

SCIENCE

Time allowed : 3 hrs 15 Min

Maximum Marks : 90

General Instructions :

(For Regular & External Candidates)

- (i) First fifteen minutes for reading the question paper
- (ii) Only for the candidates appearing in 2019 for the first time and for unsuccessful candidates (Continuing, Compartmental, EW and External Compartmental) who appeared in 2017 & 2018 for the first time.
- (iii) Only the external Candidates will answer Group 'E'. Figures in the margin indicate full marks for each question.

GROUP 'A'

Multiple choice questions. Four alternative are given as answers for each of the following questions. Write the correct ones.

- 1.1. Which among the following gases absorb long wavelength infrared radiation emitted from the earth's surface ?
 (a) N₂ (b) O₂ (c*) CH₄ (d) He
- 1.2. At STP, 2.24 L is occupied by :
 [C = 12, O = 16, S = 32]
 (a*) 4.4 g CO₂ (b) 0.64 g of SO₂ (c) 28 g CO (d) 16g O₂
- 1.3. How many molecules of CO₂ will be produced when 1 mole C reacts completely with 1 mole O₂ ?
 (a*) 6.022 × 10²³ (b) 1.806 × 10²⁴ (c) 6.022 × 10²² (d) 6.022 × 10²⁴
- 1.4. For a solid, how many types of thermal expansion coefficients are there?
 (a) one (b) two (c*) three (d) four
- 1.5. Which one of the following has the highest wavelength?
 (a) x-ray (b) γ-ray (c*) infrared ray (d) ultraviolet ray
- 1.6. In case of refraction, if the angle of incidence and the angle of refraction are 45° and 30° respectively, then the angle of deviation is
 (a) 75° (b*) 15° (c) 7.5° (d) 37.5°
- 1.7. Temperature remaining unchanged if the potential difference between the two ends of a conductor is V and the current through the conductor is I, which of the following is true?
 (a*) V ∝ I (b) V ∝ I² (c) V ∝ I⁻¹ (d) V ∝ I⁻²
- 1.8. The relation among electromotive force (V), work (W) and charge (Q) is
 (a) Q = WV (b) Q = $\frac{V}{W}$ (c) Q = $\frac{V}{W^2}$ (d*) Q = $\frac{W}{V}$
- 1.9. For the atom produced by β-particle emission from a radioactive atom
 (a) mass number increases (b*) atomic number increases
 (c) mass number decreases (d) atomic number decreases

Sol. β Particle = e⁰₋₁

Eg. ${}^{14}_6\text{C} \rightarrow {}^{14}_7\text{N} + {}^0_{-1}\beta$, atomic number increases

- 1.10. To which group of the long periodic table to the halogen elements belong ?
 (a) group 1 (b) group 16 (c*) group 17 (d) group 2
- 1.11. Solid state of which of the following compounds is composed of ions ?
 (a*) sodium chloride (b) hydrogen chloride (c) naphthalene (d) glucose
- 1.12. Which of the following has the highest ability to conduct electricity ?
 (a) pure water (b) aqueous solution of sugar
 (c) liquid hydrogen chloride (d*) aqueous solution of acetic acid
- 1.13. In the first step of fixation of nitrogen which of the following compounds is formed as result of lightning :
 (a) NO (b*) NO₂ (c) N₂O₅ (d) HNO₃
- 1.14. Which of the following is the formula of bauxite, ore of aluminium ?
 (a) Al₂O₃ (b) Al₂O₃.H₂O (c*) Al₂O₃.2H₂O (d) AlF₃.3NaF
- 1.15. Which of the following is the alkyl group containing two carbon atoms ?
 (a) methyl (b*) ethyl (c) propyl (d) isopropyl

GROUP 'B'

2. Answer the following questions (alternatives are to be noted) :

2.1 Write down the unit of calorific value of fuel ?

OR

Does the temperature increase or decrease with increase in altitude in the stratosphere?

Sol. $\frac{\text{Joule}}{\text{kg}}$ or $\frac{\text{Kilo Joule}}{\text{kg}}$

OR

Temperature increases with altitude because a layer of ozone molecules absorb solar radiation which heat stratosphere.

