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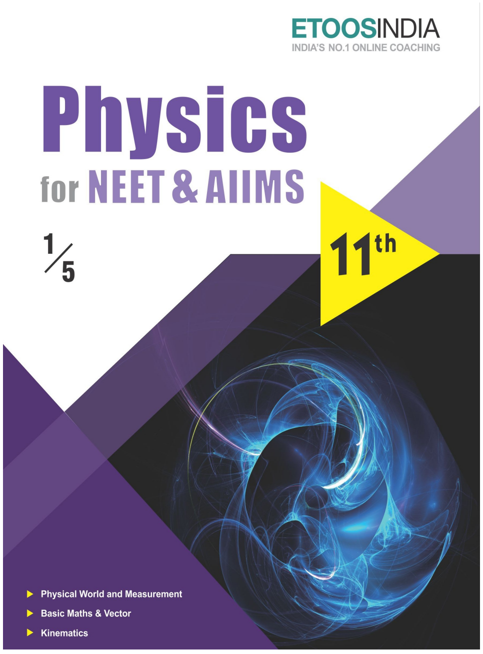


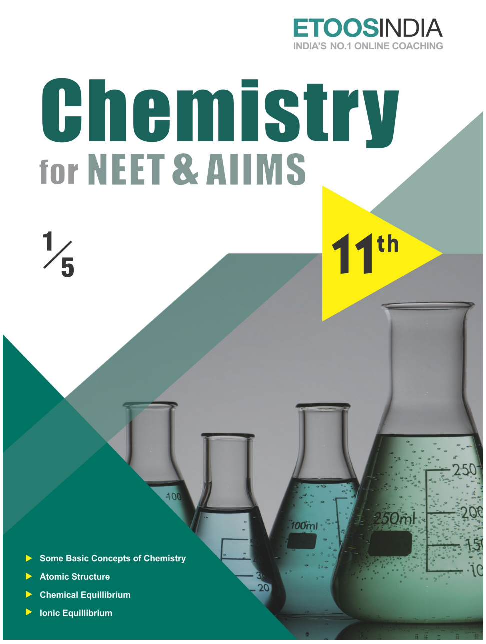


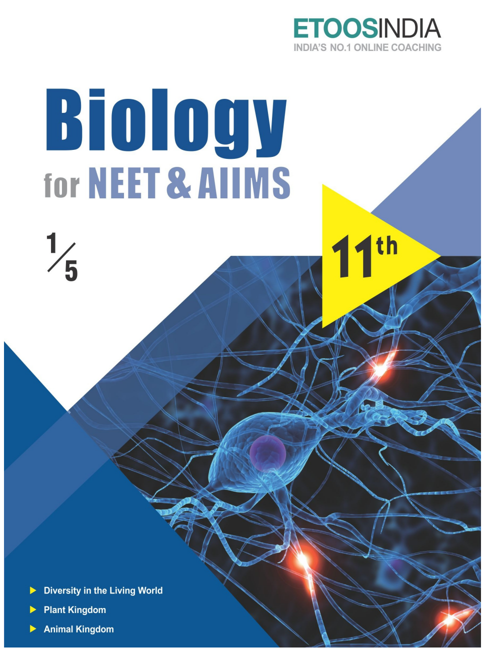


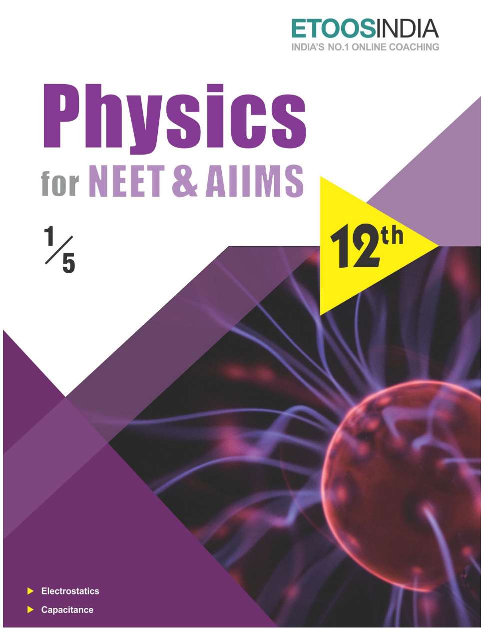


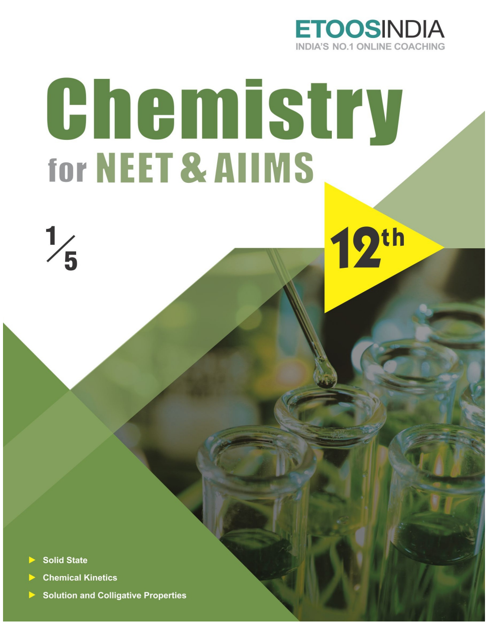


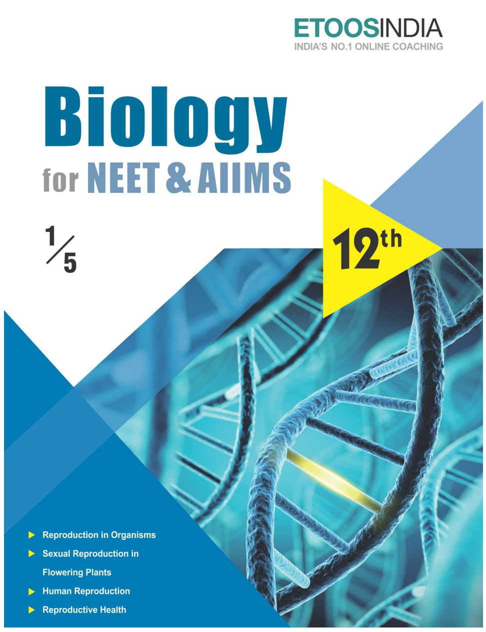


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CHAPTER 07

# STATES OF MATTER (GASEOUS AND LIQUID)

*If molecules can be structurally identical and yet possess dissimilar properties, this can be explained only on the ground that the difference is due to a different arrangement of the atoms in space.*

**" JOHANNES WISLICENUS"**

## INTRODUCTION

Matter is made up of atoms or molecules. The arrangement of these molecules determines the state of matter. There are three recognised state of matter : Solid, Liquid and Gas. Matter can change between states when the temperature or pressure is changed. State changes of matter are physical rather than chemical.

For example Water can exist as ice, which is a solid; it can exist as liquid; or it can exist in the gaseous state as water vapour or steam.Physical properties of ice, water and steam are very different,In all the three states of water chemical composition of water remain the same. Charecteristics of the three states of water depends on the energies of molecules and on the manner in which water molecules aggregate.

Chemical properties of a substance do not change with the change of its physical state; but rate of chemical reactions depands upon the physical state.

## DIFFERENCE BETWEEN STATES OF MATTER

| | Gas | Liquid | Solid |
|---|---|---|---|
| i. | Assumes the shape and volume of its container. | Assumes the shape of the part of the container which it occupies | Retains a fixed volume and shape. |
