6.7.

If food rich in lime juice is taken the action of ptyalin on starch is reduced as lime juice creates acidic condition and the enzyme does not function in acidic conditions.

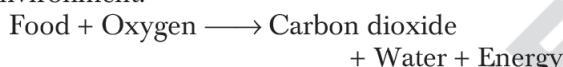


04(b)

Life Processes II : Respiration

Quick Revision

- Respiration is the process of **biochemical oxidation** of nutrients (occurring in cytoplasm of the cell) in the presence of specific enzymes at optimum temperature in the cells to release energy for metabolic activities.
- It is a **catabolic process** in which exchange of gases occurs *viz*, oxygen and carbon dioxide takes place between the body and the outside environment.



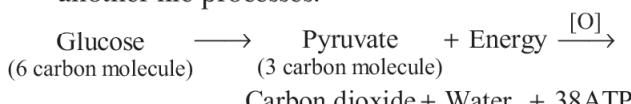
- Some organisms use oxygen, while some do not. Hence, in both the cases, the first step is the breakdown of glucose (six carbon molecule) into pyruvate (three carbon molecule).

1. Types of Respiration

The conversion of pyruvate into another substance depends on either the presence or absence of oxygen.

- (i) **Aerobic respiration** is defined as the process of release of fairly large amount of energy in the presence of oxygen from the breakdown of the food substances.

The energy released is further utilised for another life processes.



This process starts in the **cytoplasm** of a cell and continues in the **mitochondria**.

- (ii) **Anaerobic respiration** is described as the release of small amount of energy in the absence of oxygen from the breakdown of the food substances. It is also known as **fermentation**.

- This occurs in yeast, bacteria and in the human muscle.
- Anaerobic respiration produces only two molecules of ATP for each glucose molecule.

2. ATP : The Energy Currency

- ATP stands for Adenosine Triphosphate, which is also known as the **energy currency of the cell**.
- It is mainly broken down to provide large amount of energy which can drive the endothermic reaction taking place in the cell.



where, iP = inorganic phosphate

3. Stages of Respiration

Respiration takes place in three steps

- Glycolysis, (ii) Krebs' cycle and (iii) Electron transport chain

4. Respiration in Plants

- Plants exchange gases through stomata and large intercellular spaces.
- Root, stem and leaf of a plant are the parts involved in respiration. It is rapid in meristematic tissue and slower in mature regions.
- In roots of a plant, exchange of gases takes place by the process of **diffusion**.
- In woody plants, gaseous exchange occurs through the small pores in the stems called **lenticels**.
- In leaves, respiration takes place by diffusion of oxygen through **stomata** into the cells of the leaf from where carbon dioxide is released into the atmosphere.



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5. Respiration in Animals

Some animals respire (i.e. take in oxygen and give out carbon dioxide) through their skin, while some through the organs. These organs are known as **respiratory organs**, which work together to constitute a respiratory system of an organism.

6. Respiration in Aquatic and Terrestrial Organisms

- The aquatic organisms (such as fishes etc) utilise the oxygen dissolved in water for respiration. Since, the amount of dissolved oxygen is fairly lower than the amount of oxygen in the air. Therefore, aquatic organisms breathe more rapidly (through mouth) to accumulate more and more oxygen.
- In **terrestrial organisms**, atmospheric oxygen is used for respiration and this oxygen is absorbed by different organs in different animals.

7. Respiration in Human Beings

- Process of respiration in human beings like other animals serves to provide fresh oxygen to all body cells and removes harmful carbon dioxide from the body.
- This process which follows the intake of oxygen is known as **inspiration** and giving out of carbon dioxide, known as **expiration**.

8. Parts and Functions of Respiratory System

Some parts and their functions are

- Nostrils** Air is taken into the body through nostrils (which filters air by fine hairs and mucus present in them).
- Nasal passage** Air entering from nostrils is led to the nasal passage responsible for conditioning of air.
- Pharynx** It is the common pathway for the air and the food. The flap-like structure, called epiglottis prevents food particles from going into the windpipe.
- Trachea** (windpipe) The air then passes from pharynx and goes into trachea which is a cylindrical tube that provides support and split into two bronchi.

(v) **Bronchi** Trachea divides into two, smaller tubes, called bronchi which extend into lungs.

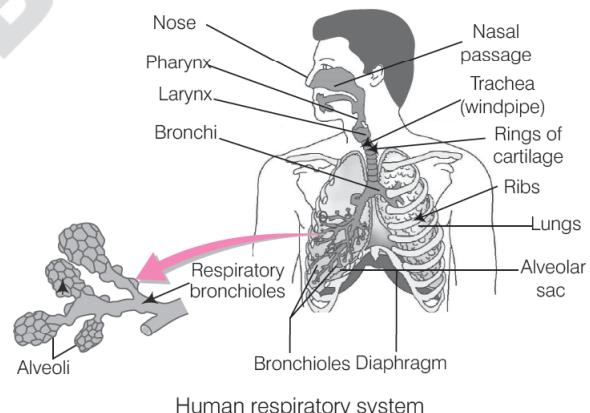
(vi) **Bronchioles** Bronchi is sub-divided into smaller tubes and form structures called bronchioles. Each bronchiole finally terminates into alveoli (balloon-like structure that provide surface for the exchange of gases).

(vii) **Alveoli** These are the air sacs occurring in clusters. Each one of these is surrounded by the networks of capillaries.

(viii) **Lungs** are major respiratory organs located on either side of the chest.

(ix) **Ribs** Lungs and heart are safely placed in it. Movement of intercostal muscles help in breathing.

(x) **Diaphragm** It forms the base of chest cavity and acts as a muscular partition between thorax and abdomen.



Mechanism of gaseous exchange in humans involves inhalation, gaseous exchange in alveoli and exhalation.

9. Respiratory Pigment

- Haemoglobin (which has very high affinity for oxygen) is the respiratory pigment in human beings.
- It is mainly responsible to carry oxygen from lungs to tissue, before releasing it. It is also responsible for the red colour of Red Blood Corpuscles (RBCs).



Objective Questions

Multiple Choice Questions

01. The breakdown of pyruvate to give carbon dioxide, water and energy takes place in (NCERT)
(a) cytoplasm (b) mitochondria
(c) chloroplast (d) nucleus

02. What is observed when air is blown from mouth into a test tube containing lime water?
(a) Lime water turns milky due to the CO₂ exhaled
(b) Lime water becomes colourless due to exhaled CO₂
(c) Lime water turns milky due to water vapour in blown air
(d) None of the above

03. The correct sequence of anaerobic reactions in yeast is (NCERT Exemplar)
(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

04. Which of the following structures is involved in gaseous exchange in woody stem of a plant?
(a) Stomata (b) Lenticel
(c) Guard cell (d) Epidermis

05. During vigorous physical exercise, lactic acid is formed from glucose inside the muscle cells because
(a) there is lack of oxygen
(b) there is lack of water
(c) there is excess of carbon dioxide
(d) None of the above

06. How does the exchange of gases occur in roots of a plant?
(a) Through lenticels
(b) Through root stomata
(c) Through root hairs
(d) None of the above

07. The product of alcoholic fermentation is
(a) ethyl alcohol (b) methyl alcohol
(c) propanol (d) Butane

08. Efficient gaseous exchange requires the respiratory surface to be thin-walled.
(a) True (b) False
(c) Can't say (d) Partially True/False

09. Terrestrial organisms use for respiration.
(a) atmospheric CO₂ (b) atmospheric O₂
(c) Stored oxygen (d) stored CO₂

10. Which among the following is the respiratory pigment found in human body?
(a) Haemoglobin (b) Chlorophyll
(c) Plasma (d) Trypsin

11. Which of the following is the first site for the exchange of inhaled air?
(a) Blood capillaries of lungs
(b) Alveoli of lungs
(c) Left auricle of the heart
(d) Blood capillaries adjacent to body cells

12. Which is the correct sequence of air passage during inhalation?
(a) Nostrils → Larynx → Pharynx → Trachea → Lungs
(b) Nasal passage → Trachea → Pharynx → Larynx → Alveoli
(c) Larynx → Nostrils → Pharynx → Lungs
(d) Nostrils → Pharynx → Larynx → Trachea → Alveoli

Assertion-Reasoning MCQs

Direction (Q.Nos. 13-17) For the following question numbers two statements are given, one labelled as Assertion (A) and the other labeled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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, but R is true

13. Assertion (A) Alcoholic fermentation takes place in the absence of oxygen.

Reason (R) It occurs in yeast.

14. Assertion (A) Respiration is a biochemical process opposite to photosynthesis.

Reason (R) Energy is released during respiration.

15. Assertion (A) In woody plants, gaseous exchange occurs through lenticels.

Reason (R) Lenticels are specialised cells found along with stomata on the stem of woody plants.

16. Assertion (A) Lungs always contain a residual volume of air.

Reason (R) It provides sufficient time for oxygen to be absorbed and for carbon dioxide to be released.

17. Assertion (A) Haemoglobin is the respiratory pigment in human beings.

Reason (R) It transports oxygen in the human body.

Case Based MCQs

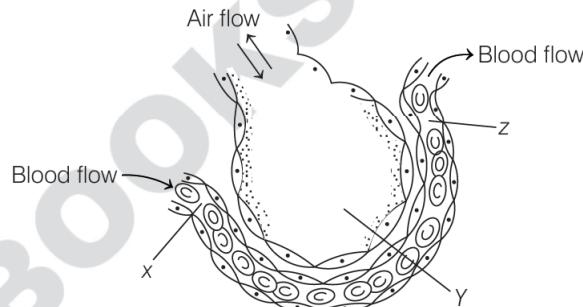
18. Read the following and answer any four questions from (i) to (v).

With the lungs, the passage divides into small tubes which finally terminate in

balloon-like structures which are called alveoli. The alveoli provide a surface where the exchange of gases can take place.

The walls of the alveoli contain an extensive network of blood vessels. As we breathe in, we lift our ribs and flatten our diaphragm and the chest cavity becomes large lift.

- (i) The diagram shows a section through an alveolus and a blood capillary.



What are the oxygen concentrations in X, Y and Z?

	X	Y	Z
(a)	High	Low	High
(b)	High	Low	Low
(c)	Low	High	High
(d)	Low	High	Low

- (ii) Which of the following is characteristic of emphysema?

- (a) Destruction of alveolar walls
- (b) Increase in the growth of lung tissue
- (c) Inflammation of the walls of the bronchi
- (d) Thickening of the artery walls to the lungs

- (iii) Chemicals in tobacco smoke lead to the breakdown of the elastic tissue in the alveoli.

What is the name of this condition?

- (a) Bronchitis
- (b) Emphysema
- (c) Heart disease
- (d) Lung cancer

- (iv) What is the percentage of oxygen in expired air when a person is resting?

- (a) 8%
- (b) 16%
- (c) 12%
- (d) 20%

- (v) What happens during the process of breathing in?

External intercostal muscles	Diaphragm
(a) Contract	Arches
(b) Contract	Flattens
(c) Relax	Arches
(d) Relax	Flattens

- 19.** Read the following and answer any four questions from (i) to (v).

We need energy to perform various activities. This energy is derived from various components of food being catabolised. Proteins, fats, carbohydrates, etc., all catabolise in the presence of oxygen and carbon dioxide is released in the process.

So, the body requires a continuous exchange of gases with oxygen from the atmosphere being taken inside and carbon dioxide being released.

In human beings, respiratory pigment, called haemoglobin present in RBCs has very high affinity for oxygen.

In tissues, gaseous exchange occurs between oxygenated blood and tissue cells.

- (i) People living at sea level have less number of RBCs in their blood when compared to those living at higher altitudes. This is because at high altitude
 (a) people eat nutritious food, so more RBCs are formed
 (b) people get pollution free air to breathe, more oxygen is available
 (c) presence of UV radiation in more amount enhances RBC production
 (d) atmospheric O_2 level is less, more RBCs are required to absorb required amount of O_2 for survival

- (ii) The given equation is incomplete and shows breakdown of glucose into pyruvate and so on when a condition of vigorous exercise is observed. Which among the following products will be obtained?

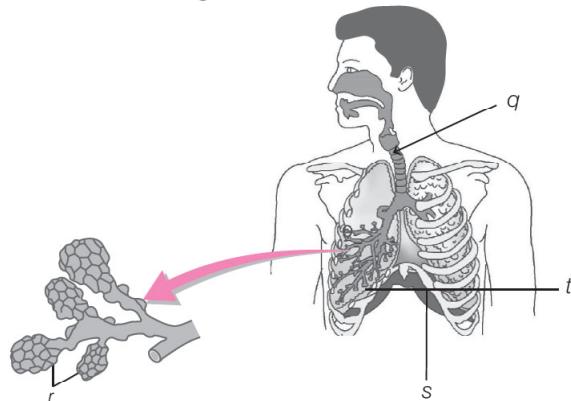


- (a) A-In muscle cells, B-Lactic acid, energy
 (b) A-In mitochondria, B-Lactic acid, CO_2 , water
 (c) A-In muscles cells, B-Ethanol, CO_2
 (d) A-In muscles cells, B-Lactic acid, ethanol

- (iii) Which one of the following is a possibility for most of us, in regard to breathing by making a conscious effort?

- (a) One can breathe out air totally without oxygen
 (b) One can breathe out air by closing both nose and mouth
 (c) Lungs can be made fully empty by forceful exhalation
 (d) One can consciously breathe in and out by moving the diaphragm alone, without any rib movement

- (iv) Refer to the given figure of Human Respiratory System and answer the following



Which of these parts

- Are actual sites of gaseous exchange?
- Is the common passage for food and air?
- Is provided with C-shaped cartilaginous rings?

- IV. Relaxe and get back to its shape during expiration?
- V. moves upward and outward during inspiration?
- (a) I-s, II-p, III-q, IV-r, V-t
 (b) I-r, II-p, III-q, IV-s, V-t
 (c) I-t, II-q, III-r, IV-s, V-p
 (d) I-p, II-q, III-r, IV-s, V-t
- (v) Which of the following sequences is correct to initial inspiration?

- I. Contraction of intercostal muscles raises ribs and sternum.
- II. Volume of thorax increases
- III. Intrathoracic pressure of lungs decreases
- IV. Diaphragm contraction
- V. Air rushes into lungs
- (a)(I)→(II)→(IV)→(V)→(III)
 (b)(I)→(II)→(III)→(IV)→(V)
 (c)(I)→(IV)→(II)→(III)→(V)
 (d)(V)→(I)→(II)→(III)→(IV)

ANSWERS

Multiple Choice Questions

1. (b) 2. (a) 3. (d) 4. (b) 5. (a) 6. (c) 7. (a) 8. (a) 9. (b) 10. (a)
 11. (b) 12. (d)

Assertion-Reasoning MCQs

13. (b) 14. (b) 15. (c) 16. (a) 17. (a)

Case Based MCQs

18. (i)-(c), (ii)-(a), (iii)-(b), (iv)-(d), (v)-(b)
 19. (i)-(d), (ii)-(a), (iii)-(b), (iv)-(b), (v)-(c)

EXPLANATIONS

- The breakdown of pyruvate to give carbon dioxide, water and energy requires the presence of oxygen and takes place in mitochondria.
- Lime water when reacts with carbon dioxide, exhaled, is turns milky.
- In yeast, the breakdown of pyruvate takes place in cytoplasm. Pyruvate converts into ethanol and carbon dioxide.
- In the stems of woody plants, the exchange of respiratory gases takes place through lenticels. These are small openings in the pits of the bark.
- During vigorous physical exercise, lactic acid is formed from glucose inside the muscle cells because there is lack of oxygen. Muscle cells respire anaerobically to produce lactic acid.
- Gaseous exchange in roots of a plant occurs via root hair by the process of diffusion. During diffusion, oxygen diffuses in and carbon dioxide diffuses out of the root cells.
- Ethyl alcohol is obtained as the product of alcoholic fermentation. This process involves release of small amount of energy.
- For efficient gaseous exchange, respiratory surface should be thin-walled, moist, rich in blood supply and have large surface area.
- Terrestrial organisms use atmospheric oxygen in order to respire.
- The respiratory pigment found in human beings is haemoglobin.
- Exchange of inhaled air occurs initially in the alveoli of lungs.
- In humans, air passes from nostrils to pharynx, larynx, trachea and then to lungs.
- Both A and R are true, but R is not the correct explanation of A.
 Alcoholic fermentation is a type of anaerobic respiration that takes place where there is lack of oxygen. This process occurs in yeast.

- 14.** Both A and R are true and R is the correct explanation of A.

Respiration is defined as the process of biochemical oxidation of nutrients at cellular level. It occurs in the presence of specific enzymes at optimum conditions in the cells to release energy for various metabolic activities. However, it is opposite to photosynthesis where energy is stored in the form of carbohydrates.

- 15.** A is true, but R is false.

In woody plants, gaseous exchange occurs through the small pores found on stems called lenticels. Stomata on the stem aid in gaseous exchange, in herbaceous plants.

- 16.** Both A and R are true and R is the correct explanation of A.

During the breathing cycle, when air is taken in and thrown out, the lungs always contain a residual volume of air. It provides sufficient time for oxygen to be absorbed and for carbon dioxide to be released.

- 17.** Both A and R are true and R is the correct explanation of A. Haemoglobin is the respiratory pigment in human beings. It takes up oxygen from the air in the lungs and carries it to tissues.

- 18.** (i) A high concentration of oxygen in the alveolar air and low concentration in blood create a higher diffusion gradient. Blood leaving the alveoli contain a higher concentration of oxygen.
(ii) Emphysema is a condition that involves damage of alveolar walls of alveoli of the lungs. These damaged alveoli cannot further support bronchial tubes.
(iii) Tobacco smoke breathed in by heavy smokers suffering from chronic bronchitis often results in emphysema. The partition walls of the alveoli breakdown due to the intense cough resulting in a reduction in the surface area of alveoli for absorption of oxygen.
(iv) Oxygen occupies about 20% by volume of air. Oxygen diffuses slowly across the alveoli walls into the blood capillaries. The absorption of oxygen by blood is limited by the diffusion gradient of oxygen and the rate of blood flow.

(v) During inspiration, the diaphragm contracts and flattens. The external costal muscles contract while the internal intercostal muscles relax. This increases the volume of the chest cavity.

- 19.** (i) RBCs count increases in people living at higher altitudes because there is a decrease in atmospheric pressure coupled with decreased oxygen levels. Thus, to carry more oxygen to the cells, RBCs (and thus more Haemoglobin) in higher number are required.

(ii) During vigorous exercise, there is lack of oxygen in the body, thus anaerobic respiration takes place in muscle cells and pyruvate is broken down to lactic acid and the energy is released.

- (iii) There stands no possibility of breathing out air totally without oxygen. The air that we breathe out has a certain percentage of oxygen.

Lungs cannot be made empty as there is always a certain volume of air that remains inside them in order to prevent their collapse. This volume is called residual volume.

The movement of diaphragm is very important during breathing process and it is impossible to breathe in or out without involving rib movement.

Eustachian tube associates the center ear depression and exhalation of air by conscious closure of mouth and nose turns the air towards eustachian tube and it gets out via middle ear.

- (iv) p-Pharynx, q-Trachea, r-Alveoli, s-Diaphragm, t-Rib cage
Alveoli are actual sites of gaseous exchange. Pharynx is a common passage for food and air. Trachea is provided with C-shaped rings. Diaphragm goes back to its original shape during expiration.

Rib cage moves upward and outward during inspiration.

- (v) Correct sequences is

I → IV → II → III → V

Firstly, the intercostal muscles raise ribs and sternum leading to contraction of diaphragm. As volume of thorax increases, intrathoracic pressure of lungs decreases and air rushes into lungs.



04(c)

Life Processes III : Transportation

Quick Revision

Transportation is a life process in which a substance absorbed (or made) in one part of the body of an organism is carried to other parts of the body through the circulating fluids like blood and lymph.

1. Components of Transport System in Humans

The transport system of human beings consists of a circulating fluid called **blood**, which is pumped by a muscular organ known as **heart** and a system of interconnecting tubes, i.e. **blood vessels**.

2. Blood

- It is a red-coloured fluid connective tissue that circulates in our body.
- It supplies nutrients and oxygen, to all living cells and collects waste products and carbon dioxide to be thrown out.
- It helps in regulation of pH and body temperature.

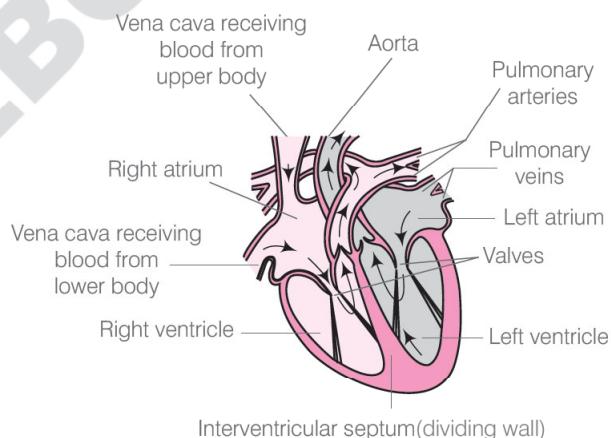
3. Maintenance by Platelets

- It is usually done in case of injury when there is bleeding and loss of blood has to be minimised.
- To prevent leakage, platelet cells in blood circulate around the body and form a mesh-like structure or clot at the site of injury.
- Blood clotting is a mechanism that prevents the loss of blood at the site of an injury or wound by forming a blood clot.

4. Heart

- The heart acts like a pumping machine in our body that pushes out the blood into the blood vessels.
- It is a muscular organ having size as big as our fist.

- The heart is situated between the lungs slightly towards the left side of the chest.
- Human heart is four-chambered (i.e. two **upper atria** and two **lower ventricles**).
- These different chambers are meant to prevent mixing of oxygenated (rich in oxygen) and deoxygenated (rich carbon dioxide) blood.



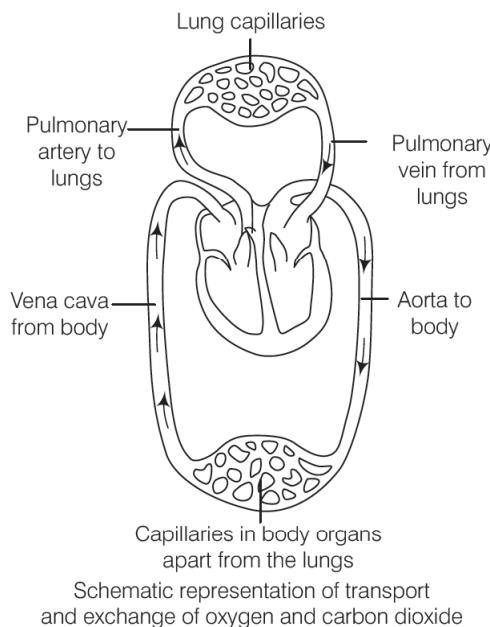
Schematic sectional view of the human heart

- Oxygen rich blood from lungs comes to thin-walled upper chamber of the heart, left atrium which relaxes (while collecting this blood) and contracts and transfer blood to left ventricle during which it expands, the left ventricle then contracts and blood is pumped to the body parts.
- Deoxygenated blood enters in right atrium and when it contracts, it transfers blood to right ventricle, which again pumps blood to the lungs for oxygenation.
- Ventricles have thick walls than atrium because they have to pump blood into various organs.