2.2 Which radiation, coming from the sun, is prevented by the ozone layer from falling on earth surface ?

2.3. State whether of following statement is true or false :

The volume of gas molecules is taken into consideration in Avogadro's law.

Ans. True

2.4. The product of volume and pressure of how many gram of N₂ gas is 224 litre atmosphere at STP [N = 14]

Ans. Given PV = 224 L- atm at STP

T = 273 K, m = ?

Applying ideal gas equation PV = nRT

$$PV = \frac{m}{M} RT$$

$$224 = \frac{m}{28} \times 0.082 \times 273$$

$$m = 280 \text{ g}$$

2.5 State whether the following statement is true or false:

The constituent particles of a material change position during conduction of heat through it.

OR

The width and the cross-section of a conductor remaining unchanged, what is the relation between the thermal resistance and thermal conductivity of that conductor ?

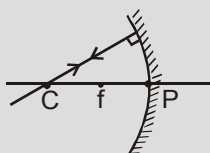
Sol. No,

OR

$$R = \frac{L}{KA}, \text{ Where } R \text{ is thermal resistance and } K \text{ is thermal conductivity.}$$

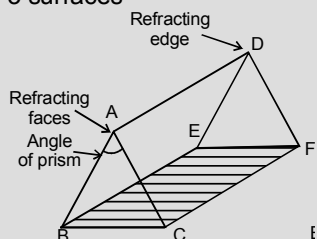
2.6 What will be the angle of incidence when a ray of light passes through the centre of curvature of a concave mirror?

Sol. 90°



2.7 How many rectangular surfaces are there in a Prism ?

Sol. 3 surfaces



2.8 Give an example of semiconductor.

Sol. Silicon (Si), Germanium (Ge)

2.9 A thin wire and a thick wire of the same conducting material have the same length. Which one of them will carry more current when connected to the same potential difference ?

Sol. $I = \frac{V}{R} = \frac{VA}{\rho l}$

$I \propto A \quad \because V, \rho, l \text{ remain same}$

Thick wire will carry more current.

2.10 Mention one misuse of nuclear fission reaction.

OR

Which law explains the release of huge amount of energy in nuclear fusion?

Sol. Nuclear bomb in war.

OR

$$E = mc^2 \text{ [Einstein's energy mass equivalence relation.]}$$

2.11. Match the right column with the left column : 1 × 4

	Left column	Left column
2.11.1	Oxide layer protects from attack by water	(a) Cu
2.11.2	Group 1 element of the long periodic table having the least reducing property	(b) Be
2.11.3	When the metal remains exposed to air, the metal	(c) Al

	slowly develops green patches on its surface	
2.11.4	Group 2 element of the long periodic table having the least atomic radius	(d) Li

sOL. 2.11.1-(c), 2.11.2-(d), 2.11.3-(a), 2.11.4-(b)
 Oxide layer protects from attack by water, Al
 Group 1 element of the long periodic table having the least reducing property, Li
 When the metal remains exposed to air, the metal slowly develops green patches on its surface, Cu.
 Group 2 element of the long periodic table having the least atomic radius, Be

2.12. Draw the Lewis dot structure of N₂ molecule (atomic number of N is 7)

Sol. : N::N:

2.13. Which kind of electricity is used in electrolysis ?

OR

Sol. Write down the cathode reaction in the electrolysis of acidulated water using platinum electrodes.

Direct electric current (DC)

OR

$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ (Hydrogen gas)

2.14. In electroplating gold brass, what is the electrolyte used ?

Sol. AuCN (Cyanaurate)

2.15. What colour is formed in the reaction of ammonia with Nessler's reagent ?

Sol. Yellow

2.16. Write down the formula of the precipitate formed when H₂S gas is passed through an aqueous solution of silver nitrate.

OR

Write the name of the compound which is formed by the reaction of nitrogen with magnesium metal at a high temperature.

Sol. Ag₂S, **OR** Mg₃N₂(s) Magnesium nitride

2.17. What is the value of H–C–H bond angle in methane ?

OR

Write the IUPAC name of CH₃CH₂COOH

Sol. 109.5° **OR** propanoic acid

2.18. What is the industrial source of CNG ?

Sol. Product of petroleum refining.