| ii. | Particles can move past one another. | Particles can move/slide past one another. | Rigid-particles locked into place. |
| iii. | Compressible, lots of free space between particles | Not easily compressible, little space between particles. | Not easily compressible, little free space between particles. |
| iv. | Flows easily, particles can move past one another. | Flows easily, particles can move/slide past one another | Does not flow easily, rigid-particles cannot move/slide one past another |
| v. | Low density. | Intermediate density. | High density. |
| vi. | Very small intermolecular attraction but high kinetic energies. | Considerable intermolecular attraction, kinetic energy is less. | Intermolecular forces are high, vibrational motion only. |

## GASEOUS STATE

### Important Properties of Gases :

**(a) Mass :** Mass in gm = Moles × Molecular mass.

**(b) Volume :** Volume of the gas is the volume of container in which they are filled in.

**(c) Temperature :** Temperature of a gas is the measure of kinetic energy of gas.
Kinetic energy $\propto$ Temperature

**(d) Pressure :** Pressure of gas is defined as the force exerted by the gas on the walls of its container. It is often assumed that pressure is isotropic, i.e. it is the same in all the three directions.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}},$$

$$P = \frac{Mg}{A} = \frac{v \times d \times g}{A} = \frac{A \times h \times d \times g}{A}$$

**P = hdg**

Where.... h = height of the mercury column supported by the barometer.
d = density of mercury.
g = acceleration due to gravity.

### Units and Determination of Pressure of Gas :

(a) In SI unit the unit of pressure is the pascal ($N/m^2$) instead, the unit bar, kPa or MPa is used.
$1 \text{ bar} = 10^5 \text{ N/m}^2 = 100 \text{ kN/m}^2 = 100 \text{ kPa}$