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5. Blood Vessels

There are three types of vessels involved in blood circulation, i.e. arteries, veins and capillaries.

- (i) **Arteries** The arteries have thick, muscular and elastic walls which carry blood at high pressure. They do not have valves. They carry blood away from the heart to various organs of the body.
- (ii) **Veins** The veins have thin walls than arteries which carry blood at low pressure. They have valves to prevent the backflow of blood. They collect the blood from different organs and brings it back to the heart.
- (iii) **Capillaries** They are formed when artery divides into smaller tubes. They have valves to prevent the backflow of blood. The walls of capillaries are one cell thick. Exchange of materials between blood and surrounding thick cells takes place across the thin walls of capillaries.

6. Blood Circulation in Animals

- In birds and mammals, heart is four-chambered and oxygenated blood remains separated from deoxygenated blood.

- In fishes, two-chambered heart pumps blood to gills. There is no separation of pure and impure blood.
- In amphibians or reptiles, three-chambered heart is present. They can tolerate some mixing of oxygenated and deoxygenated blood.

7. Blood Circulation in Human

The blood circulatory system in human is an example of double circulation.

- (i) **Double circulation** The blood goes through the heart twice to supply blood once around the body. It is a **closed circulatory system**, i.e. blood travels around body inside the blood vessels. The following processes constitute the double circulation.
- (ii) **Pulmonary circulation** The movement of blood from heart to the lungs and back to the heart constitutes the pulmonary circulation.

Movement of blood in pulmonary circulation occurs in the following ways

Right ventricle pumps blood to the lungs for oxygenation *via* pulmonary artery.

Oxygenated blood then comes back to the left auricle of heart through four pulmonary veins, i.e. two from each lung.

The left atrium then contracts passing the blood to the corresponding expanded left ventricle (in the systemic circulation).

- (iii) **Systemic Circulation** The circulation of blood from heart to different parts of the body except lungs and back to the heart constitutes the systemic circulation. Movement of blood in systemic circulation occurs in the following ways

As the left ventricle fills up, it contracts forcing blood out.

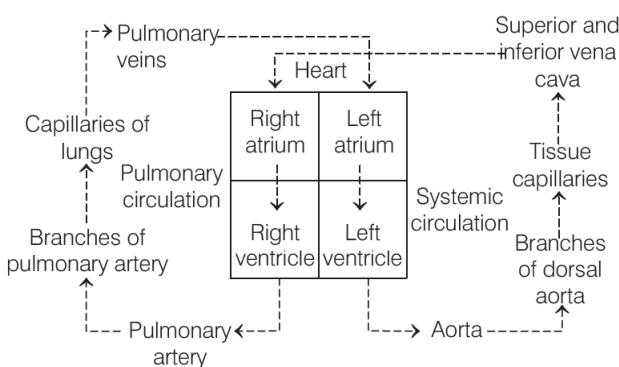
The blood is finally, pumped to the whole body *via* aorta as the muscular left ventricle contracts.

The deoxygenated blood from the different body parts enters into the right atrium.

As the right atrium contracts, the blood passes into the corresponding lower chamber, i.e. the right ventricle.



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8. Blood Pressure

- It is the pressure of circulating blood on the walls of blood vessels.
- Blood pressure is maximum during contraction of left ventricle and is known as systolic pressure. It is 120 mm Hg.
- The diastolic pressure is specifically the minimum arterial pressure during relaxation and dilation of the ventricles. It is 80 mm Hg.
- Blood pressure is measured by **sphygmomanometer**.

9. Lymph

- Apart from blood, lymph in our body is another type of fluid involved in transportation. This is also called **tissue fluid**.
- It is also meant to transport any digested and absorbed fat from intestine and drains excess fluid from extracellular space back into the blood.
- Lymph drains into lymphatic capillaries from the intercellular spaces, which join to form large lymph vessels that finally open into larger veins.

10. Transportation in Plants

- Plants lack a circulatory system. Short distance transport of certain materials occurs *via* diffusion whereas long distance transport requires a proper transportation system.
- Roots absorb raw materials, water and minerals from soil *via* diffusion.
- Plant transport system transports both food and water.
- Xylem** and **phloem** carry substances from one part of the plant body to the another.

- Xylem transports water and minerals obtained from the soil, whereas phloem (vascular tissue) transports products of photosynthesis from the leaves to the other parts of the plant.

11. Transport of Water

- Xylem consist of tracheids, xylem fibres, vessels and xylem parenchyma. Vessels and tracheids of the roots, stems and leaves that form continuous system of water conducting channels which reaches to all parts of a plant.
- There is a concentration gradient between roots and soil, so, water moves into roots from soil and creates a water column pushed upwards.
- Transport of water occurs also due to transpirational pull.

12. Transpiration

- Transpiration is the loss of water in the form of vapour from the aerial parts (i.e. stem, leaves) of the plant. It takes place through the special pores known as **stomata**.
- Transpiration helps in the absorption and upward movement of water and minerals dissolved in it from roots to the leaves.
- It also functions as a temperature regulator.
- In day time, transpiration pull is the major driving force in the movement of water in the xylem.

13. Transport of Food and Other Substances

- Translocation is the phenomenon of transport or movement of soluble products (sugar) from the leaves to the other parts of the plant with the help of phloem.
- Sugar like sucrose is transferred into phloem tissue with the help of energy (ATP).
- It increases the osmotic pressure of the tissue causing material to move according to the plants need.
- Translocation of substances takes place in the sieve tubes with the help of adjacent companion cells both in upward and downward directions (materials move from high pressure to low pressure).

Objective Questions

Multiple Choice Questions

- 01.** The blood leaving the tissues becomes richer in
(a) carbon dioxide (b) water
(c) haemoglobin (d) oxygen
- 02.** surrounds the heart.
(a) Septum (b) Pericardium
(c) Valves (d) None of these
- 03.** Valves ensure that blood does not backflow inside the heart.
(a) True (b) False
(c) Can't say (d) Partially True/False
- 04.** In fishes, the heart receives only pure blood.
(a) True (b) False
(c) Can't say (d) Partially True/False
- 05.** Single circulation, i.e. blood flows through the heart only once during one cycle of passage through the body is exhibited by *(NCERT Exemplar)*
(a) *Labeo, chameleon, salamander*
(b) *Hippocampus, Exocoetus, anabas*
(c) *Hyla, Rana, Draco*
(d) *Whale, dolphin, turtle*
- 06.** Crocodiles have chambered heart.
(a) two (b) three
(c) four (d) None of these
- 07.** Lymph does not comprise of
(a) red blood corpuscles
(b) lymphocytes
(c) white blood corpuscles
(d) nitrogenous waste
- 08.** and form a continuous system of water conducting channels that reaches all parts of the plant.
(a) Xylem, phloem (b) Phloem, tracheids
(c) Phloem, vessels (d) Tracheids, vessels

- 09.** Transpiration helps in regulation of temperature.
(a) True (b) False
(c) Can't say (d) Partially True/False
- 10.** The process of carrying food from the leaves to other parts of a plant is called
(a) transpiration (b) transportation
(c) translocation (d) transformation
- 11.** Translocation of substances takes place in the sieve tubes in downward direction only.
(a) True (b) False
(c) Can't say (d) Partially True/False
- 12.** Which of the following is accomplished in a plant by utilising the energy stored in ATP?
(a) Transport of food
(b) Transport of oxygen
(c) Transport of water and minerals
(d) Transport of water, minerals and food
- 13.** Match Column I with Column II and select the most appropriate option from the codes given.

Column I	Column II
A. Platelets	1. Size of fist
B. Heart	2. Warm-blooded animals
C. Veins	3. Translocation
D. Birds	4. Valves
E. Sieve tubes	5. Blood clotting

Codes

A	B	C	D	E
(a) 1	3	5	4	2
(b) 5	1	4	2	3
(c) 5	1	4	3	2
(d) 5	1	4	2	1

- 14.** Match Column I with Column II and choose the most appropriate option from the codes given below.

Column I	Column II
A. Xylem	1. Night
B. Phloem	2. Sucrose
C. Root pressure	3. Necessary evil
D. Transpiration	4. Minerals
E. Translocation	5. Companion cells

Codes

A	B	C	D	E
(a) 5	4	1	3	2
(b) 4	1	3	2	5
(c) 4	2	1	3	5
(d) 4	2	5	3	1

Assertion-Reasoning MCQs

Direction (Q.Nos. 15-19) For the following question numbers two statements are given one labeled **Assertion (A)** and the other labeled **Reason (R)**. Select the correct answer to these question from the codes (a), (b), (c) and (d) as given below

- (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 the A
- (c) A is true, but R is false
- (d) A is false, but R is true

- 15. Assertion (A)** Blood pressure is arterial blood pressure.

Reason (R) It is measured by sphygmomanometer.

- 16. Assertion (A)** Interauricular septum separates left atrium from right atrium.

Reason (R) Interventricular septum separates left ventricle from right ventricle.

- 17. Assertion (A)** All the arteries carry oxygenated blood from the heart to various organs.

Reason (R) Pulmonary vein carries deoxygenated blood to the heart.

- 18. Assertion (A)** Translocation in phloem is mainly achieved by utilising energy.

Reason (R) Translocation takes place in sieve tubes.

- 19. Assertion (A)** Transpiration is a necessary evil.

Reason (R) It causes water loss but helps in absorption and upward movement of water and minerals.

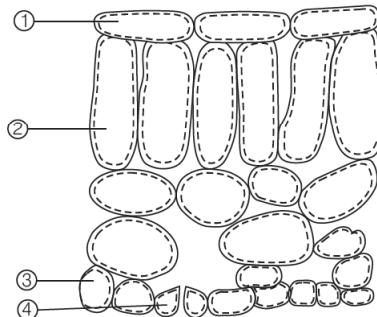
Cased Based MCQs

- 20.** Read the following and answer questions from (i) to (v).

The general requirement for energy and materials is common in all organisms, but it is fulfilled in different ways. Organisms use simple food material obtained from inorganic sources in the form of carbon dioxide and water these organisms, called as autotrophs, include green plants and some bacteria other organisms utilise complex substances, known as heterotroph.

The process by which green plants make their food is called photosynthesis which occurs in chloroplast, after that food and minerals are transported to all parts of the plants with the help of xylem and phloem tissue and from various processes like translocation, absorption, osmosis, etc.

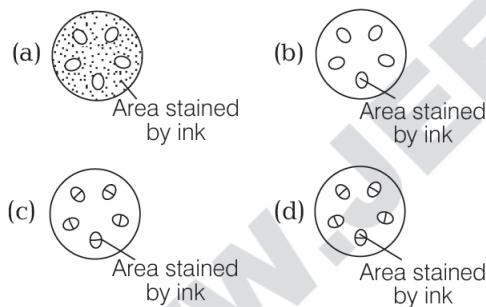
- (i) The diagram shows the arrangement of cells inside the leaf of a green plant. Which cells normally contain chloroplast?



- (a) 1 and 3 (b) 2 and 4
 (c) 1, 4 and 3 (d) All of these

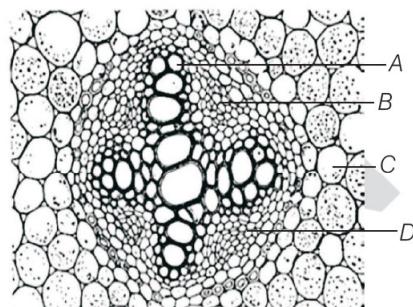
- (ii) A plant shoot is left in ink solution for several hours.

A section is cut through the stem. What would you see?



- (iii) The diagram shows a transverse section from the middle of a root of a dicotyledonous plant.

In which tissue are sugars and amino acids transported?



- (a) Tissue marked as A
 (b) Tissue marked as B
 (c) Tissue marked as C
 (d) Tissue marked as D

- (iv) A young plant may wilt when dug up and re-planted in another place. What causes this?

- (a) The leaves lose less water
 (b) The roots cannot take up mineral salts
 (c) The stem cannot transport water
 (d) The surface area of the root is reduced

- (v) What causes water to enter plant roots from the soil?

- (a) Water potential in root hairs and soil is equal
 (b) Water potential in root hairs and xylem is equal
 (c) Water potential in roots hair is higher than in the soil
 (d) Water potential in root hairs is lower than in the soil

ANSWERS

Multiple Choice Questions

1. (a) 2. (b) 3. (a) 4. (b) 5. (b) 6. (c) 7. (a) 8. (d) 9. (a) 10. (c)
 11. (b) 12. (a) 13. (b) 14. (c)

Assertion-Reasoning MCQs

15. (b) 16. (b) 17. (d) 18. (b) 19. (a)

Case Based MCQs

20. (i)-(b), (ii)-(d), (iii)-(b), (iv)-(c), (v)-(c)

EXPLANATIONS

1. The blood leaving the tissues is richer in carbon dioxide because the main artery carries oxygenated blood from heart to various organs from where it is passed through their capillaries and provides oxygen to body cells and at the same time, CO_2 which is a byproduct of respiration, enters into the blood. Thus, indicating gaseous exchange.
The deoxygenated blood then leaves the tissues and is passed to lungs for oxygenation.
2. Pericardium is a double-layered membrane that surrounds the heart. It protects the heart and keeps it in place.
3. Valves ensure the backflow of the blood inside the heart does not occur and that the blood flows unidirectionally only.
4. False; Impure blood is received by the heart in case of fishes.
5. The examples and the relation of animal group and heart are as

Animal Group	Heart	Examples
Fishes	2-chambered heart (one atrium and one ventricle) single circulation	<i>Labeo, Hippocampus, Exocoetus, Anabas, etc.</i> Fishes.
Amphibians and Reptiles	3-chambered heart (two atria and one ventricle) mixing of oxygenated and deoxygenated blood.	<i>Salamander, Hyla, Rana</i> (Amphibians) <i>Chameleon, Draco, turtle</i> (Reptiles)
Birds and Mammals	4-chambered heart (two atria and two ventricles) No mixing of blood	Pigeon, parrot (birds), whale, dolphins, humans (Mammals)

According to this chart, 2 chambered heart is present only in fishes and blood flows only once during one cycle. Group (b)-contain fishes, so correct answer is option 'b'.

6. The heart of a crocodile is different from other reptiles because it is four chambered.

The blood sent to the lungs for gaseous exchange from the right ventricle, is pumped to the body *via* left ventricle post for oxygenation.

7. Lymph does not contain RBCs and platelets, but it is rich in lymphocyte or WBC count.
8. Xylem tissues of plants have an interconnected network of vessels and tracheids of stem, roots and leaves, forming a continuous system of water conducting channels throughout the plant.
9. Plants lose water through the process of transpiration. The water that escapes into atmosphere, actually cools down the leaves thereby regulating temperature of the plant.
10. The transport of soluble products (sugar) of photosynthesis from leaves to other parts of the plant is translocation.
11. False, translocation of substances occurs in both upward and downward direction, i.e. bidirectional.
12. Transport of food in a plant is accomplished by using the energy stored in ATP, whereas transport of water and minerals takes place *via* diffusion and transpiration pull.
13. The correct matches are as follows
Platelets cause clotting of blood.
The size of the heart is the same as that of our fist.
Most of the veins have valves to prevent backflow of blood.
Birds are warm-blooded with a constant body temperature.
Translocation occurs in sieve tubes with the aid of companion cells.
14. The correct matches are as follows Water and minerals are transferred in plants *via* xylem.
Sucrose is transferred into phloem using ATP.
Root pressure is critical during night time.
Transpiration is a necessary evil as it helps the plant absorb more water.
Translocation occurs *via* companion cells.

- 15.** Both A and R are true, but R is not the correct explanation of A.

Blood pressure is the pressure exerted by circulating blood upon the walls of blood vessels and is measured within large arteries. The instrument used to measure blood pressure is sphygmomanometer.

- 16.** Both A and R are true but R is not the correct explanation of A.

There are four chambers in the human heart. The left atria and right atria are separated by an interauricular septum. The two inferior chambers of the heart, i.e. right and left ventricles are separated by an interventricular septum.

- 17.** A is false, but R is true.

The arteries carry oxygenated blood from the heart to various organs, except for pulmonary artery. The veins collect deoxygenated blood from different organs and bring it back to the heart, except for pulmonary vein that carries oxygenated blood.

- 18.** Both A and R are true but R is not the correct explanation of A.

Materials are translocated *via* phloem by utilising energy from ATP.

Translocation of substances takes place in sieve tubes with the aid of companion cells, lying adjacent to them, bi-directionally.

- 19.** Both A and R are true and R is the correct explanation of A.

Transpiration is a necessary evil. It is so because water is lost in the form of vapours from the aerial parts of the plant through transpiration.

But, it helps in absorption and upward movement of water and minerals creating a transpiration pull.

- 20.** (i) The palisade mesophyll cell (at (2)) and guard cell (at (4)) possess chloroplasts which absorb sunlight. Most chloroplasts are concentrated in the former area to acquire maximum sunlight in order to photosynthesise.

- (ii) When a plant shoot is left in ink solution for several hours, its xylem portion will get stained as it is the water conducting tissue.

- (iii) Sugars and amino acids are transported by phloem tissue, here, B. They are found alternating between central core of xylem.

- (iv) A young plant may wilt when dug up and re-planted because while digging up, the stem may break which hampers the transportation of water and other nutrients, causing wilting.

- (v) Higher water potential in roots as compared to soil, leads to movement of water into roots by osmosis.

The intake of water in roots increases water potential in root xylem, which drives water up.



04(d)

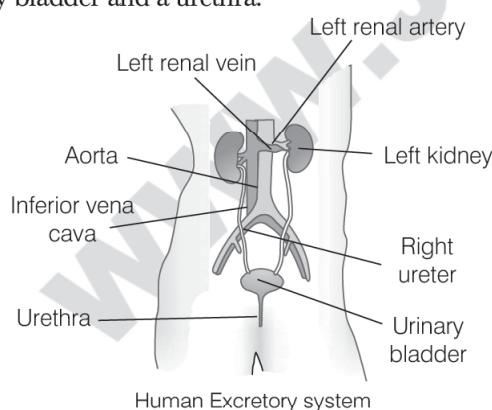
Life Processes IV : Excretion

Quick Revision

- It is the biological process by which an organism removes the metabolic wastes from the body.
- The mode of excretion is completely different in **unicellular** (animals consisting single cell) and **multicellular** (animals consisting many cells) organisms.
- Unicellular organisms excrete waste by simple process like diffusion, whereas multicellular organisms use specialised organs for the removal of waste products.

1. Excretion in Human beings

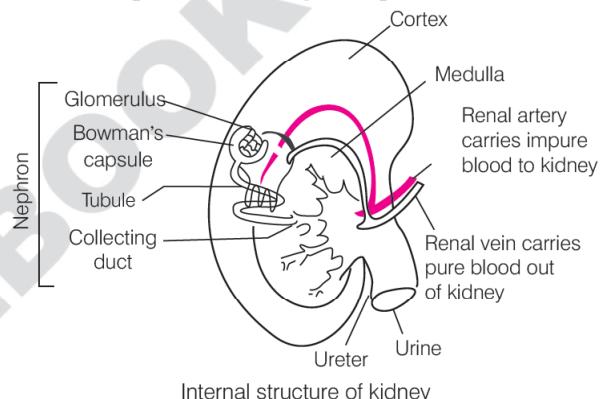
The main organs involved in the human excretory system are a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.



2. Kidney : Structure and Functions

- Kidneys are situated in the abdomen, one on the either side of the backbone.
- Left kidney is placed a little higher than the right one due to the positioning of the liver.
- They are reddish brown and bean shaped.
- Kidneys remove excess of water from the body with nitrogenous wastes from blood as urine.

- They maintain constant concentration of blood plasma and regulate pH of blood.



3. Structure of Nephron

- Nephrons are structural and functional units of kidney.
- Nephron has a cup-like capsule called **Bowman's capsule**, at its upper end and the lower end is tube-like and called **tubule**.
- Bowman's capsule and tubule together form a nephron.
- Blood flows into tubules by blood capillaries called **glomerulus**. It is surrounded by Bowman's capsule.
- A long convoluted tubular structure follows the Bowman's capsule and finally leads to collecting duct which collects the filtered urine.
- Each kidney has thousand of tiny tubules called **nephron**, i.e. filtration unit which are closely packed together.

4. Formation and Removal of Urine

- The urine is formed to filter out waste products from the blood.



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Waste products	Removed from
(i) CO ₂	Blood in the lungs
(ii) Nitrogenous waste (urea or uric acid).	Blood in the kidney

- The blood passes through the tubular part of nephron (where important or useful substances such as glucose, amino acids, fats and a major amount of water are selectively reabsorbed by the tubular part) of the nephron.
- The collecting duct finally gathers all the materials that have not returned to the blood through the tubular membranes.
- The urine formed in each kidney then enters a long tube, the **ureter** (which connects the kidneys with the urinary bladder).
- Urine is stored in the **urinary bladder** for sometime before eliminating through urethra (an opening by which urine passes out).
- Pressure of the expanded bladder leads to the urge to pass it out through the urethra.
- As the bladder is muscular, it is under the control of nervous system hence, we can usually control the urge to urinate.

5. Haemodialysis

- Artificial kidney is a device used to remove nitrogenous waste from blood through dialysis.
- It is different from natural kidney as the process of reabsorption does not occur in artificial kidney.

6. Excretion in Plants

- Plants give off gaseous wastes like carbon dioxide and oxygen through stomata and lenticels during **respiration** and **photosynthesis**.
- Plants also get rid of excess of water by the process of **transpiration** and can also store waste substances in old xylem such as resins and gums.
- Some plants store waste substances in the **cell vacuoles** and get rid of them by dropping their leaves, e.g. deciduous plants. While, other plants also excrete some solid waste substances into the soil around them.
- However, some plants like oak, store their excretory products as tannins, essential oils, gums, etc.

Objective Questions

Multiple Choice Questions

- 01.** Which of the following organisms are ammonotelic?
- (a) Birds (b) Humans
 (c) Reptiles (d) Aquatic animals
- 02.** The right kidney is placed a little higher than the left kidney to adjust in the abdominal cavity.
- (a) True (b) False
 (c) Can't say (d) Partially True/False
- 03.** An adult human on an average produces
- (a) 1-2 L of urine per day (NCERT Exemplar)
 (b) 1-5 L of urine per day
 (c) 2-5 L of urine per day
 (d) 4-5 L of urine per day

- 04.** Choose the correct path of urine in our body. (NCERT Exemplar)

- (a) Kidney → Ureter → Urethra → Urinary bladder
 (b) Kidney → Urinary bladder → Urethra → Ureter
 (c) Kidney → Ureter → Urinary bladder → Urethra
 (d) Urinary bladder → Kidney → Ureter → Urethra

- 05.** The dialyser works as kidney except does not perform

- (a) osmoregulation
 (b) tubular secretion
 (c) selective reabsorption
 (d) ultrafiltration



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- 06.** Match the following columns and select the most appropriate options from the codes given below.

Column I	Column II
A. Nephridia	1. Glomerulus
B. Bowman's capsule	2. Kidney
C. Osmoregulation	3. Dialysis
D. Kidney failure	4. Pale yellow
E. Urine	5. Earthworm

Codes

A	B	C	D	E
(a) 5	1	2	3	4
(b) 1	2	5	4	3
(c) 2	4	3	1	5
(d) 5	2	4	3	1

- 07.** Match the Column I with Column II and select the most appropriate option from the codes given below.