GROUP 'C'

3. Answer the following questions (alternatives are to be noted) :

3.1 What is the concept of sustainable development ?

Sol. Sustainable development involves sustainable agriculture which is farming in sustainable ways means meeting society's food and textile needs in the present without compromising the ability of future generations to meet their own needs.

3.2. 1 g of a gas at 7°C and 2 atmosphere pressure occupies a volume of 410 mL. Determine the molar mass of the gas.

(R = 0.082 litre atm⁻¹ K⁻¹)

OR

A fixed mass of gas occupies a volume of 273 cm³ at STP. At what pressure the above gas will occupy a volume of 300 cm³ at 27°C ?

Sol. $m = 1\text{g}$, $p = 2\text{ atm}$
 $T = 7^\circ\text{C} = 273 + 7 = 280\text{ K}$
 $V = 410\text{ ml} = 0.41\text{ l}$
 $M = ?$
 ideal gas equation
 $PV = nRT$

$$2 \times 0.41 = \frac{1}{M} \times 0.082 \times 280$$

$$M = 28\text{ g/mol}$$

OR

$m \rightarrow \text{fixed}$

$V_1 = 273\text{ cm}^3$ at STP

$P_1 = 1\text{ atm}$, $T_1 = 273\text{ K}$

$V_2 = 300\text{ cm}^3$

$P_2 = ?$, $T_2 = 300$

Combined gas equation

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{1 \times 273}{273} = \frac{P_2 \times 300}{300}$$

$$P_2 = 1\text{ atm}$$

3.3 What is the refractive index of a medium ?

OR

Which type of defect of vision is rectified by a convex lens ?

Sol. The refractive index of a medium may be defined in terms of the speed of light as follows :
 The refractive index of a medium for a light of given wavelength may be defined as the ratio of the speed of light in vacuum to its speed in that medium.

$$\text{Refractive index} = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$

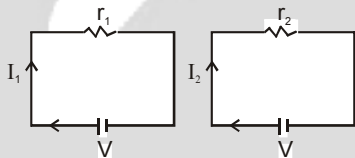
$$\text{or } \mu = \frac{c}{v}$$

OR

Far sightedness or hypermetropia.

3.4 Two resistances r_1 and r_2 , when connected separately to the same potential difference, it was seen that the current flowing through r_1 was six times the current flowing through r_2 . Determine the ratio of r_1 and r_2 .

Sol.



$$I_1 = \frac{V}{r_1}$$

$$I_2 = \frac{V}{r_2}$$

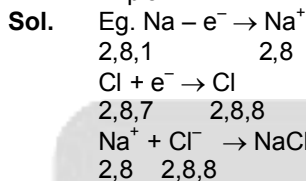
$$I_1 = 6 I_2$$

$$\frac{V}{r_1} = 6 \frac{V}{r_2} \text{ or } \frac{r_1}{r_2} = \frac{1}{6}$$

3.5. How did Kossel explain the formation of ionic bond ?

“OR”

Liquid hydrogen chloride cannot conduct electricity, but molten sodium chloride can conduct electricity. Explain



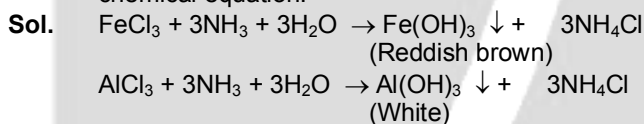
“OR”

Liquid hydrogen chloride does not produce ion but molten sodium chloride decompose to sodium ion and chloride ion which is responsible for conduction of electricity.

3.6. Distinguish between sodium chloride and naphthalene by two physical properties.

Sol. NaCl sodium chloride	Naphthalene
1. It is an ionic compound.	It is a covalent compound
2. Soluble in water	Insoluble in water
3. Non-sublime	Sublime

3.7. Between two aqueous solutions, one is ferric chloride and the other is aluminium chloride. How would you identify the ferric chloride solution using aqueous solution of ammonia ? Answer with balanced chemical equation.