(b) Pressure are also stated in mm or cm of mercury.
$1 \text{ atm} = 760 \text{ mm Hg} = 1.01325 \text{ bar} = 1.01325 \times 10^5 \text{ Pa} = 101.325 \text{ KN/m}^2 = 1.0332 \text{ Kgf/cm}^2$
$1 \text{ Pa} = 1 \text{ Nm}^{-2} = 1 \text{ Kgm}^{-1} \text{ S}^{-1}$
$1 \text{L} = 1 \text{dm}^3 = 10^{-3} \text{ m}^3$ (SI unit)
$1 \text{L atm} = 101.325 \text{ J}$

$$1 \frac{KN}{m^2} = 1 \times 10^3 \frac{N}{m^2} = \frac{1 \times 10^3 \times kg}{9.8 \times 10^4 cm^2} = \frac{1}{98} \text{ kgf/cm}^2$$

$$1 \text{Torr} = \frac{101325}{760} \text{ Pa} = 133.322 \text{ Pa}$$

$$= \frac{(\text{Force / Area}) \times (\text{Area} \times \text{Length})}{\text{Mole} \times \text{Degree(K)}}$$

$$= \frac{\text{Force} \times \text{Length}}{\text{Mole} \times \text{Degree(K)}} = \frac{\text{Work or energy}}{\text{Mole} \times \text{Degree (K)}}$$

**Physical Significance of R**

The dimentions of R are energy per mole per kelvin and hence it represents the amount of work (or energy) that can be obtained from one mole of a gas when its temperature is raised by 1K.

## ETOOS KEY POINTS

**Units of R**

(i) In lit-atm $R = \dfrac{1 \text{ atm} \times 22.4 \text{ lit}}{273 \text{ K}} = 0.0821$ lit-atm $mol^{-1}K^{-1}$

(ii) In C.G.S system $R = \dfrac{1 \times 76 \times 13.6 \times 980 \text{ dyne cm}^{-2} \times 22400 \text{ cm}^3}{273 \text{ K}}$

$= 8.314 \times 10^7$ erg $mole^{-1}K^{-1}$.

(iii) In M.K.S. system R $= 8.314$ Joule $mole^{-1}K^{-1}$. [$10^7$ erg = 1 joule]

(iv) In calories $R = \dfrac{8.314 \times 10^7 \text{ erg mole}^{-1}K^{-1}}{4.184 \times 10^7 \text{ erg}}$

$= 1.987 \approx 2$ calorie $mol^{-1}K^{-1}$.

**Ex.** Some spherical balloons each of volume 2 litre are to be filled with hydrogen gas at one atm & 27°C from a cylinder of volume 4 litres. The pressure of the $H_2$ gas inside the cylinder is 20 atm at 127°C. Find number of balloons which can be filled using this cylinder. Assume that temperature of the cylinder is 27°C.

**Sol.** No. of moles of gas taken initially $= \dfrac{20 \times 4}{R \times 400} = 2.43$ L

No. of moles of gas left in cylinder $= \dfrac{1 \times 4}{R \times 300} = 0.162$L

No. of moles of gas to be filled in balloons = 2.43 – 0.162 = 2.268

Let we have 'n' balloons that we can fill

No. of moles of gas that can be filled in 1 balloon $= \dfrac{1 \times 2}{0.082 \times 300} = 0.081$

$\therefore 0.081 \times n = 2.268$

n = 28 balloons.

**Ex.** At room temperature following reaction goes to completion

$$2NO + O_2 \longrightarrow 2NO_2 \longrightarrow N_2O_4$$

Dimer $N_2O_4$ at 262 K is solid. A 250 ml flask and a 100 ml flask are separated by a stop cock. At 300 K, the nitric oxide in the large flask exerts a pressure of 1.053 atm and the smaller on contains $O_2$ at 0.789 atm. The gases are mixed by opening the stop cock and after the end of the reaction, the flasks are cooled to 220 K. Neglecting the vapour pressure of dimer. Find out the pressure and composition of gas remaining at 220 K (Assume gases behave ideally).

## Etoos Tips & Formulas

**1. GAS LAW**

**(I) Boyle's Law**

$$V \propto \frac{1}{P} (n, T = \text{co nst})$$

$$P_1V_1 = P_2V_2$$

**(II) Charle's Law**

$V \propto T$ (n, P = const)

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

**(III) Gay lussac's Law**

$P \propto T$ (n, V = const)

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

**(IV) Avogadro's Law**

$V \propto$ moles $\propto$ number of molecules (P, T = cosnt)

Ideal gas equation PV = nRT

$R = 0.0821$ lit atm $mol^{-1}$ $K^{-1}$

$R = 8.314$ J $K^{-1}$ $mol^{-1}$ or 8.314 N × $K^{-1}$ $mol^{-1}$

$R = 2$ cal $K^{-1}$ $mol^{-1}$

$R = 8.314 \times 10^7$ erg $K^{-1}$ $mol^{-1}$

**2. GRAHAM'S DIFFUSION LAW**

It is applicable for non reacting gases

$$r \propto \frac{1}{\sqrt{d}}$$

$$r \propto \frac{1}{\sqrt{VD}}$$

$$r \propto \frac{1}{\sqrt{Mw}} \quad \text{(P, T = const)}$$

$$VD = \frac{dgas}{dH_2} = \frac{Mw}{2}$$

rate of diffusion $r = \frac{\ell_{\text{diffused gas}}}{t_{\text{time taken}}}$

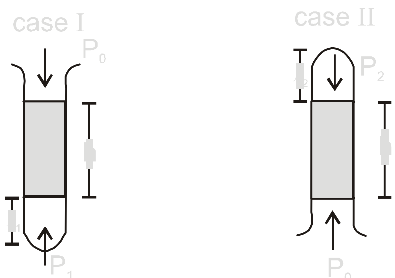
(Where, $\ell$ = distance travelled by differed gas)