Column I	Column II
A. Kidneys	1. Urea
B. Renal vein	2. No nitrogenous wastes
C. Liver	3. Aquatic animals
D. Dialysing fluid	4. Impure blood
E. Ammonia	5. Birds and humans

Codes

A	B	C	D	E
(a) 5	4	1	2	3
(b) 5	2	4	1	3
(c) 1	4	3	2	5
(d) 2	4	1	3	5

- 08.** Dialysing unit (artificial kidney) contains a fluid which is almost same as plasma except that it has
 (a) high glucose (b) high urea
 (c) no urea (d) high uric acid

- 09.** Plants release gaseous waste like CO_2 at time and others like through stomata and lenticels.
 (a) day, O_2 (b) day, CO_2
 (c) night, O_2 (d) night, CO_2

- 10.** The liquid waste product of plants formed due to oxidation of various essential oil is

(a) gums	(b) latex
(c) resins	(d) tannins

- 11.** The major gaseous excretory product of plants is

(a) carbon dioxide	(b) oxygen
(c) alkaloids	(d) gums

- 12.** Excretory product of oak is used in leather treatment.

(a) True	(b) False
(c) Can't say	(d) Partially True/False

- 13.** Match Column I with Column II and choose the right answer from the codes options given below.

Column I	Column II
A. Initial filtrate	1. Respiration
B. Carbon dioxide	2. 180 L
C. Urine	3. Tannin
d. Latex	4. Rubber
E. Oak	5. 1-2 L per day

Codes

A	B	C	D	E
(a) 2	1	5	4	3
(b) 2	1	4	5	3
(c) 2	3	1	4	5
(d) 2	1	3	5	4

Assertion-Reasoning MCQs

- Direction** (Q.Nos. 14-18) For the following question numbers two statements are given one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these question from the codes (a), (b), (c) and (d) as given below

- (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 the A
 (c) A is true, but R is false
 (d) A is false, but R is true



14. Assertion Excretion is the biological process by which harmful wastes are removed from an organism's body.

Reason The mode of excretion is completely same in both unicellular and multicellular organisms.

15. Assertion Glomerular filtration requires expenditure of energy by Kidney.

Reason It occurs due to pressure difference in glomerular capillaries and Bowman's capsule.

16. Assertion Artificial kidney is a device used to remove nitrogenous waste products from the blood through dialysis.

Reason Reabsorption does not occur in artificial kidney.

17. Assertion Plants excrete various waste products during their life processes.

Reason They produce urea just like humans.

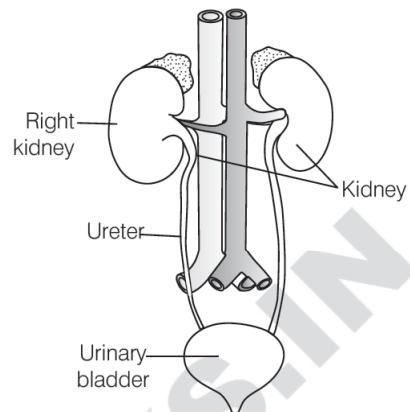
18. Assertion Excretion is a biological process.

Reason Gaseous products in plants are excreted *via* lenticels in stem.

Case Based MCQs

19. Read the following and answer questions from (i) to (v).

The excretory system is a passive biological system that removes excess, unnecessary materials from the body fluids of an organism, so as to help maintain internal chemical homeostasis and prevent damage to the body.



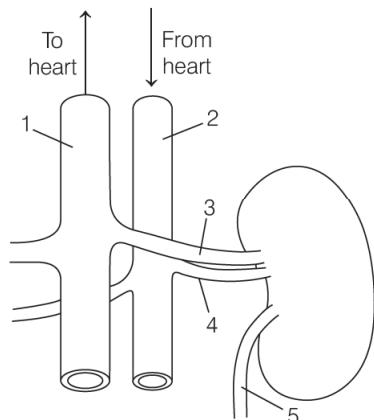
(i) Which among the following is the storage organ for urine?

- (a) Urter
- (b) Kidney
- (c) Urinary bladder
- (d) Urethra

(ii) The main function of ureter is

- (a) contain urine till it is released out
- (b) carry urine from kidney to urinary bladder
- (c) guard the urethra
- (d) passage through which urine is excreted out of the body

(iii) The diagram shows a kidney and its associated vessels.



Which structure have the most and least urea concentration?

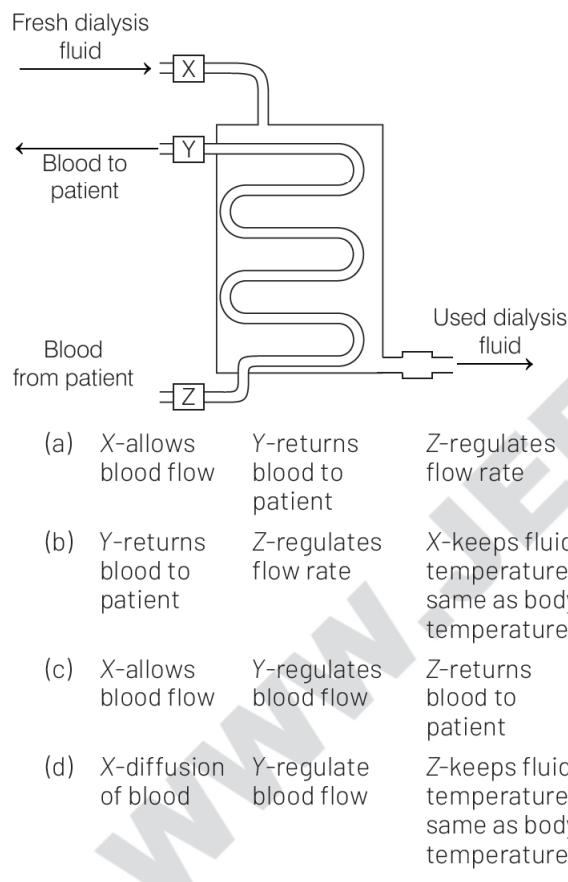
	Most	Least
--	------	-------

- | | | |
|-----|---|---|
| (a) | 1 | 2 |
| (b) | 4 | 1 |
| (c) | 4 | 3 |
| (d) | 5 | 3 |



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- (iv) If Henle's loop were absent from mammalian nephron, which one of the following to be expected?
- There will be no urine formation
 - There will be hardly any change in the quality and quantity of urine formed
 - The urine will be more concentrated
 - The urine will be more dilute
- (v) Identify *X*, *Y*, *Z* and match with their respective functions..



20. Read the following and answer questions from (i) to (v).

The organs of our excretory system help in releasing waste from our body. If these wastes are not removed, we may fall sick. Hence, wastes built up from cell activities and digestion need to be removed. The excretory system of humans consists of a pair of kidneys, pair of ureter, a urinary bladder and urethra.

Kidneys are located in abdomen, one on other side of the backbone. Urine produced in kidneys passes through the ureter into the urinary bladder where it gets stored for sometime and then is released through urethra.

Each kidney is made up of one million nephrons and each nephron consists of a cup-shaped upper end called Bowman's capsule containing a bunch of capillaries called glomerulus.

The Bowman's capsule leads to proximal convoluted tubule, loop of Henle and distal convoluted tubule which joins the collecting duct.

- (i) Which among the following is the least toxic form of excretory product?
- Urea
 - Uric acid
 - Ammonia
 - CO_2

- (ii) An outline of principal events of urination is given below in a random manner.

I. Stretch receptors on the wall of the urinary bladder send signals to CNS.

II. Bladder fills with urine and become distended.

III. Micturition

IV. CNS passes on motor messages to initiate contraction of smooth muscle of bladder and simultaneous relaxation of urethral sphincter.

The correct sequence of events is

- $\text{I} \rightarrow \text{II} \rightarrow \text{III} \rightarrow \text{IV}$
- $\text{IV} \rightarrow \text{III} \rightarrow \text{II} \rightarrow \text{I}$
- $\text{II} \rightarrow \text{I} \rightarrow \text{IV} \rightarrow \text{III}$
- $\text{III} \rightarrow \text{II} \rightarrow \text{I} \rightarrow \text{IV}$

- (iii) A person with no/less food and beverage intake, will have in urine.

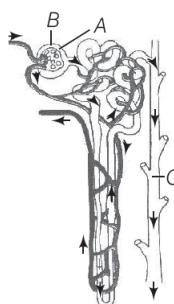
- little glucose
- less urea
- excess urea
- little fat

- (iv) Glomerular filtrate is first collected by

- distal convoluted tubule
- proximal convoluted tubule
- Bowman's capsule
- Loop of Henle



- (v) The figure given alongside figure represents a single nephron from a mammalian kidney. Identify the labelled parts by selecting the most appropriate option.



	A	B	C
(a)	Bowman's capsule	Glomerulus	Collecting duct
(b)	Renal artery	Collecting duct	Bowman's capsule
(c)	Collecting duct	Glomerulus	Bomwan's capsule
(d)	Glomerulus	Bomwan's capsule	Collecting duct

ANSWERS

Multiple Choice Questions

1. (d) 2. (b) 3. (a) 4. (c) 5. (c) 6. (a) 7. (a) 8. (c) 9. (c) 10. (c)
11. (b) 12. (a) 13. (a)

Assertion-Reasoning MCQs

14. (c) 15. (d) 16. (b) 17. (c) 18. (b)

Case Based MCQs

19. (i)-(c), (ii)-(b), (iii)-(d), (iv)-(d), (v)-(b)

20. (i)-(b), (ii)-(c), (iii)-(b), (iv)-(c), (v)-(d)

EXPLANATIONS

1. Aquatic animals are ammonotelic. They secrete waste in the form of ammonia.
2. False; The left kidney is placed a little higher than the right kidney to adjust in the abdominal cavity.
3. An adult human on an average produces 1-2 L of urine in 24 hours. This volume depends of intake of fluids, physical activities, etc.
4. The correct path of urine in our body is Kidney→Ureter→Urinary bladder→Urethra.
5. The dialyser functions as kidney but does not perform selective reabsorption.
6. The correct matches are as follows
Nephridia are responsible for removal of waste from the body of an earthworm.
Renal corpuscle constitutes Bowman's capsule and glomerulus.
Osmoregulation is the process wherein osmotic pressure of a mammal is regulated *via* filtration and purification with the help of kidneys.
Dialysis is the procedure followed to remove excess fluid and waste from body when kidneys do not work properly.
Urine is pale yellow in colour.

7. The correct matches are as follows
Kidneys are present in birds and humans. Renal vein carries impure (deoxygenated) blood.
Urea is produced in liver.
Dialysing fluid does not contain nitrogenous waste.
Aquatic animals are ammonotelic, i.e. secrete ammonia as waste product.
8. The dialysing fluid has the same composition as that of blood plasma except that it is devoid of nitrogenous waste such as urea.
9. Plants release gaseous wastes like carbon dioxide at night and oxygen produced during photosynthesis at daytime through stomata and lenticels.
10. The liquid waste product of plants formed due to oxidation of various essential oils is resins. It protects the plants from pathogens.
11. The only major gaseous excretory product of plants is oxygen. Other excretory products of plants include resins, gums, alkaloids, etc.
12. Plants like oak store their excretory products as tannins in their trunks. This is used in the treatment of leather.

- 13.** The correct matches are as follows
 Volume of initial filtrate is 180 L, i.e 180 L of filtrate is given out everyday by kidney.
 CO_2 is exhaled during respiration.
 Around 2L of urine is passed each day.
 Natural rubber is obtained as latex—a milky, white fluid.
 Tannins are excretory products of Oak trees.
- 14.** A is true, but R is false.
 Excretion is the biological process by which harmful metabolic wastes are removed from an organism's body.
 The mode of excretion is completely different in unicellular and multicellular organisms. In unicellular organisms, waste products are diffused into surrounding water through body surface. While, in multicellular organisms, specialised organs perform the function of excretion.
- 15.** A is false, but R is true.
 Glomerular filtration occurs as the pressure of blood flowing in glomerular capillaries is higher than that of filtrate. The process takes advantage of pressure, hence does not require energy expenditure by kidney cells.
- 16.** Both A and R are true, but R is not the correct explanation of A.
 Kidney failure can be managed by artificial kidney. It is a device used to remove nitrogenous waste products from the blood through dialysis.
 Artificial kidney is different from natural kidney as the process of reabsorption does not occur in artificial kidney.
- 17.** A is true, but R is false.
 Like human beings and other organisms, plants also excrete various waste products during their life processes. The waste products include gums, CO_2 , O_2 , resins, rubber, etc.
 Plants do not produce urea.
- 18.** Both A and R are true but R is not the correct explanation of A.
 Excretion is a biological process by which harmful wastes are removed from the body of an organism.
 Plants excrete out gaseous products like CO_2 and water vapour via stomata in leaves and lenticels in stems.

- 19.** (i) The storage organ for urine is urinary bladder. However urine is stored there fore a certain time period i.e. temporarily.
 (ii) The main function of ureter is that it carries urine from kidney to bladder which is the storage organ.
 (iii) Structure 5 (ureter) has high concentration of urea since it carries urine. Structure 3 (renal vein) has least amount of urea.
 (iv) If Henle's loop were absent from mammalian nephron, the counter current mechanism would not have taken place, the urine would not be hypertonic. Thus, will be more diluted.
 (v) X is needed to keep the temperature of dialysis fluid at body temperature, before it enters dialysis machine. Bubble trap Y, must be just before the blood is returned to patient.
 The pump Z helps the blood flow through dialysis and can also regulate flow rate.
- 20.** (i) Uric acid is less toxic than ammonia and urea, hence, only small amount of water is needed for its removal.
 (ii) The correct sequence of events is as follows
 II. Urinary bladder becomes distended post getting filled with urine.
 I. Stretch receptors present on the walls of the bladder send signals to the CNS.
 IV. After receiving the signal, the CNS passes the signal to initiate the contraction of smooth muscles of bladder and a simultaneous relaxation of sphincter.
 III. After the smooth muscles of urinary bladder have contracted, the relaxation of sphincter causes micturition.
 (iii) Urea is a nitrogenous compound that is produced by protein metabolism. Urea is then filtered in kidneys to form urine.
 As the person has low/no food or beverage intake, his protein intake will be zero/less, thus producing less urea.
 (iv) Bowman's capsule first collects Glomerular filtrate.
 (v) A represents Glomerulus that filters the blood.
 B represents Bowman's capsule that carries out ultrafiltration.
 C is collecting duct that collects urine from nephron.

05

Light : Reflection and Refraction

Quick Revision

Light is a form of energy which enables us to see a variety of objects in the world around us. An object reflects the light rays that fall on it. These reflected light rays, when received by our eyes, make the object visible to us.

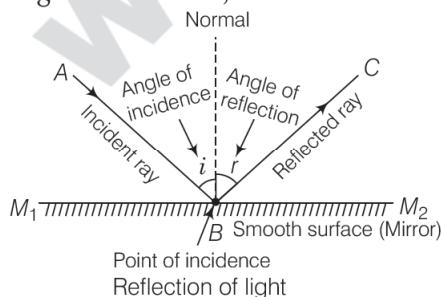
1. Reflection of Light

The phenomenon of bouncing back of light rays in the same medium on striking a smooth surface, is called reflection of light.

2. Laws of Reflection

There are two laws of reflection

- The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.
- Angle of incidence is always equal to the angle of reflection, i.e. $\angle i = \angle r$.



A ray of light which is incident normally on a mirror is reflected back along its own path.

3. Image

If light rays coming from a point after reflection meet at another point or appear to meet at another point, then second point is called the image of first point.

There are two types of image, i.e.

- Real image** If the light rays coming from a point actually, meet after reflection, then the image formed is called a real image.
- Virtual image** If the light rays coming from a point, after reflection does not actually meet, but appear to meet at a point when produced backwards then the image formed is called a virtual image.

4. Mirror

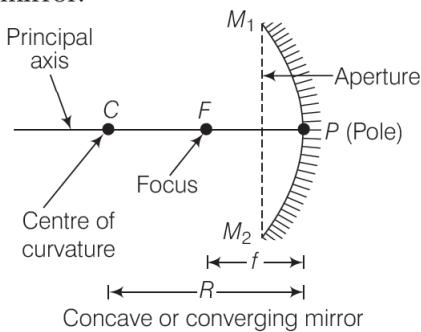
Mirror is a polished surface like glass, having a silvery shining coating on one side which reflects almost all the light incident on it.

Mainly, there are two types of mirror

- Plane mirror** If the reflecting surface of mirror is a plane, then the mirror is called a plane mirror.
- Spherical mirror** If the reflecting surface of the mirror is curved inwards or outwards, then the mirror is called a spherical mirror.

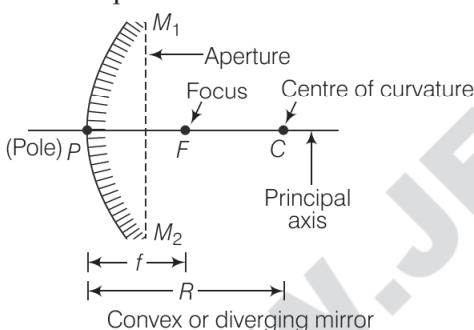
There are two types of spherical mirror

- (i) **Concave mirror** A spherical mirror whose reflecting surface is towards the centre of the sphere is called concave mirror.



where, f = focal length, R = radius of curvature.

- (ii) **Convex mirror** A spherical mirror whose reflecting surface is away from the centre of the sphere is called convex mirror.

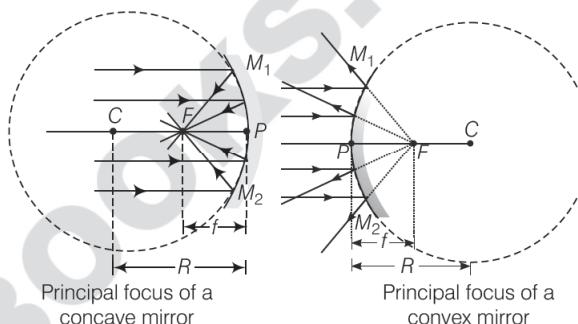


5. Some Definitions Related to Spherical Mirror

- (i) **Pole** The mid-point of reflecting surface of the spherical mirror is called pole.
- (ii) **Centre of curvature** It is the centre of the imaginary sphere of which, mirror is a part. In case of concave mirror, the centre of curvature lies in front of it, while in case of convex mirror, the centre of curvature lies behind it. It is marked by C .
- (iii) **Radius of curvature** The distance between pole and centre of curvature is called radius of curvature. It is denoted by R in the above figures.
- (iv) **Principal axis** The principal axis of a spherical mirror is the line joining the pole and centre of curvature. In the figure, PC is the principal axis.

- (v) **Aperture** The diameter of the reflecting surface of a spherical mirror is called its aperture. M_1M_2 is the aperture of the mirror.

- (vi) **Principal focus of a spherical mirror** It is a point on the principal axis of the mirror at which the light rays coming parallel to principal axis, after reflection actually meet (or appear to be coming from). It is represented by F . For a concave mirror, the focus is in front of the mirror, while for a convex mirror, the focus is behind the mirror.



The focus of a concave mirror is real, while the focus of a convex mirror is virtual.

- (vii) **Focal length** The distance between pole and principal focus of a spherical mirror is called its focal length. It is represented by f .

If the aperture of the mirror is small, then

$$f = \frac{R}{2}$$

The focal length of a plane mirror is infinite.

- (viii) **Focal plane** The plane passing through focus and perpendicular to the principal axis is called focal plane.

6. Reflection by Spherical Mirrors

- The rays coming parallel to the principal axis pass through the focus after reflection or appear to come from focus.
- The rays coming through the focus of mirror or coming towards focus, becomes parallel to principal axis after reflection.
- The light ray coming through centre of curvature or towards centre of curvature, reflects on the same path.
- A ray incident obliquely to principal axis, towards a point P on the concave or convex mirror is reflected obliquely, following the laws of reflection.



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Image Formation by Concave Mirror

Position of Object	Position of Image	Nature and Size of Image
At infinity	At focus or in the focal plane	Real, inverted, extremely diminished in size
Beyond the centre of curvature but at finite distance from mirror	Between focus and the centre of curvature	Real, inverted and diminished
At the centre of curvature	At the centre of curvature	Real, inverted and same size as that of object
Between focus and centre of curvature	Beyond the centre of curvature	Real, inverted and magnified
At the focus	At infinity	Real, inverted and extremely magnified
Between the pole and focus	Behind the mirror	Virtual, erect and magnified

Image Formation by Convex Mirror

Position of Object	Position of Image	Nature and Size of Image
At infinity	At the principal focus, behind the mirror	Virtual, erect and extremely diminished
Between infinity and the pole (i.e. at finite distance)	Between the principal focus and the pole, behind the mirror	Virtual, erect and diminished

7. Sign Conventions for Reflection by Spherical Mirrors

- For concave mirror f, u and v are always negative (-).
- If image is formed behind concave mirror, then v is taken positive (+) and if image is formed in front of the mirror, then v is taken negative (-).
- For convex mirror f and R are positive (+) and u is negative (-). In convex mirror, images formed behind the mirror, then v is taken as positive (+).
- Distances measured perpendicularly above the principal axis (along Y -axis) are taken as positive and distances below the principal axis (along Y -axis) are taken as negative.

8. Mirror Formula

- In a spherical mirror, the distance of object (u), distance of image (v) and focal length (f) are related as by the formula
- The mirror formula is expressed as

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

where, u = object distance from mirror,
 v = image distance from mirror
and f = focal length of the mirror.

9. Magnification by Spherical Mirror

It is expressed as the ratio of height of image to the height of object.

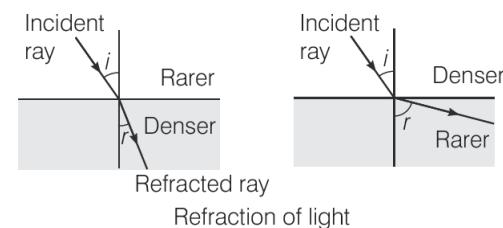
$$\text{Magnification, } m = \frac{h_i}{h_o}$$

$$\text{or } m = -\frac{v}{u}$$

10. Refraction of Light

- Change in path of a light ray as it passes from one transparent medium to another medium is called refraction of light.
- When light travels from a rarer medium to a denser one, it bends towards the normal ($i > r$) and when travels from a denser medium to a rarer one, it bends away from the normal ($i < r$).

where, i = angle of incidence, r = angle of refraction.



- (i) **Cause of refraction** Speed of light is different in different media, i.e. more in rarer medium and comparatively less in denser medium. So, when light enters a denser medium, its speed reduces and it bends towards the normal and when it enters a rarer medium, its speed increases and it bends away from the normal.

(ii) **Laws of refraction** Refraction of light occurs according to the following laws

- The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
- The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, i.e. $\frac{\sin i}{\sin r} = (\mu \text{ or } n) \text{ constant}$

It is also known as **Snell's law** and that constant is called refractive index (μ).

- Refractive index of any medium 2 with respect to other medium 1 is written as

$${}_{1\mu_2} = \frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r}$$

where, i = incident angle in medium 1
and r = refracted angle in medium 2.