3.8. Why zinc blende can be called both mineral and ore of zinc ?

OR

Mention two ways of preventing rusting of iron.

Sol. Zinc is obtained naturally from the earth crust in the form of zinc blende. From zinc blende, zinc is profitably & economically extracted. So zinc blende is mineral & ore of zinc

OR

- Galvanization - zinc metal is used for protecting iron.
- Alloying - Mix iron with other stable metal, which slow down the process of rusting.

3.9. Write with balanced chemical equation what happens when methane is burnt in oxygen.

OR

Mention one use of each of acetic acid and ethyl alcohol.



OR

Acetic acid - used in vinegar which is used in the pickling of raw vegetables.
ethyl alcohol - used in power alcohol. (Mixture of petrol & ethanol (80 : 20) good fuel for automobile.)

GROUP 'D'

4. Answer the following questions (alternatives are to be noted):

4.1. What is meant by molar volume of a gas ? Mention two reasons for deviation of real gases from the behaviour of ideal gases.

Sol. Volume occupied by one mol of gas at a given temperature and pressure is known as molar volume. Two reasons
(i) There is no forces of attraction between the molecules of gas.
(ii) Volume occupied by the molecules of gas is negligible in comparison to volume of container.

- 4.2. How many gram of Al is required to prepare 558 g of Fe by the reduction of Fe₂O₃ with Al at high temperature ? How many mole of Fe₂O₃ will be required in the reaction ?
 [Fe = 55.8, Al = 27, O = 16]

OR

By heating 32.1 g ammonium chloride with calcium hydroxide 10.2 g NH₃, 33.3 g CaCl₂, and 10.8 g H₂O are obtained. How many gram of calcium hydroxide takes part in the reaction ? How many mole of NH₃, and how many litre of NH₂ at STP are formed in the reaction ? (N = 14, H = 1)

- Sol.** 4Al + 2Fe₂O₃ → 4Fe + 2Al₂O₃
 4 × 55.8 g Fe is produced by = 4 × 27 g of Al

$$1\text{g of Fe is produced by} = \frac{4 \times 27}{4 \times 55.8} \text{ g of Al}$$

$$\therefore 558 \text{ g of Fe is produced by} = \frac{4 \times 27}{4 \times 55.8} \times 558$$

$$= 270 \text{ g of Al}$$

$$\text{mol of Fe} = \frac{\text{Mass of Fe}}{\text{molar mass}}$$

$$\text{mol of Fe} = \frac{558}{55.8}$$

$$\text{mol of Fe} = 10$$

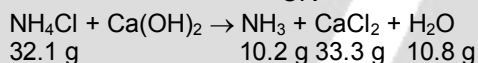
$$4 \text{ mol of Fe produced by} = 2 \text{ mol of Fe}_2\text{O}_3$$

$$1 \text{ mol of Fe produced by} = \frac{2}{4} \text{ mol of Fe}_2\text{O}_3$$

$$\therefore 10 \text{ mol of Fe produce by} = \frac{2}{4} \times 10 \text{ mol of Fe}_2\text{O}_3$$

$$= 5 \text{ mol of Fe}_2\text{O}_3$$

OR



$$32.1 \text{ g} \qquad 10.2 \text{ g} \quad 33.3 \text{ g} \quad 10.8 \text{ g}$$

Law of conservation of mass

Total mass of reactant = total mass of product

Mass of (NH₄Cl + Ca(OH)₂) = mass of (NH₃ + CaCl₂ + H₂O)

$$32.1 + x = 10.2 + 33.3 + 10.8$$

$$32.1 + x = 54.3$$

$$\text{mass of Ca}(\text{OH})_2(x) = 22.2 \text{ g}$$

$$\text{Mol of ammonia} = \frac{\text{mass of NH}_3}{\text{Molar mass}}$$

$$= \frac{10.2}{17} = 0.6$$

$$\text{Mol of ammonia} = \frac{\text{Given volume}}{22.4 \text{ l}}$$

$$0.6 = \frac{\text{Given volume}}{22.4 \text{ l}}$$

$$\text{Given volume} = 0.6 \times 22.4 = 13.44 \text{ l}$$

- 4.3 Which quantities remain fixed in the definition of volume expansion coefficient of a gas? Name a non-metal which is a good conductor of heat.