$$r = \frac{V_{\text{diffused gas}}}{t_{\text{time taken}}}$$

$$r = \frac{n_{\text{diffused gas}}}{t_{\text{time taken}}}$$

## SOLVED EXAMPLE

**Ex. 1** A gas column is trapped between closed end of a tube and a mercury column of length (h) when this tube is placed with its open end upwards the length of gas column is ($\ell_1$), the length of gas column becomes ($\ell_2$) when open end of tube is held downwards. Find atmospheric pressure in terms of height of Hg column.




**Sol.** for gas $P_1 = (P_O + h)$ $\quad P_2 = (P_O - h)$

$V_1 = \pi r^2 \ell_1$ $\quad V_2 = \pi r^2 \ell_2$

at const T. and moles.

$P_1V_1 = P_2V_2$ ; $(P_O + h)\, \pi r^2 \ell_1 = (P_O - h)\, \pi r^2 \ell_2$

$P_O\ell_2 + h\ell_1 = P_O\ell_2 - h\ell_2$

$P_O\ell_2 - P_o\ell_1 = h\ell, + h\ell_2$

$$P_0 = \frac{h(\ell_1 + \ell_2)}{(\ell_2 - \ell_1)}$$ cm of Hg column **Ans.**

**Ex. 2** The diameter of a bubble at the surface of a lake is 4 mm and at the bottom of the lake is 1 mm. If atmospheric pressure is 1 atm and the temperature of the lake water and the atmosphere are equal. what is the depth of the lake ?
(The density of the lake water and mercury are 1 g/ml and 13.6 g/ml respectively. Also neglect the contribution of the pressure due to surface tension)

**Sol.** $P_1V_1 = P_2V_2$

$$\therefore\ (760\text{ mm} \times 13.6 \times g)\ \frac{4}{3}\pi(4\text{ mm}/2)^3$$

$$= (760\text{ mm} \times 13.6 \times g + h \times 1 \times g)\ \frac{4}{3}\pi(1\text{ mm}/2)^3$$

$760 \times 13.6 \times 64 = (760 \times 13.6 + h)$

$h = 64 \times 760 \times 13.6 - 760 \times 13.6$

$h = 63 \times 760 \times 13.6$ mm

$$h = \frac{63 \times 760 \times 13.6}{1000 \times 1000}\text{ km} = 0.6511\text{ km} = 651.1\text{ m}$$ **Ans.**

**Ex. 3** A gas is initially at 1 atm pressure. To compress it to 1/4 th of initial volume, what will be the pressure required ?

**Sol.** $P_1 = 1$ atm $\quad V_1 = V$

$P_2 = ?$ $\quad V_2 = \frac{V}{4}$

$P_1V_1 = P_2V_2$ $\quad$ at const. T & n

$$P_2 = \frac{P_1V_1}{V_2} = \frac{1\text{ atm} \times V}{\frac{V}{4}} = 4\text{ atm}$$ **Ans.**

**Ex. 4** Find the lifting power of a 100 litre balloon filled with He at 730 mm and 25°C. (Density of air = 1.25 g/L).

**Sol.** Since, $\quad PV = nRT$

$$PV = \frac{W}{M}RT \quad \therefore W = \frac{PVM}{RT} = \frac{730}{760} \times \frac{100 \times 4}{0.082 \times 298}\text{ g}$$

i.e., Wt. of He = 15.72 g

Wt. of air displaced = 100 × 1.25 g/L = 125 g

∴ Lifting power of the balloon = 125 g – 15.72 g

**= 109.28 g Ans.**

**Ex. 5** A weather balloon filled with hydrogen at 1 atm and 300 K has volume equal to 12000 litres. On ascending it reaches a place where temperature is 250 K and pressure is 0.5 atm. The volume of the balloon is :

**(A)** 24000 litres **(B)** 20000 litres
**(C)** 10000 litres **(D)** 12000 litres

**Sol.** Using $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ ; $\quad \frac{1\text{ atm} \times 12000\text{ L}}{300\text{ K}}$

$$= \frac{0.5\text{ atm} \times V_2}{250\text{ K}}$$

$\therefore\ V_2 = 20{,}000$ L

Hence **Ans. (B)**

**Ex. 6** If water is used in place of mercury then what should be minimum length of Barometer tube to measure normal atmospheric pressure.