(iii) **Refractive index** If c is the speed of light in air and v is the speed of light in medium, then the refractive index of the medium is

$$\begin{aligned}\mu &= \frac{\text{Speed of light in vacuum/air}}{\text{Speed of light in medium}} \\ &= \frac{c}{v}\end{aligned}$$

(iv) **Absolute refractive index** The refractive index of a medium with respect to vacuum is called absolute refractive index of the medium. The absolute refractive index of a medium is simply called its refractive index.

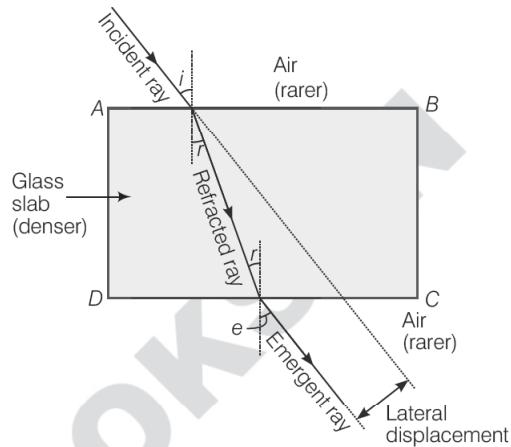
For glass-water pair,

$${}_w\mu_g = \frac{{}^a\mu_g}{{}^a\mu_w}$$

11. Refraction through a Rectangular Glass Slab

- When a light ray enters into a glass slab, then the emergent ray is parallel to the incident ray but it is shifted sideward slightly.
- This perpendicular distance between the emergent ray and incident ray when the light passes out of a glass slab is called **lateral displacement**.

- In this case, refraction takes place twice, first when ray enters glass slab from air and second when exists from glass slab to air.



Refraction through a glass slab

where, i = angle of incidence,

r = angle of refraction

and e = angle of emergence.

Angle of incidence = Angle of emergence, i.e. $\angle i = \angle e$.

If the incident ray falls normally to the surface of glass slab, then there is no bending of the ray of light, it goes straight without any deviation.

12. Lens

It is a transparent medium bounded by two surfaces, atleast one of which is curved.

Lens are of two types

- Convex or convergent lens** A lens which is thicker at the centre and thinner at its end is called convex lens. Convex lenses are of three types (as shown)



(a) Double convex lens



(b) Plano-convex lens



(c) Concavo-convex lens

A convex lens is also known as **converging lens** because it converges a parallel beam of light rays passing through it.



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- (ii) **Concave or diverging lens** A lens which is thinner at the centre and thicker at its ends is called concave lens. Concave lenses are of three types (as shown)



(a) Double concave lens



(b) Plano-concave lens



(c) Convexo-concave lens

A concave lens is also known as **diverging lens** because it diverges a parallel beam of light rays passing through it.

13. Some Definitions Related to Lens

- (i) **Optical centre** The centre point of a lens is known as its optical centre. It is represented by O .
- (ii) **Centre of curvature** The centres of the two imaginary spheres of which the lens is a part are called centres of curvature of the lens. It is represented by C .
- (iii) **Radii of curvature** The radii of the two imaginary spheres of which the lens is a part are called radii of the curvature of lens.
- (iv) **Focal plane** The plane passing through the focus and perpendicular to the principal axis is called focal plane.
- (v) **Principal focus** Lens has two principal foci
 - **First principal focus** It is a point on the principal axis of lens, from where the directed rays become parallel to principal axis after refraction.
 - **Second principal focus** It is the point on the principal axis at which the rays coming parallel to the principal axis, converge on the other side of lens (convex) or appear to meet on the same side of lens (concave), after refraction from the lens.
- (vi) **Focal length** The distance between focus and optical centre of lens is called focal length of lens.
- (vii) **Aperture** The effective diameter of the circular outline of a spherical lens is called its aperture.

14. Refraction through a Lens

Rays which are parallel to the principal axis, after refraction will pass through principal focus in case of convex lens and will appear to be coming from principal focus in case of concave lens.

Ray passing through or directed to the focus will emerge parallel to the principal axis.

Ray directed to optical centre will emerge out undeviated.

Image Formation by a Convex Lens

Position of Object	Position of Image	Nature and Size of Image
At infinity	At F_2	Real, inverted and extremely diminished
Beyond $2F_1$ (at finite distance)	Between F_2 and $2F_2$	Real, inverted and diminished
At $2F_1$	At $2F_2$	Real, inverted and of same size as that of object
Between F_1 and $2F_1$	Beyond $2F_2$	Real, inverted and magnified
At F_1	At infinity	Real, inverted and highly magnified
Between lens and F_1	On same side of the lens as the object	Virtual, erect and magnified

Image Formation by a Concave Lens

Position of Object	Position of Image	Nature and Size of Image
At infinity	At focus on same side of lens as object	Virtual, erect and highly diminished
Any where between optic centre and infinity	Between focus and optical centre, on the same side of lens as object	Virtual, erect and diminished

15. Sign Convention for Spherical Lenses

- Sign convention for lenses is same as that for mirrors.
- Focal length of convex lens is positive, whereas focal length of concave lens is negative.

16. Lens Formula

- The relation between object distance (u), image distance (v) and focal length (f) is known as lens formula.
- The lens formula is expressed as $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$
- All distances in lens are measured from optical centre.

17. Linear Magnification

- The ratio of height of image to height of object is called linear magnification.
- Linear magnification, $m = \frac{i}{o}$ or $m = \frac{v}{u}$

- Linear magnification is positive, when image formed is **virtual** and linear magnification is negative, when image formed is **real**.

18. Power of a Lens

The ability of a lens to converge or diverge light rays is called power (P) of the lens. It is defined as the reciprocal of focal length,

$$\text{i.e. } P \text{ [in Dioptrre (D)]} = \frac{1}{f(\text{in m})} = \frac{100}{f(\text{in cm})}$$

For combination of lenses,

$$P = P_1 + P_2 + P_3 + \dots$$

Objective Questions

Multiple Choice Questions

01. Which of the following is not correct?

- (a) Light is an electromagnetic wave.
- (b) Light travels in a straight line.
- (c) Light is a transverse wave.
- (d) Light is a longitudinal wave.

02. In which of the following media, velocity of the light will be maximum?

- (a) Air
- (b) Water
- (c) Glass
- (d) Vacuum

03. The laws of reflection hold good for

- (a) plane mirror only *(NCERT Exemplar)*
- (b) concave mirror only
- (c) convex mirror only
- (d) all mirrors irrespective of their shape

04. Image formed by a mirror is always straight whatever will be the distance, then mirror is

- (a) only plane
- (b) only concave
- (c) only convex
- (d) either plane or convex

05. Focal length of a plane mirror is

- (a) zero
- (b) infinite
- (c) 25 cm
- (d) -25 cm

06. An object is placed at a distance of 10 cm in front of a plane mirror, then the distance of image from mirror will be

- (a) 5 cm
- (b) 10 cm
- (c) 20 cm
- (d) 0

07. The relation between focal length f and radius of curvature R for a spherical mirror is

- (a) $f = 2R$
- (b) $f = \frac{R}{2}$
- (c) $f = \frac{R}{4}$
- (d) $f = \frac{2}{R}$

08. For a convex mirror, parallel rays of light appear to diverge from a point called the

- (a) radius of curvature
- (b) pole
- (c) aperture
- (d) principal focus

09. The radius of curvature of concave mirror is 12 cm. Then, the focal length will be

- (a) 12 cm
- (b) 6 cm
- (c) -24 cm
- (d) -6 cm

10. The focal length of a spherical mirror is 10 cm. Hence, its radius of curvature will be 5 cm.

- (a) True
- (b) False
- (c) Can't say
- (d) Partially true/false

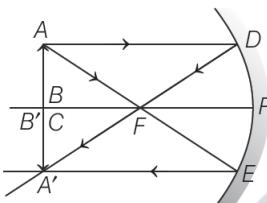
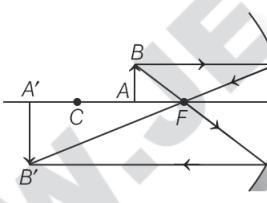
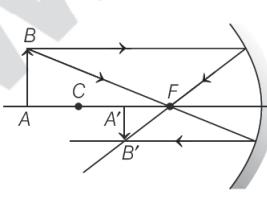
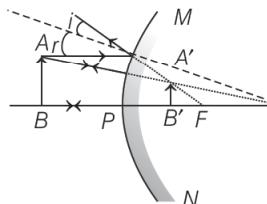


- 11.** Whose sight area is the highest?
 (a) Plane mirror (b) Convex mirror
 (c) Concave mirror (d) Concave lens
- 12.** The image of an object is real, inverted and smaller in size, if it is placed before a mirror which is
 (a) convex (b) concave
 (c) plane (d) None of the above
- 13.** What will be the position and nature of the image of an object formed by a convex mirror placed between infinity and pole (*P*) of the mirror ?
 (a) In between pole (*P*) and focus (*f*) behind mirror, virtual and erect
 (b) In between pole (*P*) and focus (*f*) behind mirror, virtual and inverted
 (c) In front of mirror, real and erect
 (d) In front of mirror, virtual and erect
- 14.** A full length image of a distant tall building can definitely be seen by using
 (a) a concave mirror
 (b) a convex mirror
 (c) a plane mirror
 (d) both concave as well as plane mirror
- 15.** Nature of a mirror having a focal length +10 cm is converging in nature.
 (a) True (b) False
 (c) Can't say (d) Partially true/false
- 16.** Where an object should be placed in front of the concave mirror, so that its image be erect and larger in size ?
 (a) At the centre of curvature (*C*) of the mirror
 (b) At the focus point (*f*) of the mirror
 (c) In between the centre of curvature (*C*) and the focus point (*f*) of the mirror
 (d) In between the pole (*P*) and the focus point (*f*) of the mirror
- 17.** When an object is kept within the focus of a concave mirror, an enlarged image is formed behind the mirror. This image is (*CBSE 2020*)
 (a) real (b) inverted
 (c) virtual and inverted (d) virtual and erect
- 18.** 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)
- 19.** What will be the position and nature of the image of an object formed by a concave mirror placed between focus (*f*) and pole (*P*) of the mirror ?
 (a) In between pole (*P*) and focus (*f*) in front of mirror, virtual and erect
 (b) In between pole (*P*) and focus (*f*) in front of mirror, virtual and inverted
 (c) Behind the mirror, real and erect
 (d) Behind the mirror, virtual and erect
- 20.** 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? (*NCERT Exemplar*)
 (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
- 21.** To determine the focal length of a concave mirror by forming image of a distant object, the screen should be placed
 (a) in any direction
 (b) inclined at angle of 45°
 (c) at right angle to the plane of mirror
 (d) parallel to the plane of mirror
- 22.** A girl is standing in front of a magic mirror. She finds the image of her head bigger, the middle portion of her body of the same size and that of the legs smaller.

The following is the order of combinations for the magic mirror from the top. *(NCERT Exemplar)*

- (a) Plane, convex and concave
- (b) Convex, concave and plane
- (c) Concave, plane and convex
- (d) Convex, plane and concave

23. Match Column I with Column II and choose the most appropriate option from the codes given below.

Column I (Nature and size of image)	Column II (Ray diagram)
(A) Virtual, erect and diminished	(i) 
(B) Real, inverted and same size as that of object	(ii) 
(C) Real, inverted and enlarged	(iii) 
(D) Real, inverted and diminished	(iv) 

Codes

- | | | | |
|---|---|---|---|
| A | B | C | D |
|---|---|---|---|
- (a) (i) (ii) (iii) (iv)
 - (c) (iv) (iii) (ii) (i)

- | | | | |
|---|---|---|---|
| A | B | C | D |
|---|---|---|---|
- (b) (iv) (i) (ii) (iii)
 - (d) (i) (iii) (iv) (ii)

24. An object is placed 20 cm from the concave mirror of focal length 10 cm, then image is formed

- (a) behind the mirror
- (b) between the mirror and focus
- (c) at focus
- (d) centre of curvature of mirror

25. A concave mirror produces three times magnified real image of an object placed at 10 cm in front of it. The image is located at

- (a) 30 cm
- (b) 40 cm
- (c) 10 cm
- (d) 90 cm

26. A 10 mm long awl pin is placed vertically in front of a concave mirror. A 5 mm long image of the awl pin is formed at 30 cm in front of the mirror. The focal length of this mirror is *(NCERT Exemplar)*

- (a) -30 cm
- (b) -20 cm
- (c) -40 cm
- (d) -60 cm

27. A convex mirror of focal length f produces an image $\frac{1}{n^{th}}$ of the size of the object.

The distance of the object from the mirror is

- (a) $\frac{n+1}{n}f$
- (b) $(n+1)f$
- (c) $(n-1)f$
- (d) $\frac{n-1}{n}f$

28. 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) (a) or (b) depending upon the position of the object

- 29.** Match Column I with Column II and choose the most appropriate option from the codes given below.

Column I (Magnification, m)	Column II (Nature of image)
(A) $m = 1$	(i) Inverted image
(B) $m < 1$	(ii) Diminished image
(C) $m > 0$	(iii) Erect image
(D) $m < 0$	(iv) Size of image = Size of object

Codes

A B C D

(a) (iv) (ii) (iii) (i)

(c) (iv) (iii) (ii) (i)

A B C D

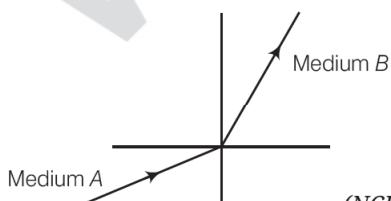
(j) (ij) (iv) (ii) (iii)

d) (i) (ii) (iii) (iv)

- 31.** Velocity of light in air is 3×10^8 m/s. While its velocity in a medium is 1.5×10^8 m/s. Then, refractive index of this medium is

(a) 3 (b) 5
 (c) 0.5 (d) 2

- 32.** 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



(NCERT Exemplar)

- (a) greater than unity (b) less than unity
(c) equal to unity (d) zero

- 33.** No refraction of light occurs if the ray of light hits the boundary of interface of medium at an angle of 90° .

- (a) True
 - (b) False
 - (c) Can't say
 - (d) Partially true/false

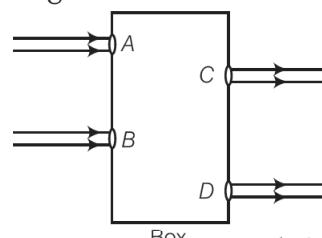
- 34.** Speed of light in vacuum is 3×10^8 m/s. Then, speed of light in glass (refractive index 1.5) will be

- (a) 4.5×10^8 m/s (b) 2.0×10^6 m/s
 (c) 3.0×10^6 m/s (d) 2.0×10^8 m/s

- 35.** Refractive index of glass with respect to air is $\frac{3}{2}$, then refractive index of air with respect to glass will be

- (a) $\frac{1}{3}$
 (b) $\frac{1}{2}$
 (c) $\frac{2}{3}$
 (d) $\frac{3}{4}$

- 36.** Beams of light are incident through the holes *A* and *B* and emerge out of box through the holes *C* and *D* respectively as shown in the figure. Which of the following could be inside the box?



(NCERT Exemplar)

- (a) A rectangular glass slab
 - (b) A convex lens
 - (c) A concave lens
 - (d) A prism

- 37.** If a ray of light passes from denser to rarer medium, the angle of refraction will be lesser than the angle of incidence.

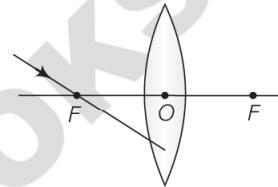
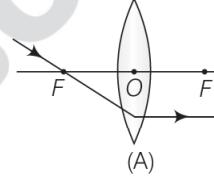
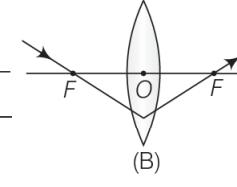
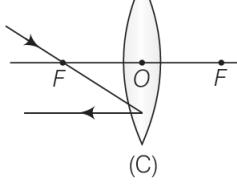
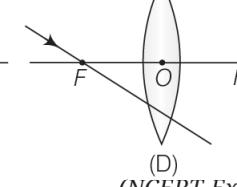
- 38.** Light ray is incident normally on the boundary surface of two media, then angle of refraction will be



- 45.** To make an image real, inverted and larger than the object with a convex lens of focal length f , the object should be placed

 - on the focus of lens
 - on the distance $2f$ of lens
 - between f and $2f$ of lens
 - between $2f$ and infinity

46. Which of the following ray diagrams is correct for the ray of light incident on a lens shown in figure?

(NCERT Exemplar)

47. A spherical mirror and a thin spherical lens each have a focal length of -15 cm . The mirror and lens are likely to be

 - both concave
 - both convex
 - mirror is concave and lens is convex
 - mirror is convex and lens is concave

48. Nature of image formed by a concave lens is always real and erect.

 - True
 - False
 - Can't say
 - Partially true/false



- 49.** A concave lens of focal length forms an image which is n times the size of object. The distance of object from the lens is

(a) $(1-n)f$ (b) $(1+n)f$
(c) $\left(\frac{1+n}{n}\right)f$ (d) $\left(\frac{1-n}{n}\right)f$

- 50.** Consider the following properties of virtual images

- A. cannot be projected on the screen
 - B. are formed by both concave and convex lens
 - C. are always erect
 - D. are always inverted

The correct properties are

- (a) (A) and (D)
 - (b) (A) and (B)
 - (c) (A), (B) and (C)
 - (d) (A), (B) and (D)

- 51.** Magnification produced by lens is always less than 1.

- 52.** The image of an object placed in front of a lens is formed at a distance three times to that of the object, the magnification of the image is

- (a) 1
(c) 3

- 53.** A doctor has prescribed a corrective lens of power + 1.5 D. The nature of lens is

- 54.** Two thin lenses of power 3D and -2D are placed in contact, then power and focal length of the lens combination is

- (a) +2 D, +100 cm
 - (b) +1 D, +100 cm
 - (c) +5 D, +20 cm
 - (d) +1 D, -100 cm

- 55.** Match Column I with Column II and choose the most appropriate option from the codes given below.

Column I (Terms or laws)	Column II (Formula or relation)
A. Lens formula	(i) $\angle i \propto \angle r$
B. Snell's law	(ii) $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$
C. Refractive index	(iii) $\frac{c}{v}$
D. Power of lens	(iv) $\frac{1}{f(\text{in metre})}$

Codes

A B C D

- (a) (i) (iii) (iv) (ii)
 (c) (ii) (i) (iii) (iv)

Assertion-Reasoning MCQs

Direction (Q.Nos. 56-62) For given questions, two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is correct explanation of the A.
 - (b) Both A and R are true but R is not the correct explanation of the A.
 - (c) A is true but R is false.
 - (d) A is false but R is true.

- 56. Assertion** Keeping a point object fixed, if a plane mirror is moved, the image will also move.

Reason In case of a plane mirror, distance of object and its image is equal from any point.

- 57. Assertion** A ray incident along normal to the mirror retraces its path.

Reason In reflection, angle of incidence is always equal to angle of reflection.



58. Assertion When a concave mirror is held under water, its focal length will increase.

Reason The focal length of a concave mirror is independent of the medium in which it is placed.

59. Assertion Higher is the refractive index of a medium or denser the medium, lesser is the velocity of light in that medium.

Reason Refractive index is inversely proportional to velocity.

60. Assertion Property of converging lens does not remain same in all media.

Reason Property of lens whether the ray is diverging or converging is independent of the surrounding medium.

61. Assertion A convex lens is made of two different materials. A point object is placed on the principal axis. The number of images formed by the lens will be two.

Reason The image formed by convex lens is always virtual.

62. Assertion Although the surfaces of a goggles, lenses are curved, it does not have any power.

Reason In case of goggles, both the curved surfaces have equal radii of curvature.

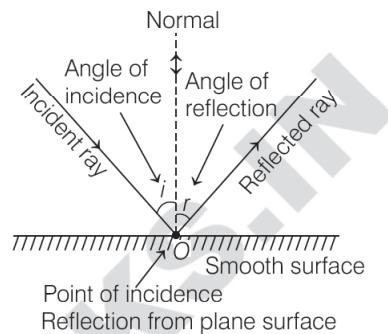
Case Based MCQs

63. Read the following and answer questions from (i) to (v).

Light is a form of energy which induces sensation of vision to our eyes.

It becomes visible when it bounces off on surfaces and hits our eyes.

The phenomenon of bouncing back of light rays in the same medium on striking a smooth surface is called reflection of light.



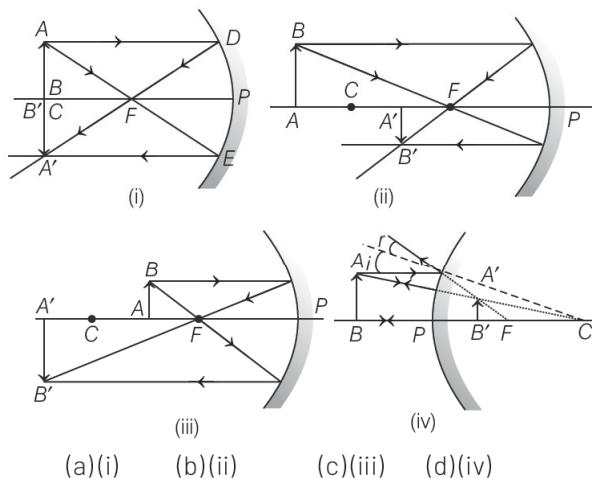
If parallel beam of incident rays remains parallel even after reflection and goes only in one direction is known as regular reflection. It takes place mostly in plane mirrors or highly polished metal surfaces.

The mirror outside the driver side of a vehicle is usually a spherical mirror and printed on such a mirror is usually the warning “vehicles in this mirror are closer than they appear.”

- (i) Which type of mirror is used outside the driver's side of a vehicle?
 - (a) Plane mirror
 - (b) Concave mirror
 - (c) Convex mirror
 - (d) Magic mirror

- (ii) No matter how far you stand from a mirror, your image appears erect. The mirror can be
 - (a) Plane
 - (b) Concave
 - (c) convex
 - (d) Either plane or convex

- (iii) Which of the following diagrams represents the image formation in above case?



- (iv) If an object is placed at 10 cm from a convex mirror of radius of curvature 60 cm, then find the position of image.
- 4 cm
 - 7.5 cm
 - 10 cm
 - 12.5 cm

- (v) The focal length of mirror is 12 cm.
The radius of curvature is
- | | |
|-----------|-----------|
| (a) 12 cm | (b) 24 cm |
| (c) 20 cm | (d) 36 cm |

64. Read the following and answer questions from (i) to (v).

If the reflecting surface of the mirror is curved inwards or outwards, then the mirror is called a spherical mirror.

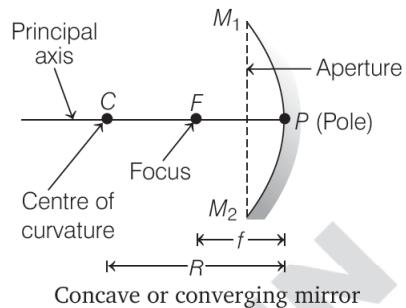
Spherical mirrors are of two types:

(i) Concave (ii) Convex

The spherical mirror with inward curved reflecting surface is called concave mirror.