OR

What is meant by 'linear expansion coefficient of copper is 17 × 10⁻⁶/ °C' ? Why does the value remain the same even in kelvin scale?

- Sol.** Mass, number of atoms, moles of gas remain fixed in the definition of volume expansion coefficient of gas. Graphite is a nonmetal which is good conductor of heat.

OR

Liner expansion coefficient determines change in length per unit change in temperature. And unit change in temperature on both Kelvin and Celsius scales is same i.e., change of 1°C on Celsius scale is same as change of 1 K on Kelvin scale. Thus the value remains same.

4.4 What type of mirror is used by the dentists? Why a ray of light does not deviate as a result of refraction through a glass slab ?

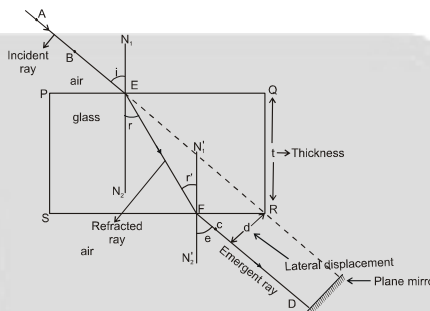
Sol. Concave mirror is used by the dentists.

Ray of light does not deviate as a result of refraction through a glass slab because

$${}_a\mu_g = \frac{10\text{cm}}{5\text{cm}} \Rightarrow {}_a\mu_g \times {}_g\mu_a = 1$$

When light travels from air to glass shows same deviation but in opposite direction when light travels from glass to air. ($\delta_1 = -\delta_2$ or $\delta_1 + \delta_2 = 0$)

$\angle e = \angle i$, hence incident ray and emergent ray are parallel and net deviation is zero.



4.5 When an object is placed 20 cm away from a convex lens, no image is obtained on either side of the lens. What is the focal length of the lens?

If the refractive index of glass with respect to air is 1.5, what is the refractive index of air with respect to glass?

OR

The length of an object is 5 cm. An image of length 10 cm is obtained when it is placed at a distance of 2cm in front of a convex lens. What is the linear magnification and image distance ?

Sol. There may be 2 possible cases for the above question

Case 1 : If image is virtual, and not obtained on screen: focal length is greater than 20 cm ($f > 20$ cm)

Case 2 : If image is real but formed at infinity: focal length is equal to 20 cm ($f = 20$ cm).

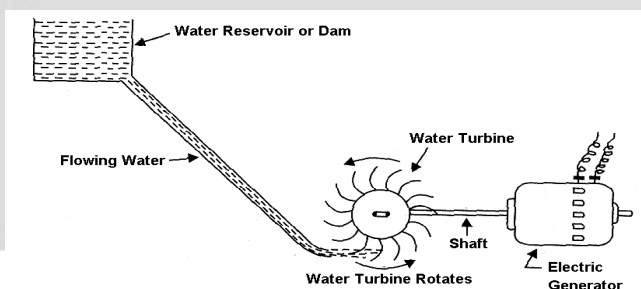
$${}_a\mu_g = 1.5 = \frac{3}{2} \Rightarrow {}_g\mu_a = \frac{2}{3}$$

OR

$$m = \frac{h_i}{h_o} = \frac{10\text{cm}}{5\text{cm}} = 2$$

4.6 Write in brief the basic principle of hydroelectric power generation.

Sol. Flowing water having a lot of kinetic energy can be utilized as hydro energy. Hydro energy can be stored by storing water in high altitude dams. Principle of hydroelectric power generation is conversion of one form of energy to another i.e., from K.E. to electric energy, through the help of turbine and generator.



4.7 A current of 1A flows when an electric bulb is connected to 220 V mains. What would be the current when the same bulb is connected to 110 V 3 mains ?

OR

Find the ratio of resistances for two bulbs of 220V-60W and 110V 60W.