**Sol.** $P_{Hg} = P_{H_2O} = P_{atm}$.

$0.76\text{ m} \times 13.6 \times g = h_{H_2O} \times 1 \times g$

$h_{H_2O} = 0.76 \times 13.6 = 10.336\text{ m}$ **Ans.**

# Exercise # 1 | SINGLE OBJECTIVE | NEET LEVEL

1. Which one of the following statements is not correct about the three states of matter i.e. solid, liquid and gaseous
(A) Molecules of a solid possess least energy whereas those of a gas possess highest energy
(B) The density of solid is highest whereas that of gases is lowest
(C) Gases like liquids possess definite volumes
(D) Molecules of a solid possess vibratory motion

2. The temperature and pressure at which ice, liquid water and water vapour can exist together are
(A) $0^o C, 1 atm$ (B) $2^o C, 4.7 atm$
(C) $0^o C, 4.7 mm$ (D) $-2^o C, 4.7 mm$

3. Which of the following is true about gaseous state
(A) Thermal energy = Molecular attraction
(B) Thermal energy >> Molecular attraction
(C) Thermal energy << Molecular attraction
(D) Molecular forces >> Those in liquids

4. Kinetic energy of molecules is highest in
(A) Gases (B) Solids
(C) Liquids (D) Solutions

5. Which of the following statement is correct
(A) In all the three states the molecules possess random translational motion
(B) Gases cannot be converted into solids without passing through liquid state
(C) One of the common property of liquids and gases is viscosity
(D) According to Boyle's law V/P is constant at constant T

6. If P, V, T represent pressure, volume and temperature of the gas, the correct representation of Boyle's law is
(A) $V \propto \frac{1}{T}$ (at constant P)
(B) $PV = RT$
(C) $V \propto 1/P$ (at constant T)
(D) $PV = nRT$

7. At constant temperature, in a given mass of an ideal gas
(A) The ratio of pressure and volume always remains constant
(B) Volume always remains constant
(C) Pressure always remains constant
(D) The product of pressure and volume always remains constant

8. Air at sea level is dense. This is a practical application of
(A) Boyle's law (B) Charle's law
(C) Avogadro's law (D) Dalton's law

9. If 20 $cm^3$ gas at 1 atm. is expanded to 50 $cm^3$ at constant T, then what is the final pressure
(A) $20 \times \frac{1}{50}$ (B) $50 \times \frac{1}{20}$
(C) $1 \times \frac{1}{20} \times 50$ (D) None of these

10. Which of the following statement is false
(A) The product of pressure and volume of fixed amount of a gas is independent of temperature
(B) Molecules of different gases have the same K.E. at a given temperature
(C) The gas equation is not valid at high pressure and low temperature
(D) The gas constant per molecule is known as Boltzmann constant

11. Densities of two gases are in the ratio 1 : 2 and their temperatures are in the ratio 2 : 1, then the ratio of their respective pressures is
(A) 1 : 1 (B) 1 : 2
(C) 2 : 1 (D) 4 : 1

12. At constant pressure, the volume of fixed mass of an ideal gas is directly proportional to
(A) Absolute temperature (B) Degree centigrade
(C) Degree Fahrenheit (D) None

13. Which of the following expression at constant pressure represents Charle's law
(A) $V \propto \frac{1}{T}$ (B) $V \propto \frac{1}{T^2}$
(C) $V \propto T$ (D) $V \propto d$

14. Use of hot air balloons in sports and meteorological obsevations is an application of
(A) Boyle's law (B) Newtonic law
(C) Kelvin's law (D) Charle's law

15. A 10 g of a gas at atmospheric pressure is cooled from 273°C to 0°C keeping the volume constant, its pressure would become
(A) 1/2 atm (B) 1/273 atm
(C) 2 atm (D) 273 atm

# Exercise # 2

SINGLE OBJECTIVE | AIIMS LEVEL

1. A and B are two identical vessels. A contains 15 g ethane at 1atm and 298 K. The vessel B contains 75 g of a gas $X_2$ at same temperature and pressure. The vapour density of $X_2$ is :
(A) 75 (B) 150
(C) 37.5 (D) 45

2. The density of neon will be highest at :
(A) STP (B) 0°C, 2 atm
(C) 273°C. 1 atm (D) 273°C. 2 atm

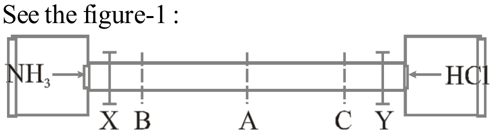
3. Equal weights of ethane & hydrogen are mixed in an empty container at 25º C, the fraction of the total pressure exerted by hydrogen is:
(A) 1: 2 (B) 1: 1
(C) 1: 16 (D) 15: 16

4. A mixture of hydrogen and oxygen at one bar pressure contains 20% by weight of hydrogen. Partial pressure of hydrogen will be
(A) 0.2 bar (B) 0.4 bar
(C) 0.6 bar (D) 0.8 bar