A beam of light generally converges after reflection from such surfaces, hence it is also called convergent mirror.

e.g. The inner curved surface of a shining spoon can be considered as a concave mirror.

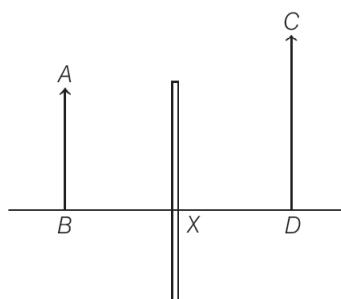


Here, f = focal length and R = radius of curvature.

Two students A and B performed an experiment on finding the image formation by a concave mirror.

They performed the experiment for different positions of object and obtained different positions of image.

- (i) If the object is placed between focus and centre of curvature, the position of image will be
- at focus
 - between focus and pole
 - beyond centre of curvature
 - None of the above
- (ii) The image of a bright object is brought on a screen with the help of a concave mirror. If the upper half of the concave mirror is covered, then
- the size of the image will become half
 - the image will be disappeared
 - the brightness of the image will be reduced
 - the image will change its position
- (iii) CD is an image of an object AB formed by an optical device X . Identify X .



- (a) Concave lens (b) Convex lens
 (c) Concave mirror (d) Convex mirror
- (iv) If the object is placed at a distance of 10 cm in front of the mirror, the image will be formed at a distance of [Take, magnification to be (- 3)]
 (a) 20 cm (b) -20 cm
 (c) 30 cm (d) -30 cm
- (v) For the given data showing the focal lengths of three concave mirrors *A*, *B* and *C*; and the respective distances of different objects from these mirrors.

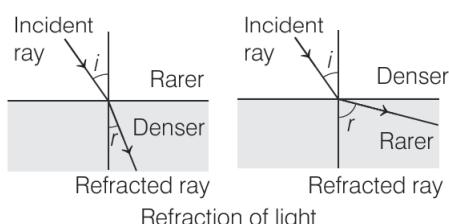
Concave mirrors	Object distance (in cm)	Focal length (in cm)
<i>A</i>	45	20
<i>B</i>	30	15
<i>C</i>	20	30

In the given positions of objects from the mirrors, the mirror(s) which will form diminished image(s) of the object(s) is/are

- (a) Only A
 (b) Only B
 (c) Only C
 (d) Both A and B

65. Read the following and answer questions from (i) to (v).

The refractive index of a medium with respect to vacuum is called absolute refractive index of the medium. It is given by, $\mu = \frac{\sin i}{\sin r}$



Absolute refractive indices of some of the materials *A*, *B*, *C* and *D* are given in the following table :

Medium	Refractive index
<i>A</i>	1.54
<i>B</i>	1.33
<i>C</i>	2.42
<i>D</i>	1.65

- (i) How is absolute refractive index related to speed of light?

- (a) $\mu = \frac{c}{v_m}$ (b) $\mu = cv_m$
 (c) $\mu_c = v_m$ (d) $v\mu = c$

- (ii) In which of the materials given in the above table, light travels fastest?

- (a) *A* (b) *B*
 (c) *C* (d) *D*

- (iii) The speed of light in air is $3 \times 10^8 \text{ ms}^{-1}$ and that in medium *A* is $2.5 \times 10^8 \text{ ms}^{-1}$. The refractive index of *A* will be

- (a) 1.2 (b) 0.5
 (c) 4.5 (d) 1.5

- (iv) When light travels from air to glass,

- (a) angle of incidence > angle of refraction
 (b) angle of incidence < angle of refraction
 (c) angle of incidence = angle of refraction
 (d) Can't say

- (v) The refractive index of *P* with respect to *Q* is 2. Find the refractive index of *Q* with respect to *P*.

- (a) 0.5 (b) 0.2
 (c) 2 (d) 2.5

66. Read the following and answer questions from (i) to (v).

Magnification products like magnifying glass, compound microscope, telescope, etc., are important instruments for the daily activities of many individuals today.

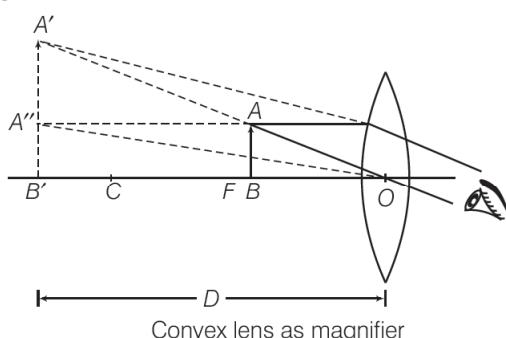
Whether the application is for commercial, professional or personal use, a magnifier enhances one's ability to perform or enjoy a task or hobby. A magnifying glass is a convex lens that is used to produce a magnified image of



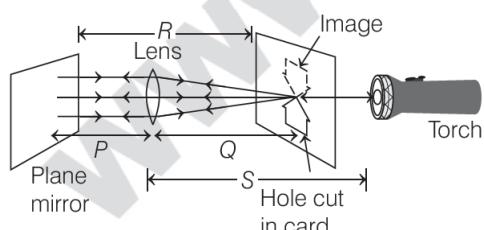
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an object. The magnification of a magnifying glass depends upon whether it is placed between the user's eye and the object being viewed and the total distance between them.

The highest magnifying power is obtained by putting the lens very close to the eye and moving the eye and the lens together to obtain the best focus.



- (i) Which one of the following materials cannot be used to make a lens?
- (a) Water
 - (b) Glass
 - (c) Plastic
 - (d) Clay
- (ii) The following diagram shows an experiment to measure the focal length of a lens. What is the focal length of the following lens?



- (a) P
 - (b) Q
 - (c) R
 - (d) S
- (iii) On what factors, magnification of a magnifying glass depends?
- (a) Position between the user's eye and the object
 - (b) Distance between user's eye and object
 - (c) Both (a) and (b)
 - (d) None of the above

(iv) Which of the following lenses would you prefer to use while reading small letters found in dictionary?

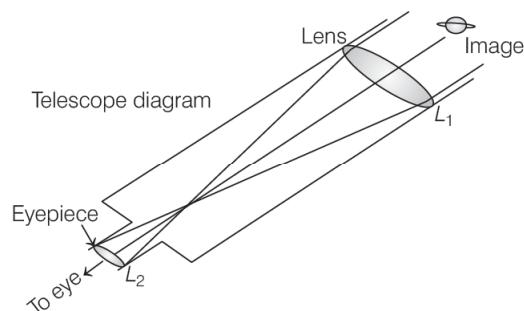
- (a) A convex lens of focal length 50 cm
- (b) A concave lens of focal length 50 cm
- (c) A convex lens of focal length 5 cm
- (d) A concave lens of focal length 5 cm

(v) A convex lens forms an image of magnification -2 of height 6 cm. The height of object is

- (a) 6 cm
- (b) 4 cm
- (c) 3 cm
- (d) 2 cm

67. Read the following and answer questions from (i) to (v).

Sumati wanted to see the stars of the night sky. She knows that she needs a telescope to see those distant stars. She finds out that the telescopes, which are made of lenses, are called refracting telescopes and the ones which are made of mirrors are called reflecting telescopes.



So, she decided to make a refracting telescope. She bought two lenses, L_1 and L_2 , out of which L_1 was bigger and L_2 was smaller.

The larger lens gathers and bends the light, while the smaller lens magnifies the image. Big, thick lenses are more powerful. So to see far away, she needed a big powerful lens.

Unfortunately, she realised that a big lens is very heavy.

Heavy lenses are hard to make and difficult to hold in the right place. Also, since the light is passing through the lens, the surface of the lens has to be extremely smooth. Any flaws in the lens will change the image. It would be like looking through a dirty window.

(CBSE Sample Paper 2021)

- (i) Based on the diagram shown, what kind of lenses would Sumati need to make the telescope?
 - (a) Concave lenses (b) Convex lenses
 - (c) Bi-focal lenses (d) Flat lenses

- (ii) If the powers of the lenses L_1 and L_2 are in the ratio of 4 : 1, what would be the ratio of the focal length of L_1 and L_2 ?
 - (a) 4 : 1 (b) 1 : 4 (c) 2 : 1 (d) 1 : 1

- (iii) What is the formula for magnification obtained with a lens?
 - (a) Ratio of height of image to height of object
 - (b) Double the focal length
 - (c) Inverse of the radius of curvature
 - (d) Inverse of the object distance

(iv) Sumati did some preliminary experiment with the lenses and found out that the magnification of the eyepiece (L_2) is 3. If in her experiment with L_2 she found an image at 24 cm from the lens, at what distance did she put the object?

- (a) 72 cm
- (b) 12 cm
- (c) 8 cm
- (d) 6 cm

- (v) Sumati bought not-so-thick lenses for the telescope and polished them. What advantages, if any, would she have with her choice of lenses?
 - (a) She will not have any advantage as even thicker lenses would give clearer images.
 - (b) Thicker lenses would have made the telescope easier to handle.
 - (c) Not-so-thick lenses would not make the telescope very heavy and also allow considerable amount of light to pass.
 - (d) Not-so-thick lenses will give her more magnification.

ANSWERS

Multiple Choice Questions

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (d) | 2. (d) | 3. (d) | 4. (d) | 5. (b) | 6. (b) | 7. (b) | 8. (d) | 9. (d) | 10. (b) |
| 11. (b) | 12. (b) | 13. (a) | 14. (b) | 15. (b) | 16. (d) | 17. (d) | 18. (c) | 19. (d) | 20. (b) |
| 21. (d) | 22. (c) | 23. (b) | 24. (d) | 25. (a) | 26. (b) | 27. (b) | 28. (a) | 29. (a) | 30. (b) |
| 31. (d) | 32. (a) | 33. (a) | 34. (d) | 35. (c) | 36. (a) | 37. (b) | 38. (a) | 39. (d) | 40. (b) |
| 41. (b) | 42. (b) | 43. (a) | 44. (d) | 45. (c) | 46. (a) | 47. (a) | 48. (d) | 49. (d) | 50. (c) |
| 51. (a) | 52. (c) | 53. (b) | 54. (b) | 55. (c) | | | | | |

Assertion-Reasoning MCQs

56. (a) 57. (a) 58. (d) 59. (a) 60. (c) 61. (c) 62. (a)

Case Based MCQs

63. (i) (c), (ii) (d), (iii) (d), (iv) (b), (v) (b)
 65. (i) (a), (ii) (b), (iii) (a), (iv) (a), (v) (a)
 67. (i) (b), (ii) (b), (iii) (a), (iv) (c), (v) (c)

64. (i) (c), (ii) (c), (iii) (c), (iv) (d), (v) (a)
 66. (i) (d), (ii) (b) (iii) (c) (iv) (c) (v) (c)

EXPLANATIONS

1. Light is an electromagnetic wave because it can travel even in vacuum and it has all other characteristics of EM wave. So, it is a transverse wave. It travels in a straight line and particles vibrate perpendicular to the direction of propagation of wave. Hence, statement (d) is incorrect.
2. Velocity of light is maximum in vacuum, i.e. 3×10^8 m/s.
3. The laws of reflection holds good for light reflected from any smooth surface i.e., all mirrors regardless of their shape.
4. The plane and convex mirrors always form the erect (straight) image.
5. Focal length of a plane mirror is infinite.
6. The distance of image is equal to the distance of object from plane mirror. Therefore, the distance of image from mirror will be 10 cm.
7. The focal length of spherical mirror is half of the radius of curvature, i.e. $f = \frac{R}{2}$.
8. Principal focus of a convex mirror is a point on its principal axis from which a beam of light rays parallel to axis, diverge after being reflected from the mirror.
9. Given, radius of curvature, $R = 12$ cm
We know that, the focal length of concave mirror has negative value.
Hence, focal length, $f = \frac{-R}{2} = \frac{-12}{2} = -6$ cm
10. False;
As, $f = \frac{R}{2}$
Hence, $R = 2f = 2 \times 10 = 20$ cm
11. The sight area of convex mirror is the highest, because it produces diminished images of objects at different positions.
12. If the object is placed between centre of curvature and focus of a concave mirror, real, inverted and diminished image is formed.
13. The image will be formed between pole (P) and focus (f) behind mirror, virtual and erect.
14. The convex mirror forms virtual, erect and diminished image of the objects. So, it can form full length image of a distant tall building.
15. False, the focal length of a convex mirror (diverging) is positive while that of a concave mirror (converging) is negative.
16. The object should be placed between the pole (P) and the focus point (f) of the mirror.
17. When object is placed on the focus or between the focus and pole of a concave mirror, the image will be formed behind the mirror, which is virtual, erect and enlarged.
18. If the light rays coming from a point actually meet or converge at a point after reflection or refraction, then the image formed is called a real image.
19. The image will be formed behind mirror, virtual and erect.
20. The rays from sun i.e., from infinity, are parallel to the principal axis after reflection converge at a point, known as focus. Therefore, focal length (f) of concave mirror is 15 cm. And we know that, same size, real and inverted image is formed by concave mirror when object is placed at $2f$ or centre of curvature. So, object should be placed at $15 \times 2 = 30$ cm.
21. The image formed by a concave mirror is always perpendicular to the principal axis. So, the screen should be placed parallel to the plane of mirror.
22. Concave mirror (of large focal length) can be used to see a larger image of the head, the plane mirror for middle portion to see her body of the same size and convex mirror to see the diminished image of leg. Hence, the combinations for magic mirror from the top is concave mirror, plane mirror and convex mirror.
23. A → (iv); When object is placed between infinity and the pole of convex mirror, image formed is virtual, erect and diminished.
B → (i); When object is at the centre of curvature of concave mirror, image formed is real, inverted and same size as that of object.

C → (ii); When object is between focus and centre of curvature of concave mirror, image formed is real, inverted and enlarged.

D → (iii); When object is at some distance from concave mirror beyond centre of curvature, image formed is real, inverted and diminished.

- 24.** Given, focal length of concave mirror, $f = -10 \text{ cm}$

Distance of object from concave mirror, $u = -20 \text{ cm}$

From the mirror formula,

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f} \Rightarrow \frac{1}{-20} + \frac{1}{v} = \frac{1}{-10}$$

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

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

$$\Rightarrow v = -20 \text{ cm}$$

Hence, the image is formed at the centre of curvature of mirror.

- 25.** Given, $u = -10 \text{ cm}$

We know that, magnification,

$$M = \frac{-v}{u}$$

$$\Rightarrow -3 = \frac{-v}{-10} \Rightarrow v = -30 \text{ cm}$$

So, the image is formed at a distance of 30 cm in front of the mirror.

- 26.** Given, object size, $h = +10.0 \text{ mm} = +1.0 \text{ cm}$
 $(\because 1 \text{ cm} = 10 \text{ mm})$

Image size, $h' = -5.0 \text{ mm} = -0.5 \text{ cm}$
 (for real image)

Image distance, $v = -30 \text{ cm}$ (For real image)
Focal length, $f = ?$

As, magnification, $M = -\frac{h'(\text{image size})}{h(\text{object size})}$

Also, magnification, $M = \frac{-v}{u} \Rightarrow -\frac{h'}{h} = \frac{-v}{u}$

$$\frac{0.5}{1} = \frac{-30}{u} \Rightarrow u = -60 \text{ cm}$$

Using mirror formula, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$$\Rightarrow \frac{1}{f} = \frac{1}{-30} - \frac{1}{60} = \frac{-2-1}{60} = \frac{-3}{60}$$

$$\Rightarrow f = -20 \text{ cm}$$

- 27.** Given, $m = \frac{1}{n} = -\frac{v}{(-u)}$

$$\Rightarrow v = \frac{u}{n}$$

$$\text{From mirror formula, } \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{n}{u} + \frac{1}{u} = \frac{1}{f}$$

$$\text{or } u = (n+1)f$$

- 28.** The convex mirror forms virtual, erect and diminished image of the object. The rear view mirror also forms same type of image. Therefore, magnification (m) produced by a rear view mirror fitted in vehicles is less than one, i.e. $m < 1$.

- 29.** A → (iv); $m = 1$ means $h_i = h_o$.

B → (ii); $m < 1$ means image is reduced or diminished in size.

C → (iii); $m > 0$ means image formed is upright or erect.

D → (i); $m < 0$ means image formed is inverted.

- 30.** Given, angle of incidence, $i = 45^\circ$

Angle of refraction, $r = 30^\circ$

Refractive index of liquid with respect to air,

$$\begin{aligned} {}_a n_l &= \frac{\sin i}{\sin r} \\ &= \frac{\sin 45^\circ}{\sin 30^\circ} = 1.41 \end{aligned}$$

- 31.** Refractive index of medium with respect to air,

$${}_a n_m = \frac{\text{Speed of light in air}}{\text{Speed of light in medium}}$$

$${}_a n_m = \frac{3 \times 10^8}{1.5 \times 10^8} = 2$$

- 32.** Since light ray in the medium B bends towards normal. So it has greater refractive index and lesser velocity of light w.r.t. medium A.

So refractive index of medium B w.r.t. medium A is greater than unity.

- 33.** True;

As $\angle i = 0^\circ$, $\angle r = 0^\circ$.

Hence, no refraction will take place.

$${}_{\text{g}} v = \frac{c}{\mu} = \frac{3 \times 10^8}{1.5} = 2.0 \times 10^8 \text{ m/s}$$



- 35.** We know that refractive index of air with respect to glass,

$$_a n_g = \frac{1}{g n_a} \Rightarrow \frac{3}{2} = \frac{1}{g n_a} \Rightarrow g n_a = \frac{2}{3}$$

- 36.** Here, the emergent rays are parallel to the direction of the incident ray. Therefore, a rectangular glass slab could be inside the box as the extent of bending of light ray at the opposite parallel faces AB (air-glass interface) and CD (glass-air interface) of the rectangular glass slab are equal and opposite. This is why the ray emerges parallel to the incident ray.

- 37.** False;

If a ray of light passes from denser to rarer medium, the refracted ray will bend away from the normal.

Hence, angle of refraction will be more than the angle of incidence.

- 38.** If a ray of light is incident normally on the boundary of separation of two media, then angle of incidence and angle of refraction both are zero.

- 39.** The given material having their refractive index as kerosene is 1.44, water is 1.33, mustard oil is 1.46 and glycerine is 1.74. Thus, glycerine is most optically denser, having the largest refractive index. Therefore, ray of light with bend most in glycerine.

- 40.** False;

$$\text{As, refractive index, } \mu = \frac{c}{v}$$

$$\Rightarrow v \propto \frac{1}{\mu}$$

So, light will travel with slowest speed in glass, being of greatest refractive index.

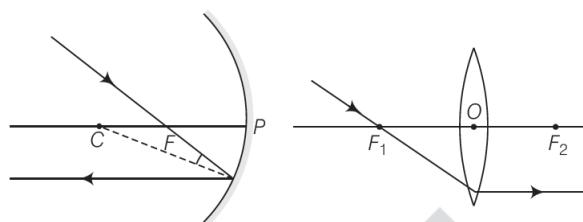
- 41.** \because Angle of incidence, $\angle i = 60^\circ$, hence $\angle e = 60^\circ$, where $\angle e$ = angle of emergence.

- 42.** As we know, $f = \frac{R}{2}$

$$\text{Hence, } f = \frac{20}{2} = 10 \text{ cm}$$

As it is concave lens, so $f = -10 \text{ cm}$

- 43.** A ray passing through the principal focus of a concave mirror or convex lens, after reflection/refraction, will emerge parallel to the principal axis.



- 44.** The incident rays which comes from an object placed at infinity will be parallel and the rays parallel to the principal axis, after reflection/refraction by concave mirror, convex mirror, concave lens and convex lens, will pass or appear to pass through the principal focus. Hence, image will be highly diminished and point sized.

- 45.** The object should be placed between f and $2f$ of the lens.

- 46.** A ray of light passing through the principal focus of a convex lens after refraction will emerge parallel to the principal axis.

- 47.** The focal length is taken negative for both concave mirror and concave lens.

- 48.** Partially true;

The image formed by a concave lens is always virtual, and erect.

- 49.** For concave lens,

$$\begin{aligned} \frac{1}{v} - \frac{1}{u} &= \frac{1}{f} \\ \frac{u}{v} - 1 &= \frac{u}{f} \\ \Rightarrow \left(\frac{1}{n} - 1 \right) &= \frac{u}{f} \quad (\because v = nu) \\ \Rightarrow u &= \left(\frac{1-n}{n} \right) f \end{aligned}$$

- 50.** Virtual images are always erect and can not be projected on the screen. These are formed by both concave and convex lens.

- 51.** Concave; As concave lens always produces diminished image whenever an object is placed anywhere between optical centre (C) and infinity in front of it, hence magnification produced will less than 1.

- 52.** Magnification,

$$m = \frac{v}{u} = \frac{3u}{u} = 3$$

- 53.** Given, power of lens, $P = +1.5 \text{ D}$

$$\text{Focal length of lens, } f = \frac{1 \times 100}{1.5} = 66.7 \text{ cm}$$

Focal length of the lens is positive, hence the given lens is a converging lens.

- 54.** Given, power of lenses, $P_1 = 3\text{D}$ and $P_2 = -2\text{D}$

Power of combination of lenses,

$$P = P_1 + P_2 = 3\text{D} - 2\text{D} = +1\text{D}$$

$$\text{Combined focal length} = \frac{1}{P} \times 100 \text{ cm}$$

$$= \frac{1}{1} \times 100 = 100 \text{ cm}$$

- 55.** A → (ii); The formula of lens is the relation between object distance (u), image distance (v) and focal length (f), and represented as

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

B → (i); According to Snell's law, angle of incidence (i) \propto angle of refraction (r)

C → (iii); Refractive index,

$$(\mu) = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in that medium}} = \frac{c}{v}$$

$$\text{D} \rightarrow (\text{iv}); \text{ Power of lens } (P) = \frac{1}{f(\text{in metre})}$$

- 56.** The image formed in a plane mirror is at the same distance behind the mirror as the object is in front of mirror. So, if the object or mirror is moved, then image will also move.

- 57.** When light ray incident along normal to the mirror, angle of incidence $\angle i = 0^\circ$. According to law of reflection $\angle i = \angle r$, therefore angle of reflection $\angle r = 0^\circ$, i.e. the incident ray retraces its path.

- 58.** Focal length is the property of mirror and is independent of the medium in which it is placed. So, when a concave mirror is placed under water, its focal length remains same.

- 59.** According to Snell's law,

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{c/v_2}{c/v_1} = \frac{v_1}{v_2}$$

$$\Rightarrow n_1 v_1 = n_2 v_2$$

This shows that higher is the refractive index of a medium or denser the medium, lesser is the velocity of light in that medium.

- 60.** Property of a lens depends on the refractive index of surrounding medium.

- 61.** As, the lens is made up of two materials, so it has two refractive indices and two focal lengths. Hence, two images will be formed. The image formed by convex lens is always real except in case when the object is placed between focus and optical centre.