Sol. $R = \frac{V}{I} = \frac{220}{1} = 220 \ \Omega$
 $I' = \frac{V'}{R} = \frac{110}{220} = 0.5 \ \Omega$

OR

$$R_1 = \frac{V_1^2}{P_1} = \frac{220 \times 220}{60}$$

$$R_2 = \frac{V_2^2}{P_2} = \frac{110 \times 110}{60}$$

$$\frac{R_1}{R_2} = \frac{4}{1}$$

4.8 Explain why a new element is formed by α -particle emission but no new element is formed by γ -ray emission from a radioactive element.

Sol. α particle is ${}^4_2\text{He}$. α emission changes the atomic number and mass number of atom and hence new element is formed.

Eg. ${}^{238}_{92}\text{U} \rightarrow {}^4_2\text{He} + {}^{234}_{90}\text{Th}$, Uranium transmuted to thorium after α -particle emission.

4.9. Write down Dobereiner's law of triads. Arrange Cl, Br, I, F in increasing order of their oxidising power.

OR

What is the important conclusion of Moseley's experiment? What is the importance of this conclusion in regard to periodic table?

Sol. Dobereiner's law

It states that atomic mass of the middle element is nearly same as the average of the atomic masses of other two elements.

Arrange the 3 elements in group with increasing atomic mass, called triads.

eg. Li, Na, K

$$\text{Atomic mass of Na} = \frac{7 + 39}{2} = 23 \text{ u}$$

Increasing order of oxidising power - $\text{I}_2 < \text{Br}_2 < \text{Cl}_2 < \text{F}_2$

OR

Moseley's (Modern periodic table)- physical & chemical properties of an element is a periodic function of their atomic number.

Importance : Using the moseley's conclusion modern periodic table is produced.

4.10. Write two difference between the conduction of electricity through a metallic wire and an electrolyte during electrolysis. In electrolytic refining of copper metal, impure copper rod is used as which electrode?

Sol. Metallic wire :

Flow of electricity takes place without the decomposition of the substance.

Conduction is due to the flow of electrons.

Electrolysis : Flow of electricity takes place with the decomposition of the substance.

Conduction is due to the flow of ions.

- Impure copper electrode is used as anode.

4.11. Write the names of the chemicals used and balanced chemical equation in the industrial production of urea.



Ammonium carbamate

- Ammonia and carbondioxide used equation in the industrial production of urea.

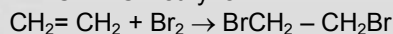
- 4.12. (A) and (B) are two unsaturated hydrocarbons, each containing 2 carbon atoms. On reaction with bromine, (A) adds one molecule of bromine per molecule and (B) adds two molecules of bromine per molecule. Write structural formula of (A) and (B). Write balanced chemical equation of reaction of (B) with bromine.

OR

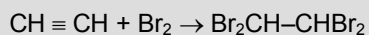
Write balanced chemical equation of the reaction of sodium hydroxide with acetic acid. Which one between jute and polyethene is environment friendly for packaging and why ?

Sol. A = CH₂ = CH₂ ethene

B = CH ≡ CH ethyne

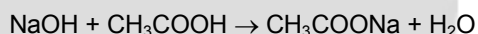


A



B

OR



Jute - Naturally occurring, easily decompose

Polythene - Synthetic polymer, hardly decompose

That why Jute is environment friendly for packaging.

GROUP 'E'

[For External Candidates Only]

5. Answer the following questions (any our) :

5.1 Give an example of a non-conventional energy with the help of which electricity can be generated.

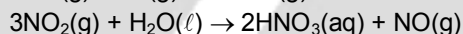
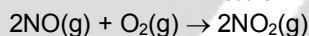
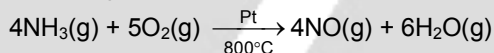
Sol. Solar energy & wind energy

5.2 Write the SI unit of electric power.

Sol. Watt or $\frac{\text{Joule}}{\text{Second}}$

5.3. Which acid is manufactured utilising catalytic oxidation of ammonia ?

Sol. Ostwald process



Nitric acid

Nitric acid is manufactured utilising catalytic oxidation of ammonia