5. A compound exists in the gaseous phase both as monomer (A) and dimer ($A_2$). The atomic mass of A is 48 and molecular mass of $A_2$ is 96. In an experiment 96 g of the compound was confined in a vessel of volume 33.6 litre and heated to 273ºC. The pressure developed if the compound exists as dimer to the extent of 50 % by weight under these conditions will be :
(A) 1 atm (B) 2 atm
(C) 1.5 atm (D) 4 atm

6. 20 $\ell$ of $SO_2$ diffuses through a porous partition in 60 seconds. Volume of $O_2$ diffuse under similar conditions in 30 seconds will be :
(A) 12.14 $\ell$ (B) 14.14 $\ell$
(C) 18.14 $\ell$ (D) 28.14 $\ell$

7. See the figure-1 :




The valves of X and Y are opened simultaneously. The white fumes of $NH_4Cl$ will first form at:
(A) A
(B) B
(C) C
(D) A,B and C simultaneously

8. X ml of $H_2$ gas effuses through a hole in a container in 5 sec. The time taken for the effusion of the same volume of the gas specified below under identical conditions is :
(A) 10 sec. He (B) 20 sec. $O_2$
(C) 25 sec. $CO_2$ (D) 55 sec. $CO_2$

9. Three identical footballs are respectively filled with nitrogen , hydrogen and helium at same pressure. If the leaking of the gas occurs with time from the filling hole, then the ratio of the rate of leaking of gases $(r_{N_2} : r_{H_2} : r_{He})$ from three footballs under identical conditions (in equal time interval) is :
(A) $(1:\sqrt{14} : \sqrt{7})$ (B) $(\sqrt{14} : \sqrt{7} : 1)$
(C) $(\sqrt{7} : 1 : \sqrt{14})$ (D) $(1:\sqrt{7} : \sqrt{14})$

10. The rates of diffusion of $SO_3$, $CO_2$, $PCl_3$ and $SO_2$ are in the following order -
(A) $PCl_3 > SO_3 > SO_2 > CO_2$
(B) $CO_2 > SO_2 > PCl_3 > SO_3$
(C) $SO_2 > SO_3 > PCl_3 > CO_2$
(D) $CO_2 > SO_2 > SO_3 > PCl_3$

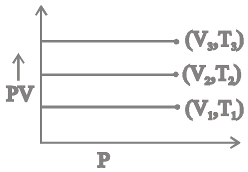
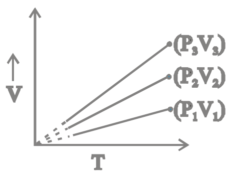
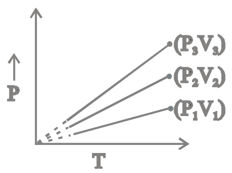
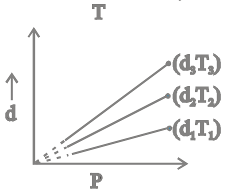
11. The kinetic energy of N molecules of $O_2$ is x joule at – 123ºC. Another sample of $O_2$ at 27ºC has a kinetic energy of 2 x. The latter sample contains ________ molecules of $O_2$.
(A) N (B) N/2
(C) 2 N (D) 3 N

12. The average kinetic energy (in joules of) molecules in 8.0 g of methane at 27º C is :
(A) $6.21 \times 10^{-20}$ J/molecule
(B) $6.21 \times 10^{-21}$ J/molecule
(C) $6.21 \times 10^{-22}$ J/molecule
(D) $3.1 \times 10^{-22}$ J/molecule

13. According to kinetic theory of gases, for a diatomic molecule :
(A) The pressure exerted by the gas is proportional to the mean velocity of the molecule.
(B) The pressure exerted by the gas is proportional to the r.m.s. velocity of the molecule.
(C) The r.m.s. velocity of the molecule is inversely proportional to the temperature.
(D) The mean translational K.E. of the molecule is proportional to the absolute temperature.

# Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. For a fixed amount of the gas match the two column :

| Column-I | Column-II |
|---|---|
| (A)   | (p) $T_1 > T_2 > T_3$ |
| (B)   | (q) $P_1 > P_2 > P_3$ |
| (C)   | (r) $V_1 > V_2 > V_3$ |
| (D)   | (s) $d_1 > d_2 > d_3$ |

2.

| Column-I | Column-II |
|---|---|
| (A) $P_1V_1 = P_2V_2 = P_3V_3 = .................$ | (1) Dalton's law of partial pressures at constant temperature |
| (B) $\frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V_3}{T_3} =$ ................ at constant pressure. | (2) Kinetic equation of ideal gases. |
| (C) $r \propto \sqrt{\frac{1}{d}}$ | (3) 22.4 litre at STP |
| (D) $P = P_1 + P_2 + P_3 + ..............$ | (4) Isotherm |
| (E) $(V-b)\left(P + \frac{a}{V^2}\right) = RT$ | (5) Isobar |
| (F) R/N | (6) Charles' law |
| (G) Molar volume | (7) Graham's law |
| (H) $PV = \frac{1}{3}mnc^2$ | (8) Boyle's law |
| (I) Graph between P and V at constant temperature | (9) Equation for real gases. |
| (J) Graph between V and T at constant pressure | (10). Boltzmann's constant. |