- 62.** In case of goggles, both the curved surfaces have equal radii of curvature. So, the focal length have of lens becomes infinite.

$$\therefore \text{Power, } P = \frac{1}{f} = 0$$

- 63.** (i) Convex mirrors are used as rear view mirrors in vehicles as they give an erect image and have a wider field of view.
(ii) The images formed by a plane mirror and also for convex mirror are always erect, for all positions of object.
(iii) When an object is placed in front of a convex mirror at any distance, the image is formed between the focus and the pole, behind the mirror.
(iv) Given, object distance, $u = -10 \text{ cm}$
Radius of curvature, $R = 60 \text{ cm}$
 \therefore Focal length, $f = R/2 = \frac{60}{2} = 30 \text{ cm}$
 \therefore By mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$
 $\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{30} - \left(-\frac{1}{10}\right) = \frac{4}{30}$
 $\Rightarrow v = 7.5 \text{ cm}$
(v) Given, $f = 12 \text{ cm}$
As, radius of curvature, $R = 2f$
 $\Rightarrow R = 2 \times 12 = 24 \text{ cm}$

- 64.** (i) When object is placed between focus and centre of curvature, the image will be formed beyond centre of curvature.

- (ii) If the upper half of the concave mirror is covered, then the total reflecting surface gets reduced. So, the brightness of the image will be reduced.

- (iii) As the image formed is erect and magnified, so it would be concave mirror.

- (iv) Given, $u = -10 \text{ cm}$, $m = -3$

$$\text{As, we know that, } m = \frac{-v}{u}$$

$$\therefore \text{Image distance, } v = -mu \\ = -(-3)(-10) = -30 \text{ cm}$$

- (v) Using mirror formula, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, we get
 $v_A = -36 \text{ cm}, v_B = -30 \text{ cm}$ and $v_C = 60 \text{ cm}$
 \therefore Magnification ($m = -\frac{v}{u}$) be less than 1 only

in case of A. So, image formed by A is diminished in size.

65. (i) Absolute refractive index (μ)

$$= \frac{\text{Speed of light in vacuum } (c)}{\text{Speed of light in that medium } (v_m)}$$

- (ii) Since, B has the least refractive index, it indicates that B is much optically rarer than all other medium, hence light travels fastest in medium B.

- (iii) Refractive index of A

$$= \frac{\text{Speed of light in air}}{\text{Speed of light in that medium}} \\ = \frac{3 \times 10^8}{2.5 \times 10^8} = 1.2$$

- (iv) Since, for glass refractive index > 1 , i.e.

$$\frac{\sin i}{\sin r} > 1$$

$\Rightarrow \sin i > \sin r$ or $i > r$

- (v) Given, ${}_{Q}\mu_P = 2$

- \therefore Refractive index of Q w.r.t. P is,

$${}_{P}\mu_Q = \frac{1}{{}_{Q}\mu_P} = \frac{1}{2} = 0.5$$

66. (i) Clay can never be transparent, so it can not be used to make lens.

- (ii) According to the diagram, Q is the focal length as it is the distance between focus and optical centre.

- (iii) The magnification of a magnifying glass depends upon whether it is placed between the user's eye and the object being viewed and total distance between them.

- (iv) A convex lens with smaller focal length would act as a better magnifier. So, a

convex lens of focal length 5 cm is used in given case.

- (v) Given, $m = -2, h_2 = -6 \text{ cm}$

$$\therefore \text{Magnification, } m = \frac{h_2}{h_1}$$

$$\Rightarrow -2 = \frac{-6}{h_1} \Rightarrow h_1 = 3 \text{ cm}$$

67. (i) As shown in the given diagram, Sumati would need convex lenses in order to make the telescope.

- (ii) Let f_1 and f_2 be the focal lengths of lenses L_1 and L_2 , respectively.

$$\text{As, power } = \frac{1}{\text{focal length}}$$

Ratio of powers of lenses L_1 and L_2 ,

$$\frac{P_1}{P_2} = \frac{4}{1} \quad (\text{given})$$

$$\Rightarrow \frac{1/f_1}{1/f_2} = \frac{4}{1} \Rightarrow \frac{f_2}{f_1} = \frac{4}{1}$$

$$\Rightarrow \frac{f_1}{f_2} = \frac{1}{4}$$

Hence, ratio of focal lengths of lenses L_1 and $L_2 = 1 : 4$

- (iii) Magnification obtained by a lens is the ratio of height of image (h_i) to the height of object (h_o), i.e.,

$$\text{Magnification, } m = \frac{h_i}{h_o}$$

- (iv) Given, magnification, $m = 3$

Image distance, $v = 24 \text{ cm}$

Object distance, $u = ?$

$$\text{As, } m = \frac{v}{u} \Rightarrow u = \frac{v}{m} = \frac{24 \text{ cm}}{3} = 8 \text{ cm}$$

Hence, she should put the object at 8 cm from the lens L_2 .

- (v) The telescope made by using not-so-thick lenses (i.e., thin lenses) will not be very heavy. Also, it will allow considerable amount of light to pass through it.

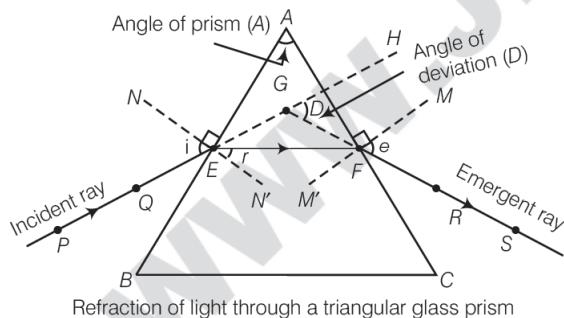
06

Human Eye and The Colourful World

Quick Revision

1. Refraction of Light through a Prism

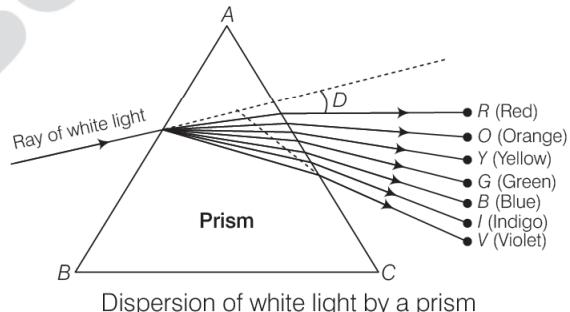
- Prism is a transparent refracting medium bounded by two plane surfaces, inclined to each other at a certain angle. It has one triangular base and three rectangular lateral surfaces.
- The angle between two lateral surfaces is called **angle of prism**.



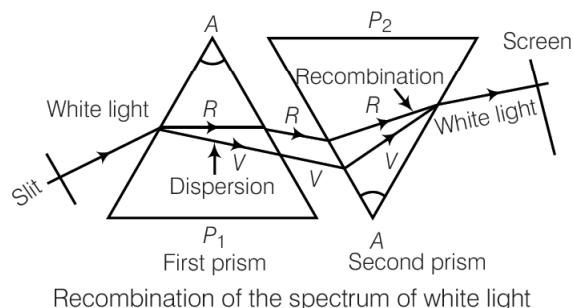
2. Dispersion of White Light by a Glass Prism

- The phenomenon of splitting of white light by prism into its constituent colours is called dispersion of white light.
- The group of different colours of light rays produced by the prism due to dispersion is called **spectrum**.
- Issac Newton was the first one to use a glass prism to obtain the spectrum of light.

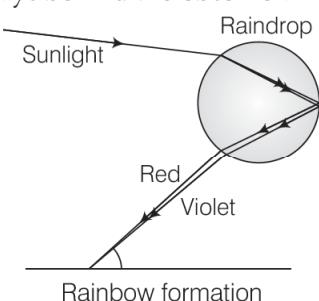
- For red colour deviation is minimum and for violet colour deviation is maximum.



- For violet colour, wavelength is minimum and for red colour wavelength is maximum, i.e. frequency for violet colour is maximum and for red colour frequency is minimum.
- Recombination of White Light** Newton obtained white light by using similar prism in inverted position.



- **Rainbow** It is a natural spectrum appearing in the sky after a rain shower. It is caused by dispersion of sunlight by tiny water droplets, present in the atmosphere.
- Conditions for the formation of rainbow are
 - (i) The formation of rainbow involves a series of physical phenomena refraction, dispersion and internal i.e., reflection.
 - (ii) Rainbow is always formed in a direction opposite to that of the sun, i.e. sun is always behind the observer.



3. Atmospheric Refraction

The earth's atmosphere is not uniform throughout, its density goes on changing as we move up or down. It can be considered to be consisted of layers of different densities, which act as rarer or denser medium with respect to each other. The refraction of light due to these layers is called atmospheric refraction.

Some phenomena based on atmospheric refraction are

- (i) **Twinkling of stars** is due to atmospheric refraction of star's light. As the light from the star enters the earth's atmosphere, it undergoes refraction due to varying optical densities of air at various altitudes. The continuously changing atmosphere refracts the light by different amounts. In this way, the star light reaching our eyes increases and decreases continuously and the star's appears to twinkle at night.

- (ii) **Advance sunrise and delayed sunset** This is because of atmospheric refraction. When the sun is slightly below the horizon, the sun's light coming from less dense to more dense air, is refracted downwards. Because of this, the sun appears to be raised above the horizon

and so the rising sun can be seen about 2 min before actual sunrise.

Similarly, due to atmospheric refraction the sun can be seen for about 2 min even after the sun has set below horizon.

4. Scattering of Light

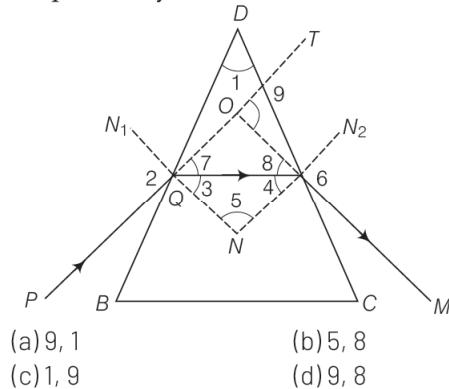
The reflection of light from an object in all directions is called scattering of light. The colour of scattered light depends on the size of scattering particles. Very fine particles scatter mainly blue light while particles of larger size scatter light of longer wavelengths. Some phenomena based on scattering of light are given below

- (i) **Tyndall effect** The path of a beam of light through a true solution is not visible. However, its path becomes visible when it passes through a colloidal solution, where the size of the particles is relatively larger. This scattering of light when it passes through a colloidal solution is called Tyndall effect. The earth's atmosphere is a heterogeneous mixture of minute particles of smoke, tiny water droplets due to suspended particles of dust and molecules of air. Tyndall effect becomes visible due to scattering of light.
- (ii) **Colour of the sky** During the day time, sky appears blue. This is because the size of the particles in the atmosphere is smaller than the wavelength of visible light, so they scatter the light of shorter wavelengths (blue end of spectrum) and hence, the sky appears blue. It should be noted that the sky appears black to the passengers flying at higher altitudes because scattering of light is not prominent at such height due to the absence of particles.
- (iii) **Colour of sun at sunrise and sunset** At sunrise and sunset, the sun appear reds. Light from the sun near the horizon passes through thicker layers of air and covers larger distance in the atmosphere before reaching our eyes. Near the horizon most of the blue light and shorter wavelength is scattered away by the particles. Therefore, the light that reaches our eyes is of longer wavelength. This give rise to the reddish appearance of the sun and the sky.

Objective Questions

Multiple Choice Questions

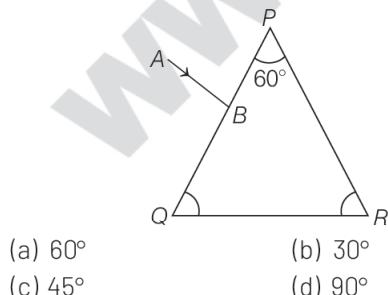
- 01.** A ray diagram of refraction through prism is shown. Locate the angle of prism and angle of deviation, respectively.



- 02.** Prism is a homogeneous transparent medium consisting of two rectangular and three triangular faces.
 (a) True (b) False
 (c) Can't say (d) Partially true/false

- 03.** In given figure, a light ray AB is incident normally on one face PQ of an equilateral glass prism.

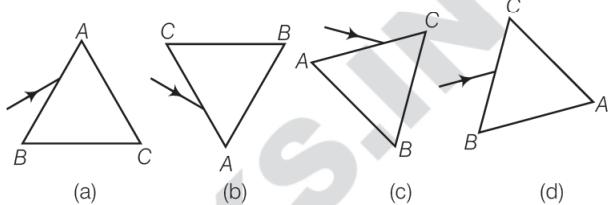
Find out the angle at face PR .



- 04.** A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in figure. In which of the following cases, after

dispersion, the third colour from the top corresponds to the colour of the sky?

(NCERT Exemplar)



- 05.** Splitting of white light into seven colours on passing through a glass prism is due to

- (a) dispersion (b) refraction
 (c) scattering (d) reflection

- 06.** The colour of the white light deviated through the largest angle by a prism is

- (a) Red (b) Yellow
 (c) Violet (d) Green

- 07.** Which of the following statements is correct regarding the propagation of light of different colours of white light in air?

(NCERT Exemplar)

- (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

- 08.** When white light is incident on a thin walled hollow glass prism, the colour of the emergent light will be

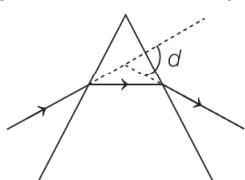
- (a) red (b) green
 (c) yellow (d) white

- 09.** To recombine the spectrum to obtain white light, the dispersive prism and recombination prism should be in same position.

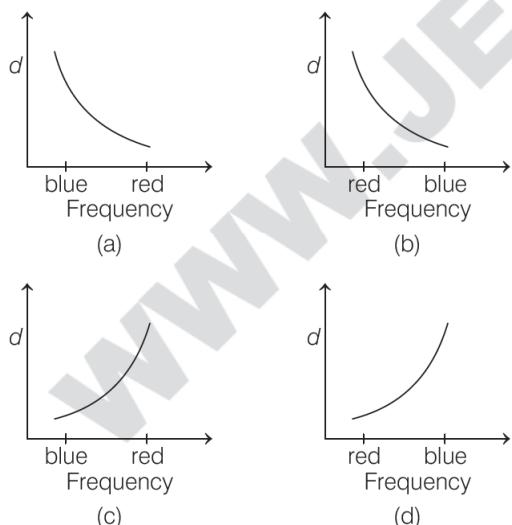
- (a) True
 (b) False
 (c) Can't say
 (d) Partially true/false

- 10.** Which of the following phenomena of light are involved in the formation of a rainbow?
- (a) Reflection, refraction and dispersion
 (b) Refraction, dispersion and outer reflection
 (c) Refraction, dispersion and internal reflection
 (d) Dispersion, scattering and total internal reflection

- 11.** Light rays are deviated by a prism



The deviation angle d is measured for light rays of different frequencies, including blue light and red light. Which graph is correct?



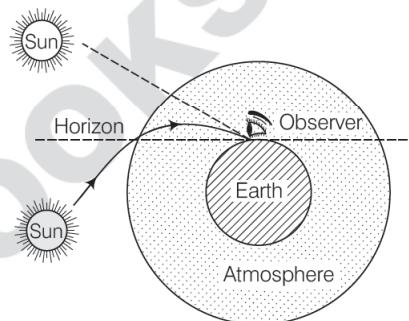
- 12.** Twinkling of stars is due to atmospheric (NCERT Exemplar)

- (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

- 13.** Is it really true or a myth that stars appear higher than they actually are? If yes, then which phenomenon is responsible for it?

- (a) Myth
 (b) Yes, refraction of light
 (c) Yes, atmospheric refraction of light
 (d) Yes, dispersion of light

- 14.** Which phenomenon is depicted in the diagram given below?



- (a) Early sunrise and late sunset
 (b) Change in shape of the sun during sunrise and at moon
 (c) Both (a) and (b)
 (d) Neither (a) nor (b)

- 15.** Stars near the horizon twinkle more than those that are overhead.

- (a) True
 (b) False
 (c) Can't say
 (d) Partially true/false

- 16.** At noon the sun appears white as

- (a) its light is least scattered (NCERT Exemplar)
 (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

- 17.** Emergency signals and danger signals are red because red can travel long distance without being scattered.

- (a) True
 (b) False
 (c) Can't say
 (d) Partially true/false

18. The clear sky appears blue, because
(NCERT Exemplar)

- (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 lights of all other colours by the atmosphere
- (d) light of all other colours is scattered more than the violet and blue colour lights by the atmosphere

19. Match Column I with Column II and choose the most appropriate option from the codes given below

Column I	Column II
A. Twinkling of stars	p. Dispersion
B. Rainbow formation	q. Internal reflection
C. White colour of clouds	r. Atmospheric refraction
D. Glittering of diamond	s. Scattering

Codes

- (a) A → s, B → r, C → q, D → p
- (b) A → p, B → s, C → r, D → q
- (c) A → r, B → p, C → s, D → q
- (d) A → p, B → q, C → r, D → s

20. The orange-reddish appearance of the sun during sunrise and sunset is because of (NCERT Exemplar)

- (a) dispersion of light
- (b) scattering of light
- (c) total internal reflection of light
- (d) reflection of light from the earth

21. The bluish colour of water in deep sea is due to (NCERT Exemplar)

- (a) less the presence of algae and other plants found in water
- (b) reflection of sky in water
- (c) scattering of light
- (d) absorption of light by the sea

22. The colour of head lights suitable for vehicle in foggy weather is

- (a) yellow
- (b) red
- (c) green
- (d) violet

23. To observe Tyndall effect, the size of the scatterer must be smaller than the wavelength of light.

- (a) True
- (b) False
- (c) Can't say
- (d) Partially true/false

24. The sky appears dark to passengers flying at very high altitudes mainly because (CBSE 2020)

- (a) scattering of light is not enough at such heights
- (b) there is no atmosphere at great heights
- (c) the size of molecules is smaller than the wavelength of visible light
- (d) the light gets scattered towards the earth

Assertion-Reasoning MCQs

Direction (Q.Nos. 25-29) For given questions two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is correct explanation of the A.
- (b) Both A and R are true but R is not the correct explanation of the A.
- (c) A is true but R is false.
- (d) A is false but R is true.

25. Assertion Higher the refractive index of prism, lower will be the angle of deviation.

Reason The angle of deviation is inversely proportional to the angle of prism.

26. Assertion Refraction of white light through prism gives rise to dispersion.

Reason Both the refracting surfaces of glass slab are parallel to each other. But the refracting surfaces of prism are inclined to an angle called angle of prism.

27. Assertion The rainbow is seen when the sun is behind the observer.

Reason Rainbow is produced due to dispersion of white light by small rain drops hanging in the air after rain.

28. Assertion The stars twinkle while the planet do not.

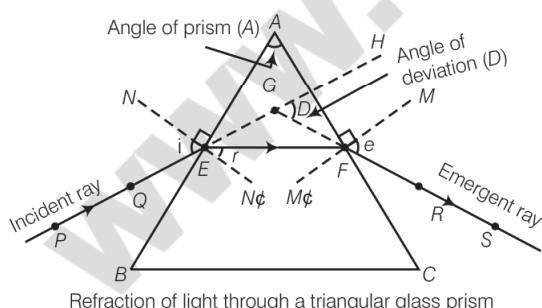
Reason The stars are much bigger in size than the planets.

29. Assertion Blue colour of sky appears due to scattering of blue colour.

Reason Blue colour has shortest wavelength in visible spectrum.

Case Based MCQs

30. Read the following and answer questions from (i) to (v).



After tracing the path of ray of light through a glass prism, a student measures the angle of incidence $\angle i$, angle of refraction $\angle r$, prism angle $\angle A$, angle of emergence ($\angle e$) and angle of deviation ($\angle D$).

Observation table based on the above experiment done by student is as follows

Number of observations	Angle of incidence ($\angle i$)	Angle of emergence ($\angle e$)	Angle of deviation ($\angle D$)
(1)	30°	60°	30°
(2)	35°	55°	30°
(3)	40°	50°	30°
(4)	45°	45°	30°
(5)	50°	40°	30°

(i) From the given ray diagram, the rays represented by the (i) PQ

- (ii) QM , respectively,
- (a) incident ray, reflected ray
 - (b) reflected ray, incident ray
 - (c) incident ray, refracted ray
 - (d) refracted ray, incident ray

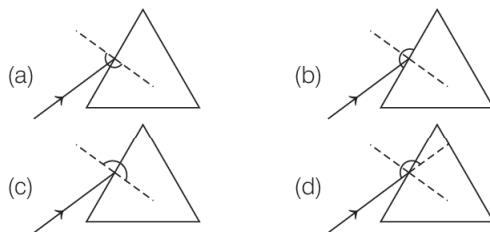
(ii) The phenomena associated with the splitting of white light into band of seven colours or spectrum is

- (a) dispersion of light
- (b) scattering of light
- (c) refraction of light
- (d) reflection of light

(iii) Select the correct option from the following, based on the analysis of his measurements:

- (a) $\angle A + \angle D = \angle i$
- (b) $\angle A + \angle D = \angle i + \angle e$
- (c) $\angle A + \angle e = \angle i + \angle D$
- (d) $\angle i + \angle D = \angle A + \angle e$

(iv) Which of the following is the correct set-up of protractor for tracing the path of ray of light through a glass prism, for measuring the angle of incidence?



(v) The angle of deviation depends on

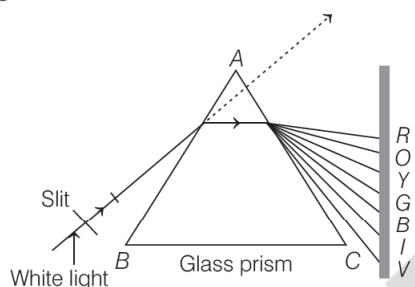
- (a) refractive index of prism
- (b) angle of incidence
- (c) angle of emergence
- (d) All of the above

31. Read the following and answer questions from (i) to (v).

The phenomenon of splitting of white light into its constituent colours, when it passes through a prism is called dispersion.

This band of seven colours so obtained, the VIBGYOR (V = violet, I = indigo, B = blue, G = green, Y = yellow, O = orange and R = red) is called spectrum.

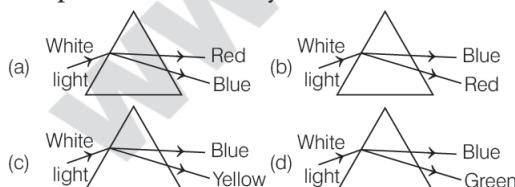
Isaac Newton was the first one to use a glass prism to obtain the spectrum of light.



(i) The splitting of white light can be done by

- (a) lens
- (b) prism
- (c) water drop
- (d) Both (b) and (c)

(ii) Which of the following diagram shows dispersion correctly?

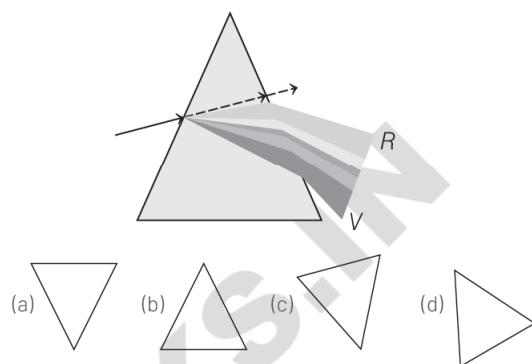


(iii) When a red light passes through a prism, it will

- (a) not split
- (b) split into seven colours
- (c) split into white colour
- (d) split into many different colours

(iv) Dispersion of white light by a prism is shown in the diagram below. What should be the position of second prism

in order to recombine the spectra and yield white light?



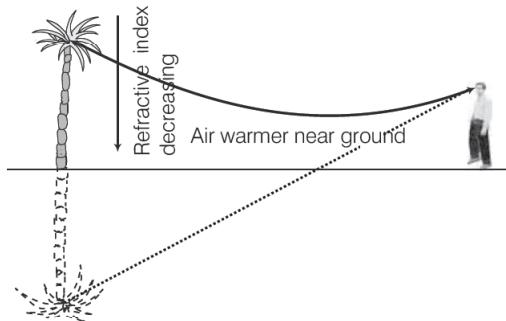
(v) A glass slab is placed over a page on which the word VIBGYOR is printed with each letter in corresponding colour. Then, which of the following is correct?

- (a) The images of all the letters will be in the same place as that on paper
- (b) Letter V is raised more
- (c) Letter R is raised more
- (d) None of the above

32. Read the following and answer questions from (i) to (v).

A mirage is a naturally occurring optical phenomenon in which light rays are bent to produce a displaced image of distant objects on the sky.

The fluctuations in the refractive index of the earth's atmosphere is responsible for atmospheric refraction. Mirage is one of the example of atmospheric refraction.



In contrast to hallucination, a mirage is a real optical phenomenon that can be captured on camera, since light rays are actually refracted to form the false image at the observer's location, e.g. inferior images on land are very easily mistaken for the reflections from a small water body. Heat-haze, also known as heat swimmer, refers to the inferior which can be experienced when viewing objects through a mirage layer of heated air. A superior mirage occurs when the air below the line of sight is colder than the air above it.

- (i) When light travels from hot air to cold air, then it bends
 - (a) towards the normal
 - (b) away from the normal
 - (c) towards the normal and scatter
 - (d) away from the normal and scatter
- (ii) Mirage is formed due to
 - (a) bending of light because of multiple layers of atmosphere having different densities
 - (b) bending of light because of temperature difference of air
 - (c) dispersion of light because of temperature difference of air
 - (d) scattering of light because of temperature difference of air
- (iii) Due to atmospheric refraction, apparent length of day
 - (a) increases
 - (b) decreases
 - (c) remains the same
 - (d) All of these
- (iv) The sun appears oval shaped or flattened due to
 - (a) scattering of light
 - (b) dispersion of light
 - (c) atmospheric refraction
 - (d) None of the above
- (v) Choose the wrong statement related to refraction of light.
 - (a) Twinkling of stars
 - (b) Early sunrise and delayed sunset
 - (c) Object in water appears bigger in size
 - (d) Red light undergoes dispersion, while passing through prism

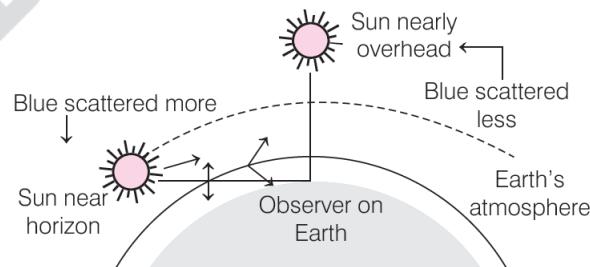
- 33.** Read the following and answer questions from (i) to (v).

At sunrise and sunset, the Sun and the sky appear red. Light from the Sun near the horizon passes through thicker layers of air and covers larger distance in the atmosphere before reaching our eyes.

Near the horizon, most of the blue light and shorter wavelengths light rays are scattered away by the particles.

Therefore, the light that reaches our eyes is of longer wavelengths. This gives rise to the reddish appearance of the Sun and the sky.

However at the noon, the light from the Sun overhead would travel relatively shorter distance. So, it appears white as only a little of the blue and violet colours are scattered.



- (i) To an astronaut in a spaceship, the colour of earth appears
 - (a) red
 - (b) blue
 - (c) white
 - (d) black
- (ii) At the time of sunrise and sunset, the light from the sun has to travel
 - (a) longest distance of atmosphere
 - (b) shortest distance of atmosphere
 - (c) Both (a) and (b)
 - (d) Can't say
- (iii) The colour of sky appears blue, it is due to the
 - (a) refraction of light through the atmosphere
 - (b) dispersion of light by air molecule
 - (c) scattering of light by air molecule
 - (d) All of the above

- (iv) At the time of sunrise and sunset
 (a) blue colour scattered and red colour reaches our eye
 (b) red colour scattered and blue colour reaches our eye
 (c) green and blue scattered and orange reaches our eye
 (d) None of the above

- (v) The danger signal is made red in colour, because
 (a) the red light can be seen from farthest distance
 (b) the scattering of red light is least
 (c) Both (a) and (b)
 (d) None of the above

ANSWERS

Multiple Choice Questions

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (b) | 3. (a) | 4. (b) | 5. (a) | 6. (c) | 7. (c) | 8. (d) | 9. (b) | 10. (c) |
| 11. (d) | 12. (b) | 13. (c) | 14. (a) | 15. (a) | 16. (a) | 17. (a) | 18. (c) | 19. (c) | 20. (b) |
| 21. (c) | 22. (a) | 23. (b) | 24. (a) | | | | | | |

Assertion-Reasoning MCQs

25. (d) 26. (b) 27. (b) 28. (b) 29. (a)

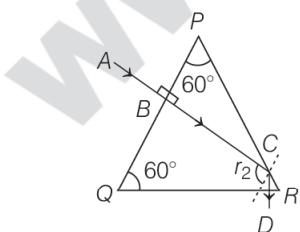
Case Based MCQs

30. (i)-(c), (ii)-(a), (iii)-(b), (iv)-(d), (v)-(d)
 32. (i)-(a), (ii)-(b), (iii)-(a), (iv)-(c), (v)-(d)

31. (i)-(d), (ii)-(a), (iii)-(a), (iv)-(a), (v)-(b)
 33. (i)-(b), (ii)-(a), (iii)-(c), (iv)-(a), (v)-(c)

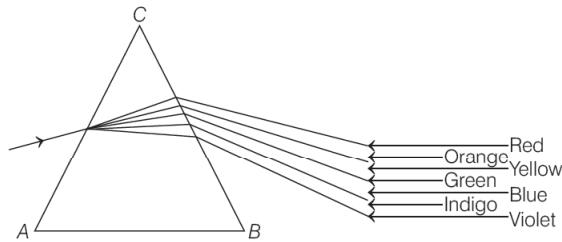
EXPLANATIONS

- According to the diagram, in prism BDC ,
 $\angle D = \angle 1$ = angle of the prism
 $\angle 9$ = angle of deviation.
- False; Prism is a homogeneous transparent medium consisting of three rectangular and two triangular faces.
- The ray traces path inside prism as shown

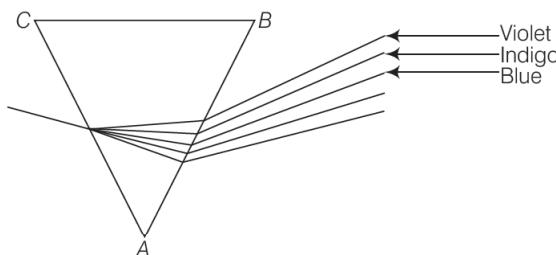


Here, $i = 0^\circ \Rightarrow r_1 = 0^\circ$ and $A = 60^\circ$
 Also, $\angle P = r_1 + r_2$
 $60^\circ = 0^\circ + r_2$ or $r_2 = 60^\circ$

- Generally, in case of a prism, the formation of spectrum is shown below



In the above figure, from top the third colour is yellow. But we can see that from bottom the third colour is blue which is the colour of sky. So, we can obtain the correct situation by inverting the prism. Thus the required orientations can be found in case (b).



5. The splitting of white light into its component colours on passing through a glass prism is called dispersion.
6. When white light passes through prism, then violet colour has maximum deviation and red has minimum deviation.
7. All the colours of white light in air or vacuum move with the same speed but different wavelengths and frequencies.
8. The emergent light will be white, because the outer faces of the prism behave like hollow plates.
9. False; To recombine the spectrum to obtain white light, the recombination prism should be in inverted position with dispersive prism.
10. Rainbow is a phenomenon due to combined effect of dispersion, refraction and internal reflection of sunlight by spherical water droplets of rain.
11. In dispersion through a prism, the red deviates least while blue deviates more. Hence, the wavelength of red is more than blue light.
Also, frequency is related to wavelength by relation

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

So, correct graph is shown in option (d).

12. The twinkling of a star is due to atmospheric refraction of light of stars. This light, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth.

The path of rays of light coming from the distant star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers. The star sometimes appears brighter and at some other time fainter, which gives us the twinkling effect.

13. Star light coming from far undergoes atmospheric refraction due to gradually changing refractive index of the different layers of atmosphere and hence rays coming from stars refract downwards causing the appearance of the stars above than they actually are.
14. Diagram given depicts early sunrise and late sunset due to atmospheric refraction.

15. True; As the light from the stars have to cover more distance in horizon than from the stars overhead, hence have to cover more layers of atmosphere, having different optical densities and refractive index, hence more twinkling effects.
16. At noon the sun appears white because the light from the sun is directly over head and travels relatively shorter distance. So, only a little light is scattered.
17. True; Scattering depends on wavelength, hence red is scattered least as its wavelength is more.
18. The clear sky appears blue is due to scattering of sunlight. The molecules in the air scatter blue or violet light from the sun more than they scatter other colour's light.
19. A → r; Twinkling of stars is due to atmospheric refraction of light.
B → p; Rainbow is formed in sky due to dispersion of sunlight through rain drops.
C → s; White colour of clouds is due to least scattering of sunlight.
D → q; Glittering of diamond is due to multiple internal reflection of light entering it.
20. The orange-reddish appearance of the sun at sunrise or sunset is due to least scattering of red light as red light have the maximum wavelength and the rays of light have to travel a larger part of the atmosphere.
21. The bluish colour of water in deep sea is due to scattering of light as the very fine particles in water scatter mainly blue light.
The red, green, orange and yellow having longer wavelengths are absorbed more strongly by water than blue which has shorter wavelength. So, when white light from the sun enters the sea, it is mostly the blue that gets returned.
22. Yellow headlights are suitable for a vehicle in foggy weather, because wavelength of yellow colour of light is larger and it does not undergo large scattering.
23. False; The scattering of light when it passes through a colloidal solution is called Tyndall effect. And for scattering the size of the scatterer must be comparable to the wavelength of light.

- 24.** At very high altitudes, the thickness of atmosphere is low. So, there are less number of particles present for scattering. Hence, the sky appears dark to the passengers.
- 25.** Higher the refractive index of prism, greater will be the angle of deviation.
- 26.** Both A and R are true, but R is not the correct explanation of A. Light rays of different colours travel with different speeds and bend through different angles when pass through different media which is the cause of dispersion.
- 27.** Just after rain, the water drops are floating in the air. Each drop acts like a prism. So, when sun rays fall on them, dispersion of light takes place and we see a spectrum of light in the sky.
- 28.** As planets are of larger size but not more than stars and much closer to the earth than stars, so, planets can be considered as a collection of large number of point sized sources of light. The total variation in the amount of light entering our eye from all these individual point sized sources will average out to zero which nullify the twinkling effect of each other. Therefore, planets do not twinkle.
- 29.** During the day time, sky appears blue. This is because the size of the particles in the atmosphere is smaller than the wavelength of visible light, so they scatter the light of shorter wavelengths, i.e. blue colour light is scattered.
- 30.** (i) Incident ray of light is represented by PQ . Refracted ray of light is represented by EF .
(ii) Dispersion of light.
(iii) From the given table, it is clear that

$$\angle A + \angle D = \angle i + \angle e$$

(iv) As angle of incidence is the angle between the incident ray and normal drawn on the refracting surface. So, correct setup of protractor is shown in (d).
(v) The angle of deviation is given by

$$\angle D = \angle i + \angle e - \angle A$$
- Thus, it depends on angle of incidence, angle of emergence and angle of prism. It also depends on the refractive index of prism.

- 31.** (i) The white light splits into its constituent colours on passing through a prism or water drops in case of rainbow.
(ii) The deviation is more for blue and minimum for red, so, correct diagram is in option (a).
(iii) As red light has a single wavelength and when it enters a prism, it will not split into other different colours.
(iv) To recombine the spectra to yield white light, the second prism should be kept inverted with respect to given prism as in option (a).
(v) The refractive index of a material depends on the wavelength of light used. Since, refractive index of glass is maximum for violet light, so, letter V is raised to the maximum.
- 32.** (i) When light travels from hot air (rarer) to cold air (denser), then it bends towards the normal.
(ii) Mirage is formed due to bending of light because of temperature difference of different layers of air. Due to which the refractive index changes with height.
(iii) Due to atmospheric refraction, apparent length of the day increases by 4 minutes.
(iv) It is due to atmospheric refraction.
(v) The statement (d) is wrong as white light undergoes dispersion while passing through prism.
- 33.** (i) As, light is scattered by the air molecules present in atmosphere and blue colour has shorter wavelength, so it is scattered most and the earth would appear blue.
(ii) As, the distance between us and sun is more at the time of sunrise and sunset. So, light has to travel longest distance during these times.
(iii) Sky appears blue due to more scattering of blue light by molecules of air.
(iv) Red light being of longest wavelength scatters least and reaches our eye while blue colour scatters most.
(v) As, scattering of red light is least, so, it can be seen from farthest distance.

Practice Papers

1-3





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PRACTICE PAPER 1

Science Class 10th (Term I)

Instructions

1. This paper has 31 questions.
2. All questions are compulsory. Q. no. 1-28 carry 1 mark each and Q. nos. 29-31 carry 4 mark each.
3. Answer the questions as per given instructions.

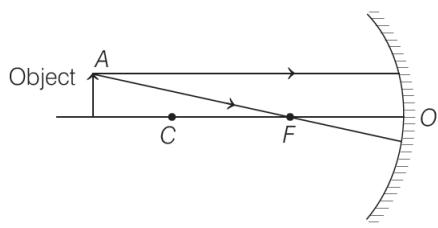
Time : 90 Minutes

Max. Marks : 40

Multiple Choice Questions

Direction (Q. Nos. 1-20) Each of the question has four options out of which only one is correct. Select the correct option as your answer.

1. Which of the following reactions involves the combination of two elements ?
(a) $2\text{CO} + \text{O}_2 \longrightarrow 2\text{CO}_2$
(b) $\text{NH}_3 + \text{HCl} \longrightarrow \text{NH}_4\text{Cl}$
(c) $2\text{Mg} + \text{O}_2 \longrightarrow 2\text{MgO}$
(d) $\text{NO} + \text{O}_2 \longrightarrow 2\text{NO}_2$
2. When sodium carbonate is added to two tubes (*A*) containing dil. HCl and (*B*) containing dil. NaOH, then which of the following observations is correct ?
(a) A yellow coloured gas liberated in test tube *A*
(b) A yellow coloured gas liberated in test tube *A* and colourless gas in test tube *B*
(c) A colourless gas liberated in test tube *A*
(d) A colourless gas liberated in test tube *B*
3. The diagram shows the path of incident rays to a concave mirror.



Where would the reflected rays meet for the image formation to take place?

- (a) Behind the mirror (b) Between F and O
(c) Between C and F (d) Beyond C

4. Which of the following is acidic in nature ?
(a) Apple juice
(b) Lime water
(c) Soap solution
(d) Sodium bicarbonate
5. NaOH is a strong base because it
(a) can be oxidised
(b) gives OH^- ions
(c) can turn blue litmus dark red
(d) All of the above
6. What is the difference in water of crystallisation of washing soda and gypsum ?
(a) 2 (b) 4
(c) 8 (d) 1
7. The element 'X' of atomic number 16 forms basic oxide. The number of electrons in X^{2-} ion will be
(a) 16 (b) 14 (c) 12 (d) 18
8. Which of the following is amphoteric oxide ?
(a) Na_2O (b) SO_2
(c) CaO (d) Al_2O_3

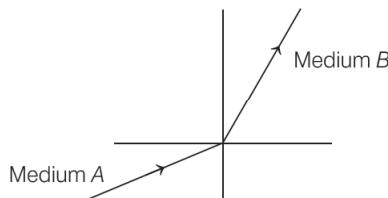


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- 9.** Which of the following gives nitrogen dioxide on reacting with concentrated nitric acid ?
- Pb
 - Ca
 - Al
 - K
- 10.** When a plane mirror is rotated through a certain angle, the reflected ray turns through twice or much and the size of image
- is doubled
 - is halved
 - becomes infinite
 - remains same
- 11.** On heating copper powder, it gets coated with
- white copper oxide
 - yellow copper oxide
 - red copper oxide
 - black copper oxide
- 12.** Choose the correct path of urine in our body
- Kidney → Ureter → Urethra → Urinary bladder
 - Kidney → Urinary bladder → Urethra → Ureter
 - Kidney → Ureters → Urinary bladder → Urethra
 - Urinary → Bladder → Kidney → Ureter → Urethra
- 13.** 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 the image is equal to the size of the object ?
- 15 cm in front of mirror
 - 30 cm in front of mirror
 - Between 15 cm and 30 cm in front of the mirror
 - More than 30 cm in front of the mirror.
- 14.** The magnification m of an image formed by a spherical mirror is negative. It means, the image is
- smaller than the object
 - larger than the object
 - erect
 - inverted
- 15.** Which of the following phenomena of light are involved in the formation of a rainbow?
- Reflection, refraction and dispersion
 - Refraction, dispersion and scattering
 - Refraction, dispersion and internal reflection
 - Dispersion, scattering and reflection
- 16.** A person uses a convex lens of focal length 20 cm in spectacles, the power of lens will be
- 5 D
 - +5 D
 - +2 D
 - 2 D
- 17.** Which part of alimentary canal receives bile from the liver?
- Stomach
 - Small intestine
 - Large intestine
 - Oesophagus
- 18.** Choose the correct statement that describes arteries.
- They have thick elastic walls, blood flows under high pressure; collect blood from different organs and bring it back to the heart
 - 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
 - They have thick elastic walls, blood flows under low pressure carry blood from the heart to various organs of the body
 - 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

- 19.** A light ray enters from medium *A* to medium *B* as shown in figure. The refractive index of medium *B* relative to *A* will be



- (a) greater than unity (b) less than unity
 (c) equal to unity (d) zero

- 20.** The breakdown of pyruvate into carbon dioxide, energy and water takes place in
 (a) mitochondria (b) cytoplasm
 (c) endoplasmic reticulum (d) ribosomes

Assertion-Reasoning MCQs

Direction (Q. Nos. 21-28) For given questions two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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, but R is true.

- 21. Assertion** When a mixture of hydrogen and bromine is placed in sunlight, hydrogen bromide is formed.

Reason It is an example of combination reaction.

- 22. Assertion** Magnesium ribbon burns in the presence of oxygen.

Reason Magnesium acts as an oxidising agent.

- 23. Assertion** Dry hydrogen chloride gas does not change the colour of blue litmus paper to red.

Reason Dry hydrogen chloride gas is strongly basic.

- 24. Assertion** If a ray of light is incident on a convex mirror along its principal axis, then the angle of incidence as well as the angle of reflection for a ray of light will be zero.

Reason A ray of light going towards the centre of curvature of convex mirror is reflected back along the same path.

- 25. Assertion** Linear magnification of a mirror has no unit.

Reason The ratio of height of the image to the height of the object is the linear magnification produced by mirror.

- 26. Assertion** The light of violet colour deviates the most and the light of red colour the least, while passing through a prism.

Reason For a prism material, refractive index is highest for red light and lowest for the violet light.

- 27. Assertion** Raw materials needed for photosynthesis are carbon dioxide, water and minerals.

Reason Nutrients provide energy to an organism.

- 28. Assertion** All the arteries carry oxygenated blood from the heart to various organs.

Reason Pulmonary vein carries oxygenated blood to the heart.

Case Based MCQs

- 29.** Read the following and answer any four questions from (i) to (v).

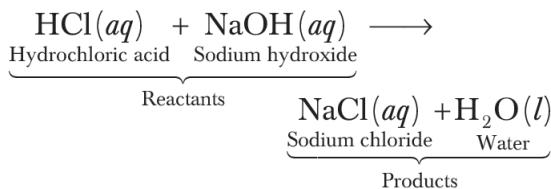
All the chemical changes are accompanied by chemical reactions and these are represented with the help of chemical equations. Chemical equation is a method of representing a chemical reaction with the help of symbols and formulae of the substances involved in it.



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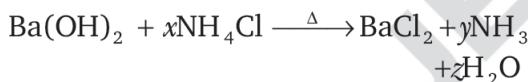
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In a chemical equation, the reacting species (molecule, atom, ion) are known as reactants (the substances that undergo chemical change in the chemical reaction) and the new species formed as a result of the reaction are called products (the new substances formed during reaction).



A chemical equation is a short hand method of representing a chemical reaction. A balanced chemical equation has equal number of atoms of different elements in the reactants and products side. Law of conservation of mass is followed in a balanced chemical equation.

- (i) What will be the value of 'x', 'y' and 'z' in the following reaction?



- (a) $x=2, y=3, z=1$
 (b) $x=3, y=2, z=2$
 (c) $x=1, y=2, z=3$
 (d) $x=2, y=2, z=2$

- (ii) Which of the following is incorrect about balanced chemical equation?
- It tells us about the physical state of reactants and products.
 - It tells us about the number of atoms or molecules of the reactants and products formed.
 - It gives idea about feasibility of particular reaction.
 - It conveys the information about symbols and formulae of all the substances involved in a particular reaction.
- (iii) The balanced chemical equation is based on
- law of combining volumes
 - law of conservation of mass
 - law of constant proportions
 - law of conservation of charge

- (iv) Which of the following is unbalanced equation?

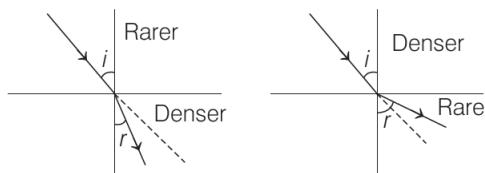
- $3\text{Fe} + 4\text{H}_2\text{O} \longrightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$
- $2\text{NaHCO}_3 \longrightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$
- $6\text{CO}_2 + 12\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 4\text{O}_2 + 6\text{H}_2\text{O}$
- $\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$

- (v) Which of the following is correct about physical state?

- $2\text{Na}(s) + 2\text{H}_2\text{O}(l) \longrightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$
- $\text{Mg}(s) + \text{H}_2\text{SO}_4(aq) \longrightarrow \text{MgSO}_4(s) + \text{H}_2(g)$
- $\text{CaCO}_3(s) \xrightarrow{\text{Heat}} \text{CaO}(aq) + \text{CO}_2(g)$
- $2\text{AgBr}(s) \xrightarrow{\text{Sunlight}} 2\text{Ag}(s) + \text{Br}_2(l)$

30. Read the following and answer any four questions from (i) to (v).

When the rays of light travels from one transparent medium to another medium, the path of rays is deviated. This phenomenon is called the refraction of light. The bending of light depends on the optical density of medium through which the light passes.



The speed of light varies from medium to medium. A medium in which the speed of light is more is optically rarer medium whereas in which the speed of light is less is optically denser medium.

Whenever light goes from one medium to another, the frequency of light does not change. However, speed and wavelength change. It is concluded that the change in speed of light is the basic cause of refraction.

- (i) When light ray travels from glass to air, the ray bends
- towards the normal
 - away from normal
 - anywhere
 - do not bend

- (ii) When a ray passes from a medium *A* to *B*, no bending occurs if the ray of light hits the boundary of medium *B* at an angle of
 (a) 0°
 (b) 45°
 (c) 90°
 (d) 120°
- (iii) When light passes from a denser medium to a rarer medium, the frequency of light in the second medium
 (a) increases
 (b) decreases
 (c) remains same
 (d) None of the
- (iv) A light ray passes from glass to water.
 The speed of light
 (a) increases
 (b) decreases
 (c) remains same
 (d) first increases then decreases
- (v) The bottom of pool filled with water due to refraction, appears to be
 (a) shallower
 (b) deeper
 (c) at some depth
 (d) empty

31. Read the following and answer any four questions from (i) to (v).

All the living cells need nutrients, oxygen and other essential substances for their proper functioning.

Also, the waste and harmful substances need to be removed continuously for healthy functioning of cells.

Therefore, there is a dire need for a well-developed transport in living organisms.

Complex organisms have special fluids within their bodies to transport such materials and blood is the most commonly used one.

Lymph also helps in transport of certain substances of comparison between the two is given below is the table.

Comparison between Blood and Lymph

Feature	Blood	Lymph
Cells	RBCs, WBCs and platelets	Lymphocytes (WBCs)
Proteins	Hormones and plasma proteins	Few proteins
Fats	Some transported as lipoproteins	More than that in blood (absorbed from lacteals in small intestine)
Glucose	80-120 mg per 100 cm ³	Less than that in blood
Amino acids	More than in other fluids	Less than that in blood
Oxygen	More than in other fluids	Less than that in blood
Carbon dioxide	Little	More

(i) Which among the following is a similarity between Blood and Lymph ?

- (a) Blood clotting
- (b) Unidirectional flow
- (c) Protection against diseases
- (d) Presence of haemoglobin

(ii) Amount of blood corpuscles observed in a dengue patient shows variation. Which among the following is observed in a person affected with dengue fever?

- (a) Increase in RBC count
- (b) Decrease in WBC count
- (c) Decrease in Platelet count
- (d) Decrease in RBC count

- (iii) The clear liquid that carries other blood cells is
(a) lymph
(b) serum
(c) plasma
(d) blood vessel
- (iv) WBCs are called soldiers of the body because
(a) they are capable of squeezing out of blood capillaries
(b) they are produced in bone marrow
- (v) The blood vessels whose reduction in number can cause clotting disorder thereby leading to excessive blood loss from body are
(a) erythrocytes
(b) thrombocytes
(c) leucocytes
(d) All of the above

PRACTICE PAPER 1

OMRSHEET

Instructions

- Use black or blue ball point pens and avoid gel pens and fountain pens for filling the sheets
- Darken the bubbles completely. Don't put a tick mark or a cross mark half-filled or over-filled bubbles will not be read by the software.
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PRACTICE PAPER 2

Science Class 10th (Term I)

Instructions

1. This paper has 31 questions.
 2. All questions are compulsory. Q. no. 1-28 carry 1 mark each and Q. nos. 29-31 carry 4 mark each.
 3. Answer the questions as per given instructions.

Time : 90 Minutes

Max. Marks : 40

Multiple Choice Questions

Direction (Q. Nos. 1-20) Each of the question has four options out of which only one is correct. Select the correct option as your answer.





Assertion-Reasoning MCQs

Direction (Q. Nos. 21-28) For given questions two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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, but R is true.

21. Assertion Chemical reaction can change the physical and chemical state of a substance.

Reason When electric current is passed through water, it decomposes into hydrogen and oxygen gases.

22. Assertion Higher the H^+ ion concentration, lower will be the pH value.

Reason The pH of a neutral solution = 7 and pH of acid > 7.

23. Assertion Metals generally have very high melting and boiling points.

Reason Metals have the strongest chemical bonds which are metallic in nature.

24. Assertion There is no dispersion of light refracted through a rectangular glass slab.

Reason Dispersion of light is the phenomenon of splitting of a beam of white light into its constituents colours.

25. Assertion The scattering of light makes path of light visible.

Reason Scattering of light is the result of Tyndall effect.

26. Assertion A convex lens is made of two different materials. A point object is placed on the principal axis, then two images are formed by the lens.

Reason The image formed by convex lens is always virtual.

27. Assertion The main organ of human excretory system is kidney.

Reason Kidneys perform the function of removing excess water and nitrogenous wastes from the body.

28. Assertion Haemoglobin is the respiratory pigment in human beings.

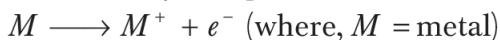
Reason It transports oxygen in the human body.

Case Based MCQs

29. Read the following and answer any four questions from (i) to (v).

Metals have a tendency to lose electrons to form cations and non-metals have tendency to gain electrons to form anions. When metal and non-metals react with each other then both of them, tries to achieve completely filled outermost shell by the transfer of electrons.

Ionic compounds is a chemical compound in which ions are held together by ionic bonds. An ionic bond is the type of chemical bond in which two oppositely charged ions are held through electrostatic forces. Ionic compounds are generally solid and exist in the form of crystal. They have high melting and boiling point. They are good conductors of electricity in aqueous solution.



(i) Which of the following element can converted into an anion?

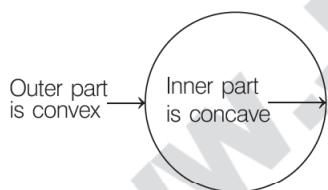
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| (a) Magnesium | (b) Chlorine |
| (c) Xenon | (d) Calcium |

(ii) Which of the following element can be converted into a cation?

- | | |
|---------------|------------|
| (a) Potassium | (b) Neon |
| (c) Iodine | (d) Oxygen |

30. Read the following and answer any four questions from (i) to (v).

A lens is a piece of any transparent material bounded by two curved surfaces. There are two types of lenses convex and concave.



Convex lens is made up of a transparent medium bounded by two spherical surfaces such that it is thicker at the middle and thinner at the edges.

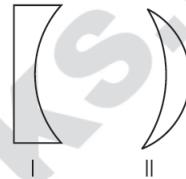
Concave lens is also made up of a transparent medium such that it is thicker at the edges and thinner at the middle. The mid point of the lens is called optical centre. A point on the principal axis, where the incident parallel rays meet or appear to come out after refraction is called focus.

A convex lens converges a parallel beam of light to other side while a concave lens spreads out or diverges them.

- (i) Which of the following lens would you prefer to use while reading small letters found in dictionary?

 - (a) a convex lens of focal length 50 cm
 - (b) a concave lens of focal length 50 cm
 - (c) a convex lens of focal length 5 cm
 - (d) a concave lens of focal length 5 cm

- (ii) Which types of lenses are shown in given figures I and II?



- (a) Plano concave, concavo convex
 - (b) Plano convex, convexo concave
 - (c) Double concave, concavo convex
 - (d) Convexo concave, double convex

- (iii) A small bulb is placed at the focal point of a converging lens. When the bulb is switched ON, the lens produces,

 - (a) a convergent beam of light
 - (b) a divergent beam of light
 - (c) a parallel beam of light
 - (d) a patch of coloured light

- (iv) The part of lens through which the refraction takes place is called

- (a) aperture (b) centre of curvature
(c) principal axis (d) focus

- (v) A water drop acts as a

- (a) convex lens
 - (b) concave lens
 - (c) double concave lens
 - (d) None of the above

31. Read the following and answer any four questions from (i) to (v).

A dialysis machine is a machine designed to remove waste from blood. It is used when the kidney fail, or when blood acidity, urea or potassium levels increase much above normal. In kidney dialysis, blood flows through a system



of tubes composed of partially permeable membranes.

Dialysis fluid has a composition similar to that of blood except that the concentration of waste is low. It flows in the opposite direction to the blood on the outside of the dialysis tubes.

Consequently, waste products like urea diffuse from the blood into the dialysis fluid which is constantly replaced. For some people, dialysis is an ongoing procedure but for others, it just allows the kidneys to rest and recover.

- (i) Why is the dialysing solution constantly replaced ?
 - (a) To maintain the concentration gradient
 - (b) As it contains waste products of metabolism
 - (c) As existing solution can no longer be filtered
 - (d) as existing solution will not be efficient

- (ii) The best long term solution for kidney failure is
 - (a) increased water intake
 - (b) decreased amount of toxicants
 - (c) dialysis
 - (d) kidney transplant

- (iii) Where can one find kidneys in a human body?
 - (a) At the back, behind the lungs
 - (b) At the back, above the waist
 - (c) Near belly button
 - (d) Behind pancreas gland

- (iv) Which among the following is/are not the function of kidney?
 - I. Cleaning of blood by filtering it and removing waste products.
 - II. Regulation of minerals in the body and production of hormones
 - III. Providing energy for the flow of life giving blood
 - IV. Keeping higher concentration of electrolytes.

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

- (v) The major difference between a natural and an artificial kidney is that
 - (a) natural kidney has nephrons whereas artificial one lacks them
 - (b) natural kidney does not support reabsorption
 - (c) artificial kidney does not support reabsorption
 - (d) artificial kidney is the donated one



PRACTICE PAPER 2

OMRSHEET

Instructions

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PRACTICE PAPER 3

Science Class 10th (Term I)

Instructions

1. This paper has 31 questions.
2. All questions are compulsory. Q. no. 1-28 carry 1 mark each and Q. nos. 29-31 carry 4 mark each.
3. Answer the questions as per given instructions.

Time : 90 Minutes

Max. Marks : 40

Multiple Choice Questions

Direction (Q. Nos. 1-20) Each of the question has four options out of which only one is correct. Select the correct option as your answer.

1. When the gases sulphur dioxide and hydrogen sulphide mix in the presence of water, the reaction is $\text{SO}_2 + 2\text{H}_2\text{S} \longrightarrow 2\text{H}_2\text{O} + 3\text{S}$. Here, hydrogen sulphide is acting as

- (a) an oxidising agent
- (b) a reducing agent
- (c) a dehydrating agent
- (d) a catalyst

2. In the following equations :



- (a) 1
- (b) 2
- (c) 3
- (d) 4

3. Two thin lenses, one of focal length + 60 cm and the other of focal length - 20 cm are kept in contact. Their combined focal length is

- (a) - 30 cm
- (b) + 30 cm
- (c) - 15 cm
- (d) + 15 cm

4. Of the aqueous solutions listed below, which would be the best conductor of an electric current ?

- (a) HCl
- (b) H_3PO_4
- (c) HOX
- (d) CH_3COOH

5. $2\text{NaOH} + \text{MgSO}_4 \longrightarrow ?$

- (a) $\text{MgO} + \text{Na}_2\text{SO}_4$
- (b) $\text{Mg(OH)}_2 + \text{Na}_2\text{SO}_4$
- (c) $\text{Mg(OH)}_2 + \text{Na}_2\text{O}$
- (d) $\text{MgO} + \text{Na}_2\text{O}$

6. The pH of the gastric juices released during digestion is

- (a) less than 7
- (b) more than 7
- (c) equal to 7
- (d) equal to 0

7. Which of the following is an example of neutral oxide ?

- (a) Fe_2O_3
- (b) Al_2O_3
- (c) CO
- (d) NO_2

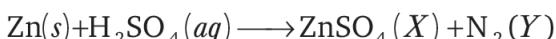
8. Which of the following pairs will give displacement reactions?

- (a) ZnSO_4 solution and aluminium metal
- (b) MgCl_2 solution and aluminium metal
- (c) FeSO_4 solution and silver metal
- (d) AgNO_3 solution and copper metal.

9. The composition of aqua-regia is

- (a) Dil HCl : Conc. HNO_3
3 : 1
- (b) Conc. HCl : Dil. HNO_3
3 : 1
- (c) Conc. HCl : Conc. HNO_3
3 : 1
- (d) Dil HCl : Dil. HNO_3
3 : 1

10. Identify 'X' and 'Y' in the following reactions:



- (a) X = aq, Y = l
- (b) X = s, Y = g
- (c) X = aq, Y = g
- (d) X = s, Y = l

11. When light travels from one medium to another whose refractive index is different, then which of the following will change?

- (a) Wavelength and velocity
- (b) Frequency and wavelength
- (c) Frequency and velocity
- (d) Frequency, wavelength and velocity

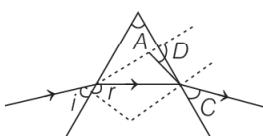
12. Oxygen liberated during photosynthesis comes from

- (a) water
- (b) chlorophyll
- (c) carbon dioxide
- (d) glucose

13. Which of the following colours is least scattered by fog, dust and smoke?

- (a) Violet
- (b) Blue
- (c) Red
- (d) Yellow

14. In the following diagram the correctly marked angles are

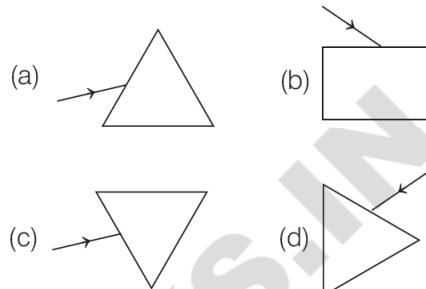


- (a) i and e
- (b) A and D
- (c) i, e and D
- (d) r, A and D

15. The effect of glass prism is only to separate the seven colours of

- (a) white light
- (b) light from bulb
- (c) sunlight
- (d) All of these

16. In which of the following cases will no dispersion of light takes place when sunlight passes through it?



17. The filtration units of kidneys are called

- (a) ureter
- (b) urethra
- (c) neurons
- (d) nephrons

18. 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

19. Which is the correct sequence of air passage during inhalation?

- (a) Nostrils → Larynx → Pharynx → Trachea → Lungs
- (b) Nasal passage → Trachea → Pharynx → Larynx → Alveoli
- (c) Larynx → Nostrils → Pharynx → Lungs
- (d) Nostrils → Pharynx → Larynx → Trachea → Alveoli

20. A ray of light is incident on a plane mirror at an angle of incidence 30° . The ray after reflection is deviated through

- (a) 30°
- (b) 60°
- (c) 90°
- (d) 120°

Assertion-Reasoning MCQs

Direction (Q. Nos. 21-28) For given questions two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct



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answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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, but R is true.

21. Assertion The oxides of sulphur and phosphorus are acidic in nature.

Reason Metal oxides are acidic in nature.

22. Assertion pH of ammonium nitrate solution is acidic.

Reason Solution of a salt of weak base and strong acid is acidic in nature.

23. Assertion AgBr is used on photographic and X-ray film.

Reason AgBr is photosensitive and changes to silver and bromine in the presence of sunlight and undergoes decomposition.

24. Assertion The size of the mirror affects the nature of the image.

Reason Small mirrors always form virtual images.

25. Assertion Keeping a point object fixed, if a plane mirror is moved, the image will also move.

Reason In case of a plane mirror, distance of object and its image is equal from any point on the mirror.

26. Assertion The twinkling of stars is due to the fact that refractive index of earth's atmosphere fluctuates.

Reason When light propagates from one medium to another, its direction of propagation changes.

27. Assertion Photosynthesis mainly occurs in leaves.

Reason Leaves have chloroplast.

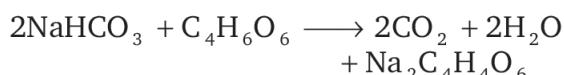
28. Assertion Respiration is a biochemical process opposite to photosynthesis.

Reason Energy is released during respiration.

Case Based MCQs

29. Read the following and answer any four questions from (i) to (v).

Baking powder produces carbon dioxide on heating, so that the batter becomes spongy in cooking. Baking soda also produced CO_2 on heating, but it is not used for cooking because on heating, baking soda forms sodium carbonate along with CO_2 . Sodium carbonate which formed, makes the taste bitter. Baking powder is the mixture of baking soda and a mild edible acid. Tartaric acid is generally mixed with baking soda to make baking powder. On heating, NaHCO_3 decomposes to give CO_2 which makes bread and cake fluffy. Tartaric acid helps to remove bitter taste due to formation of sodium tartrate.



(i) What will be produced if excess of CO_2 is passed in aqueous solution of sodium carbonate?

- | | |
|--|---|
| (a) NaHCO_3 | (b) NaOH |
| (c) $\text{Na}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$ | (d) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ |

(ii) When sodium hydrogen carbonate is added to acetic acid, it evolves a gas. Which of the following statements are right about the gas evolved ?

- I. It turns lime water milky.
 - II. It has fruity smell.
 - III. It is soluble in solution of sodium hydroxide.
- (a) I, II
 (b) I and III
 (c) II, III
 (d) All of these



30. Read the following and answer any four questions from (i) to (v).

Light of all the colours travels at the same speed in vacuum for all wavelengths. But in any transparent medium (glass or water), the light of different colours travels with different speeds for different wavelengths. That means the refractive index of a particular medium is different for different wavelengths.

As there is a difference in their speed, so the light of different colours bend through different angles. The speed of

violet colour is maximum and speed of red colour is minimum in glass. So, the red light deviates least and violet light most.

Hence, higher the wavelength of a certain colour of light, small the refractive index and less will be the bending of light.

Also, frequency, $v = \frac{c}{\lambda}$

- (i) Which of the following statement 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 colours move with same speed
 - (d) Yellow light moves with the mean speed as that of red and violet light

(ii) Which of the following is the correct order of wavelength?

 - (a) Red > Green > Yellow
 - (b) Red > Violet > Green
 - (c) Yellow > Green > Violet
 - (d) Red > Yellow > Orange

(iii) Which of the following is the correct order of the speed of light in glass?

 - (a) Red > Green > Blue
 - (b) Blue > Green > Red
 - (c) Violet > Red > Green
 - (d) Green > Red > Blue

(iv) The colour having maximum frequency from following is

 - (a) red
 - (b) violet
 - (c) blue
 - (d) green

(v) The correct order of angle of deviation is

 - (a) red > green > blue
 - (b) blue > yellow > orange
 - (c) orange > red > green
 - (d) blue > green > violet



- 31.** Read the following and answer any four questions from (i) to (v).

Nutrition is the process by which an organism obtains nutrients from food and utilises them to obtain energy and also for repairing its tissues. Thus, nutrients become substances which are required for proper growth and maintenance of a living being.

However, not all living organisms obtain food by the same process.

The mode of nutrition wherein organisms synthesize their food from simple inorganic compounds like CO_2 and water, in the presence of sunlight is called autotrophic mode of nutrition. It is followed by green plants and some bacteria.

In heterotrophic mode of nutrition, organisms which cannot produce their own food (heterotrophs) obtain their energy from organic molecules synthesised by the plants.

Heterotrophic nutrition is of three types—saprophytic, parasitic and holozoic.

- (i) In which of the following organisms does the food material get broken down outside the body prior to absorption?
 - (a) Mushroom, green plants, Amoeba
 - (b) Yeast, mushroom, bread mould
 - (c) Paramecium, Amoeba, Cuscuta
 - (d) Cuscuta, lice, tapeworm
- (ii) Which of the following is a parasite?
 - (a) Yeast
 - (b) *Taenia*
 - (c) Amoeba
 - (d) Earthworm
- (iii) Which among the following shows saprotrophic mode of nutrition?
 - (a) Grass
 - (b) Mushroom
 - (c) Amoeba
 - (d) Paramecium
- (iv) What does heterotrophic nutrition involve?
 - (a) Production of simple sugar from inorganic compound
 - (b) Utilisation of energy obtained by plants
 - (c) Utilisation of chemical energy to prepare food
 - (d) All of the above
- (v) In *Paramecium*, food enters the body via
 - (a) cilia
 - (b) pseudopodia
 - (c) mouth
 - (d) cytostome



PRACTICE PAPER 3

OMRSHEET

Instructions

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16	(a)	(b)	(c)	(d)
17	(a)	(b)	(c)	(d)
18	(a)	(b)	(c)	(d)
19	(a)	(b)	(c)	(d)
20	(a)	(b)	(c)	(d)
21	(a)	(b)	(c)	(d)
22	(a)	(b)	(c)	(d)

23	(a)	(b)	(c)	(d)
24	(a)	(b)	(c)	(d)
25	(a)	(b)	(c)	(d)
26	(a)	(b)	(c)	(d)
27	(a)	(b)	(c)	(d)
28	(a)	(b)	(c)	(d)
29	(i) (a)	(b)	(c)	(d)
	(ii) (a)	(b)	(c)	(d)
	(iii) (a)	(b)	(c)	(d)
	(iv) (a)	(b)	(c)	(d)
	(v) (a)	(b)	(c)	(d)
30	(i) (a)	(b)	(c)	(d)
	(ii) (a)	(b)	(c)	(d)
	(iii) (a)	(b)	(c)	(d)
	(iv) (a)	(b)	(c)	(d)
	(v) (a)	(b)	(c)	(d)
31	(i) (a)	(b)	(c)	(d)
	(ii) (a)	(b)	(c)	(d)
	(iii) (a)	(b)	(c)	(d)
	(iv) (a)	(b)	(c)	(d)
	(v) (a)	(b)	(c)	(d)

Students should not write anything below this line

SIGNATURE OF EXAMINER WITH DATE	MARKS SCORED
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ANSWERS

Practice Paper 1

1. (c) 2. (c) 3. (c) 4. (a) 5. (b) 6. (c) 7. (d) 8. (d) 9. (a) 10. (d)
 11. (d) 12. (c) 13. (b) 14. (d) 15. (c) 16. (b) 17. (b) 18. (d) 19. (a) 20. (a)
 21. (a) 22. (c) 23. (c) 24. (b) 25. (a) 26. (c) 27. (b) 28. (d)
 29. (i)-(d), (ii)-(c), (iii)-(b), (iv)-(c), (v)-(a)
 30. (i)-(b), (ii)-(c), (iii)-(c), (iv)-(a), (v)-(a)
 31. (i)-(c), (ii)-(c), (iii)-(c), (iv)-(c), (v)-(b)

Practice Paper 2

1. (d) 2. (a) 3. (b) 4. (d) 5. (c) 6. (d) 7. (d) 8. (d) 9. (d) 10. (b)
 11. (b) 12. (a) 13. (d) 14. (c) 15. (a) 16. (a) 17. (b) 18. (c) 19. (d) 20. (c)
 21. (b) 22. (c) 23. (a) 24. (b) 25. (b) 26. (c) 27. (a) 28. (a)
 29. (i)-(b) (ii)-(a), (iii)-(a), (iv)-(c), (v)-(a)
 30. (i)-(c) (ii)-(a), (iii)-(c), (iv)-(a), (v)-(a)
 31. (i)-(b) (ii)-(d), (iii)-(b), (iv)-(d), (v)-(c)

Practice Paper 3

1. (b) 2. (b) 3. (a) 4. (a) 5. (b) 6. (a) 7. (c) 8. (d) 9. (c) 10. (c)
 11. (a) 12. (a) 13. (c) 14. (d) 15. (d) 16. (b) 17. (d) 18. (a) 19. (d) 20. (d)
 21. (c) 22. (a) 23. (a) 24. (d) 25. (a) 26. (a) 27. (a) 28. (a)
 29. (i)-(a), (ii)-(b), (iii)-(d), (iv)-(b), (v)-(c)
 30. (i)-(c), (ii)-(c), (iii)-(b), (iv)-(b), (v)-(b)
 31. (i)-(b), (ii)-(b), (iii)-(b), (iv)-(b), (v)-(d)