3.

| Column – I | Column – II |
|---|---|
| (A) At low pressure | (p) $Z = 1 + \frac{pb}{RT}$ |
| (B) At higher pressure | (q) $Z = 1 - \frac{a}{V_m RT}$ |
| (C) At low density of gas | (r) gas is more compressible than ideal gas |
| (D) For $H_2$ and He at 0°C | (s) gas is less compressible than ideal gas |

# Exercise # 4

PART - 1

PREVIOUS YEAR (NEET/AIPMT)

1. Which of the following expressions correctly represents the relationship between the average molar kinetic energy. $\overline{KE}$ of CO and $N_2$ molecules at the same temperature? **[CBSE AIPMT 2000]**
(A) $\overline{KE}_{CO} < \overline{KE}_{N_2}$
(B) $\overline{KE}_{CO} > \overline{KE}_{N_2}$
(C) $\overline{KE}_{CO} = \overline{KE}_{N_2}$
(D) Cannot be predicited unless volumes of the gases are given

2. A compound formed by elements A and B crystallises in the cubic structure, where A atoms are present at the corners of a cube and B atoms are present at the face centres. The formula of the compound is **[CBSE AIPMT 2000]**
(A) $A_2B_2$ (B) $AB_3$
(C) AB (D) A3B

3. The beans are cooked earlier in pressure cooker, because **[CBSE AIPMT 2001]**
(A) boiling point increases with increasing pressure
(B) boiling point decreases with increasing pressure
(C) extra pressure of pressure cooker, softens the beans
(D) internal energy is not lost while cooking in pressure cooker

4. Zn converts from its melted state to its solid state, it is hcp structure, then find out the number of nearest atoms. **[CBSE AIPMT 2001]**
(A) 6 (B) 8
(C) 12 (D) 4

5. The der Waals'real gas, act as an ideal gas, at which condition? **[CBSE SIPMT 2002]**
(A) High temperature, low pressure
(B) Low temperature, high pressure
(C) High temperature, high pressure
(D) Low temperature, low pressure

6. The pyknometic density of sodium chloride crystal is $2.165 \times 10^3$ kg m$^{-3}$ while its X-ray density is $2.178 \times 10^3$ kg m$^{-3}$. The fraction of unoccupied sites in sodium chloride crystal is **[CBSE AIPMT 2003]**
(A) $5.96 \times 10^{-1}$ (B) $5.96 \times 10^{-3}$
(C) 5.96 (D) $5.96 \times 10^{-2}$

7. A compound formed by elements X and Y crystallises in a cubic structure in which the X-atoms are at the corners of a cube and the Y-atoms are at the face centres. The formula of the compound is **[CBSE AIPMT 2004]**
(A) $XY_3$ (B) $X_3Y$
(C) XY (D) $XY_2$

8. The surface tension of which of the following liquids is maximum ? **[CBSE AIPMT 2005]**
(A) $H_2O$ (B) $C_6H_6$
(C) $CH_3OH$ (D) $C_2H_5OH$

9. In a face centred cubic (fcc) lattice, a unit cell is shared equally by how many unit cells ? **[CBSE AIPMT 2005]**
(A) 8 (B) 4
(C) 2 (D) 6

10. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 u and that of Br = 80 u and Avogadro number being $6.023 \times 10^{23}$ mol$^{-1}$, the density of CsBr is **[CBSE AIPMT 2006]**
(A) 42.5 g/cm$^3$ (B) 0.425 g/cm$^3$
(C) 8.25 g/cm$^3$ (D) 4.25 g/cm$^3$

11. The appearance of colour in solid alkali metal halides is generally due to **[CBSE AIPMT 2006]**
(A) F - centres (B) Schottky defect
(C) Frenkel defect (D) Interstitial positions

12. The fraction of total volume occupied by the atoms present in a simple sube is **[CBSE AIPMT 2007]**
(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3\sqrt{2}}$
(C) $\frac{\pi}{4\sqrt{2}}$ (D) $\frac{\pi}{4}$

13. If NaCl is doped with $10^{-4}$ mol % of $SrCl_2$, the concentration of cation vacancies will be ($N_A = 6.023 \times 10^{23}$ mol$^{-1}$) **[CBSE AIPMT 2007]**
(A) $6.023 \times 10^{15}$ mol$^{-1}$ (B) $6.023 \times 10^{16}$ mol$^{-1}$
(C) $6.023 \times 10^{17}$ mol$^{-1}$ (D) $6.023 \times 10^{14}$ mol$^{-1}$

## MOCK TEST

### STRAIGHT OBJECTIVE TYPE

1. If some moles of $O_2$ diffuse in 18 sec and same moles of other gas diffuse in 45 sec then what is the molecular weight of the unknown gas

(A) $\frac{45^2}{18^2}\times 32$ (B) $\frac{18^2}{45^2}\times 32$ (C) $\frac{18^2}{45^2\times 32}$ (D) $\frac{45^2}{18^2\times 32}$

2. The ratio of rates of diffusion of $SO_2$, $O_2$ and $CH_4$ is

(A) $1:\sqrt{2}:2$ (B) $1:2:4$ (C) $2:\sqrt{2}:1$ (D) $1:2:\sqrt{2}$

3. If $C_1, C_2, C_3......$ represent the speeds of $n_1, n_2, n_3.....$ molecules, then the root mean square speed is

(A) $\left(\frac{n_1C_1^2+n_2C_2^2+n_3C_3^2+.....}{n_1+n_2+n_3+.....}\right)^{1/2}$ (B) $\frac{(n_1C_1^2+n_2C_2^2+n_3C_3^2+.....)^{1/2}}{n_1+n_2+n_3+.....}$

(C) $\frac{(n_1C_1^2)^{1/2}}{n_1}+\frac{(n_2C_2^2)^{1/2}}{n_2}+\frac{(n_3C_3^2)^{1/2}}{n_3}+......$ (D) $\left[\frac{(n_1C_1+n_2C_2+n_3C_3+....)^2}{(n_1+n_2+n_3+....)}\right]^{1/2}$

4. 50 ml of hydrogen diffuses out through a small hole from a vessel in 20 minutes. The time needed for 40 ml of oxygen to diffuse out is

(A) 12 min (B) 64 min (C) 8 min (D) 32 min

5. At what temperature will the average speed of $CH_4$ molecules have the same value as $O_2$ has at 300 K

(A) 1200 K (B) 150 K (C) 600 K (D) 300 K

6. A sample of $O_2$ gas is collected over water at 23°C at a barometric pressure of 751 mm Hg (vapour pressure of water at 23° C is 21 mm Hg). The partial pressure of $O_2$ gas in the sample collected is

(A) 21 mm Hg (B) 751 mm Hg (C) 0.96 atm (D) 1.02 atm

7. In an experiment during the analysis of a carbon compound, 145 l of $H_2$ was collected at 760 mm Hg pressure and 27° C temperature. The mass of $H_2$ is nearly

(A) 10 g (B) 12 g (C) 24 g (D) 6 g

8. The volume of 1 g each of methane ($CH_4$), ethane ($C_2H_6$), propane ($C_3H_8$) and butane ($C_4H_{10}$) was measured at 350 K and 1 atm. What is the volume of butane

(A) 495 (B) 600 (C) 900 (D) 1700

9. The ratio of the rate of diffusion of helium and methane under identical condition of pressure and temperature will be

(A) 4 (B) 2 (C) 1 (D) 0.5

10. At what temperature in the celsius scale, V (volume) of a certain mass of gas at 27° C will be doubled keeping the pressure constant

(A) 54° C (B) 327° C (C) 427° C (D) 527° C

11. If pressure becomes double at the same absolute temperature on 2 L $CO_2$, then the volume of $CO_2$ becomes

(A) 2 L (B) 4 L (C) 25 L (D) 1 L

12. If density of vapours of a substance of molar masss 18gm/mole at 1 atm pressureand 500K is 0.36 kg $m^{-3}$, then value of Z for the vapours is : ( Take R = 0.082 L atm $mole^{-1}$ $K^{-1}$)

(A) $\frac{41}{50}$ (B) $\frac{50}{41}$ (C) 1.1 (D) 0.9

# 11th Class Modules Chapter Details

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Modules

Mathematics
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## PHYSICS

### Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

### Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

### Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

### Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

### Module-5

1. Oscillations
2. Waves

## CHEMISTRY

### Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

### Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

### Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

### Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

### Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

## BIOLOGY

### Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

### Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

### Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

### Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

### Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

# 12th Class Modules Chapter Details

Physics
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Chemistry
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Mathematics
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## PHYSICS

### Module-1
1. Electrostatics
2. Capacitance

### Module-2
1. Current Electricity
2. Magnetic Effect of Current and Magnetism

### Module-3
1. Electromagnetic Induction
2. Alternating Current

### Module-4
1. Geometrical Optics
2. Wave Optics

### Module-5
1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

## CHEMISTRY

### Module-1(PC)
1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

### Module-2(PC)
1. Electrochemistry
2. Surface Chemistry

### Module-3(IC)
1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

### Module-4(OC)
1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

### Module-5(OC)
1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

## BIOLOGY

### Module-1
1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

### Module-2
1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

### Module-3
1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

### Module-4
1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

### Module-5
1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues