ICSE 2025 EXAMINATION

Sample Question Paper - 5

Chemistry

Time: 2 Hours. **Total Marks: 80**

Maximum Marks: 80
Time allowed: Two hours
Answers to this paper must be written on the paper provided separately.
You will not be allowed to write during first 15 minutes.
This time is to be spent in reading the question paper.
The time given at the head of this paper is the time allowed for writing the answers.

***Section A** is compulsory. Attempt any four questions from **Section B**.*
The intended marks for questions or parts of questions are given in brackets [ ].

SECTION-A

(*Attempt **all** questions from this Section*)

Question 1

Choose one correct answer to the questions from the given options: [15]

(i) In a chemical equation, evolution of gas is indicated by:
- (a) An arrow pointing upwards
- (b) An arrow pointing downwards
- (c) By writing (aq)
- (d) A horizontal arrow

(ii) An electrolytic decomposition reaction can be used:
- (a) To obtain metals from their ores.
- (b) In photography.
- (c) To produce salts.
- (d) For photosynthesis in plants.

(iii) The homogeneous soilds, arranged symmetrically, directed at definite angles and having a definite geometrical shapes are called:
- (a) Cubes
- (b) Crystals
- (c) Amorphous solid
- (d) Solid

(iv) How many elements were known when Mendeleev started his work on his periodic table?

(a) 55
(b) 63
(c) 45
(d) 69

(v) **Assertion (A)**: All temperatures in the absolute (Kelvin) scale are in positive figures.
Reason (R): Celsius scale includes only positive values.
(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.

(vi) The proton has a change equal in magnitude but opposite in sign to that of:
(a) Neutron
(b) Electron
(c) Canal rays
(d) Deuteron

(vii) When water is added to quicklime, rise in temperature is observed. This is an example of:
(a) Photochemical reaction
(b) Endothermic reaction
(c) Exothermic reaction
(d) Electrochemical reaction

(viii) Efflorescent salts are:
(a) Salts that lose water of crystallisation when exposed to air
(b) Salts that gain water of crystallisation when exposed to air
(c) Salts that are easily soluble in water
(d) Both a and c

(ix) The ratio of solute and solvent in a concentrated solution is:
(a) More solute less solvent
(b) Less solute more solvent
(c) Equal quantities of solute and solvent
(d) All the above

(x) Newland classification of elements did not include:
(a) Metals
(b) Noble gases
(c) Non-metals
(d) Metalloids

(xi) **Assertion (A)**: Potassium and sodium are used for reaction with dil. Hydrochloric acid in laboratory preparation of hydrogen.
Reason (R): Potassium and sodium reacts violently with dil. HCl and dil. H_2SO_4
(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.

(xii) The metal oxide which is reduced by hydrogen is:
(a) Al_2O_3
(b) CuO
(c) CaO
(d) Na_2O

(xiii) In absolute scale, temperature is expressed in terms of:
(a) Fahrenheit
(b) Celsius
(c) Kelvin
(d) Atmosphere (atm)

(xiv) The mathematical expression for Boyle's law is
(a) PV = Constant
(b) P × Constant = V
(c) V/P = Constant
(d) V × Constant = P

(xv) Taj Mahal has recently shown discolouration and damage. The most probable reason for this is:
(a) Acid rain
(b) Storm
(c) Old age of the monument
(d) Ultraviolet rays damage

Question 2

(i) Elements of the periodic table with atomic numbers from 3 to 18 are shown in the table below. Some elements are shown by letters even though the letters are not the usual symbols of the elements. [5]

3	4	5	6	7	8	9	10
A	B	C	D	E	F	G	H
11	12	13	14	15	16	17	18
I	J	K	L	M	N	O	P

Which of these is

(a) A noble gas

(b) A halogen

(c) An alkali metal

(d) An element with valency 4

(e) An element with valency 2

(ii) Complete the following table which refers to the action of heat on three substances named in the first column. [5]

Substances	Colour before heating	Colour of the residue	Name of the gas	Name of the residue
(i) Cupric carbonate	-	-	-	-
(ii) Lead nitrate	-	-	-	-
(iii) Ammonium dichromate	Orange	-	Nitrogen	-

(iii) Fill in the blanks: [5]

(a) Pollutants such as NO_2, SO_2 and SO_3 dissolved in the moisture of air are the cause of _____.

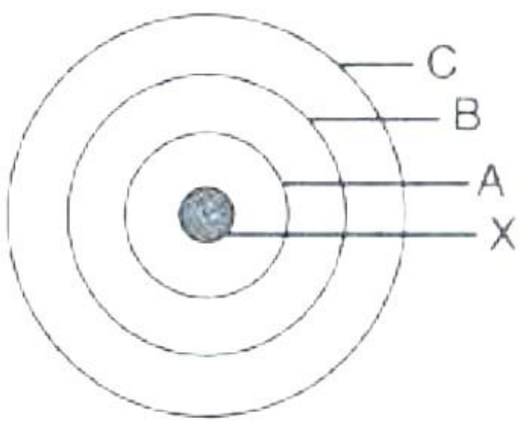
(b) Excessive release of carbon dioxide in the atmosphere is the cause of _____ effect which produces global warming.

(c) The ozone layer prevents the harmful _____ radiation of the sun from reaching the earth.

(d) Decrease of the concentration of ozone in the stratosphere is the cause of formation of _____ holes.

(e) Ozone depletion is mainly caused by the active _____ atoms generated from CFC in the presence of UV radiation.

(iv) In the given figure: [5]



Name the shells denoted by A, B, and C. Which shell has least energy?

(a) Name X and state the charge on it.

(b) The above sketch is of ..... model of an atom.

(v) [5]

(a) Deduce the molecular formula of the following compounds:

1. Ammonium dichromate
2. Lead nitrate
3. Ferrous chloride

(b) What is the valency of the underlined element in the following compounds?

1. $\underline{Mg}_3N_2$
2. $\underline{Mn}O_2$

SECTION-B

(Attempt any four questions)

Question 3

(i) Give reason: [2]

(i) Why do clothes dry up faster in an open ground than in a closed room?

(ii) Why does a desert cooler cool better on a hot dry day?

(ii) Explain with an example the following characteristics of a chemical reaction. [2]

(a) Evolution of gas

(b) Change of colour

(iii) Classify below salts as deliquescence, hygroscopic, and desiccants. [3]

$CuSO_4$, Glauber salt, $FeCl_2$, CuO, $MgCl_2$, Washing soda

(iv) Discuss any three pollutants based on the following points. [3]

(a) Origin

(b) Harmful effect

Question 4

(i) Explain closed physical contact with an example: [2]

(ii) Draw a neat and labelled diagram of Bohr's model of an atom. [2]

(iii) Rutuja went to see a paint factory along with her father who resided beside a nallah. She was in pain to see the dirty colour of water and enquired about it to her father. Her father explained to her that it was because of the pollutants flushed into the nallah. Can you write about different causes of water pollution? [3]

(iv) Write whether the given statement is True/False. [3]

(a) The constant temperature at which a gas changes into a liquid by giving out heat energy, is called the freezing point of that liquid.

(b) Ice at 0 K is more effective in cooling a substance than water at 0 K.

(c) A liquid flows easily because its particles are able to slide over one another.

Question 5

(i) Draw an orbital diagram of bonding between two oxygen atoms. [2]

(ii) Write an example with a balanced reaction of: [2]
   (a) Thermal decomposition
   (b) Electrical decomposition

(iii) Hydrogen may be prepared in the laboratory by the action of a metal on an acid. [3]
   (a) Which of the metals copper, zinc, magnesium or sodium would be the most suitable?
   (b) Which of the acids dilute sulphuric, concentrated sulphuric, dilute nitric acid and concentrated nitric acid would you choose? Explain why you would not use the acids you reject.
   (c) How would you modify your apparatus to collect dry hydrogen? Which drying agent would you employ for this purpose?

(iv) Complete the following two reactions. Write similarity and difference regarding the type of reaction between below two reactions. [3]
   (a) $NaOH + HCl \rightarrow$
   (b) $Na_2SO_4 + BaCl_2 \rightarrow$

Question 6

i. State the valency and formula of the following ions: [2]
   (a) Ammonium ion
   (b) Cupric ion

ii. Write two impacts of acid rain. [2]

iii. Explain similarities of hydrogen each with group 1 and group 17 elements based on following points : [3]
   (a) Electronic configuration
   (b) Ion formation
   (c) Valency

iv. A gas is enclosed in a vessel at standard temperature. At what temperature will the volume of a gas enclosed be $\frac{1}{6}$th of its initial volume at constant pressure? [3]

Question 7

i. Deduce the molecular formula of the following conversions: [3]

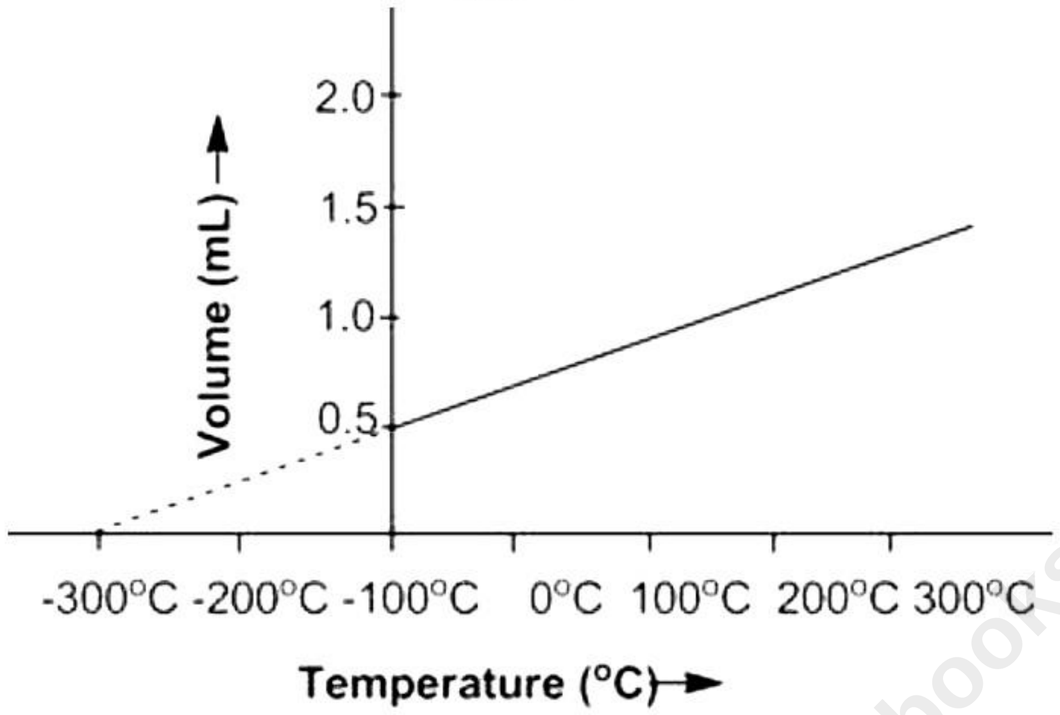
(a) Potassium dichromate

(b) Lead chromate

(c) Calcium carbonate

ii. Define solubility. Explain factors affecting solubility? [3]

iii. Observe the following graph and answer the following questions: [4]



(a) Name and state the law expressed by the given graph.

(b) Derive the mathematical expression for it.

(c) Give one application of the above law.

Question 8

i. The following questions are related to the long form of the periodic table. [2]

(a) State the modern periodic law.

(b) In which group are halogens placed in the long form of the periodic table?

ii. [2]

(a) 1 atmosphere =_____ cm. Hg =_____ mm Hg

(b) A _____ in the pressure at a constant temperature increases the volume of a gas.

iii. Explain with balanced reaction the action of cold water on: [3]

(a) Potassium

(b) Sodium

(c) Calcium

iv. What is the effect of chlorofluorocarbon on ozone layer? Explain in detail.

Solution

SECTION A

Solution 1

(i) (a)
(ii) (a)
(iii) (b)
(iv) (b)
(v) (c)
(vi) (b)
(vii) (c)
(viii) (a)
(ix) (a)
(x) (b)
(xi) (a)
(xii) (b)
(xiii) (c)
(xiv) (a)
(xv) (a)

Solution 2

(i)

(a) H and P are noble gases.
(b) G and O are halogens.
(c) A and I are alkali metals.
(d) D and L have valency 4.
(e) B and J have valency 2.

(ii)

Substances	Colour before heating	Colour of the residue	Name of the gas	Name of the residue
(i) Cupric carbonate	Green	Black	Carbon dioxide	Copper oxide
(ii) Lead nitrate	White	Reddish Yellow light yellow	Nitrogen dioxide and oxygen	Lead oxide
(iii) Ammonium dichromate	Orange	Green	Nitrogen and Water vapour	Chromium oxide

(iii)

(a) acid rain
(b) greenhouse
(c) ultraviolet
(d) ozone
(e) chlorine

(iv)

(a) A is for the K shell or I shell.
B is for the L shell or II shell.
C is for the M shell or III shell.
Shell K has the minimum amount of energy.

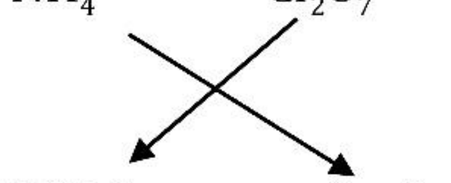
(b) X is a nucleus; it is positively charged.

(c) The above sketch is of the Bohr model of an atom.

(v)

(a)

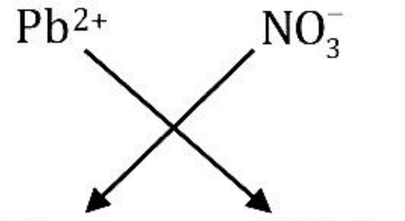
1. NH_4^+ $Cr_2O_7^{2-}$



$(NH_4)_2$ Cr_2O_7

$= (NH_4)_2Cr_2O_7$

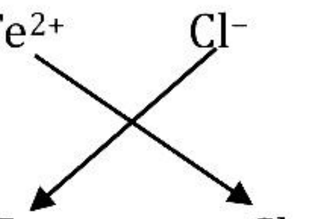
2. Pb^{2+} NO_3^-



Pb_1 $(NO_3)_2$

$= Pb(NO_3)_2$

3. Fe^{2+} Cl^-



Fe_1 Cl_2

$= FeCl_2$

(b)

1. +2
2. +4

SECTION-B

(Attempt any four questions)

Solution 3

(i)

(a) In open ground, the high speed of wind increases the evaporation rate; hence, wet clothes dry up faster.

(b) On a hot day, due to an increase in temperature, the rate of evaporation of water is high. Also, the dryness of the air, i.e., a decrease in the humidity of the air increases the rate of evaporation. Therefore, a desert cooler cools better on a hot dry day.

(ii) Characteristics of a chemical reaction:

(a) Evolution of gas: In a chemical reaction, a gas may be one of the products.
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$

(b) Change of colour: Some chemical reactions are characterised by a change in the colour of the reactants.
$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

(iii)

(a) Effervescent: Washing soda, Glauber's salt
(b) Deliquescence: $FeCl_2$, $MgCl_2$
(c) Hygroscopic: CuO, $CuSO_4$

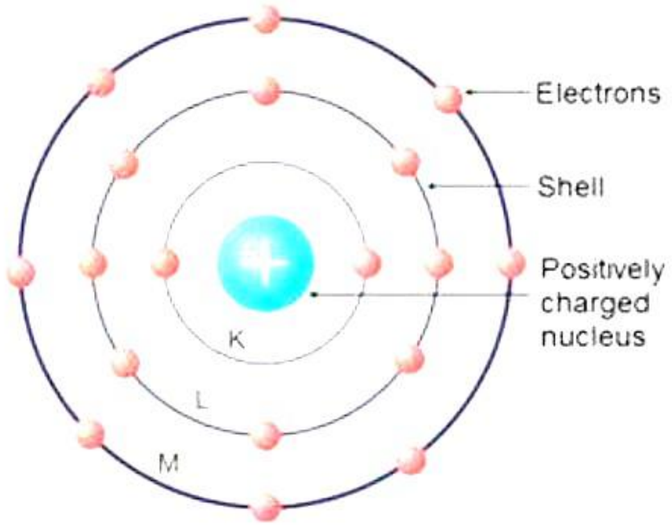
(iv)

Pollutants	**Origin**	**Harmful effect**
Carbon monoxide (CO)	It is produced by the incomplete combustion of fuels such as petrol, diesel, and wood and also cigarettes.	It reduces oxygen carrying capacity of blood which causes retardation and dizziness.
Carbon dioxide (CO_2)	It is produced by the burning of coal, oil, and natural gases.	It reduces oxygen levels.
Chlorofluorocarbons (CFC)	It is released by refrigerators and air conditioning systems.	It causes a reduction in the ozone layer that protects us from the harmful ultraviolet rays of the Sun.

Solution 4

i. Closed physical contact (mixing): A chemical reaction occurs when two substances are mixed in a solid state. Example: Iodine and sulphur react explosively when brought into close contact. When sodium metal comes in contact with cold water, it reacts violently and an explosion reaction occurs.

ii. Bohr's model of atom:



Niels Bohr's Atomic Model

iii. Causes of Water Pollution:

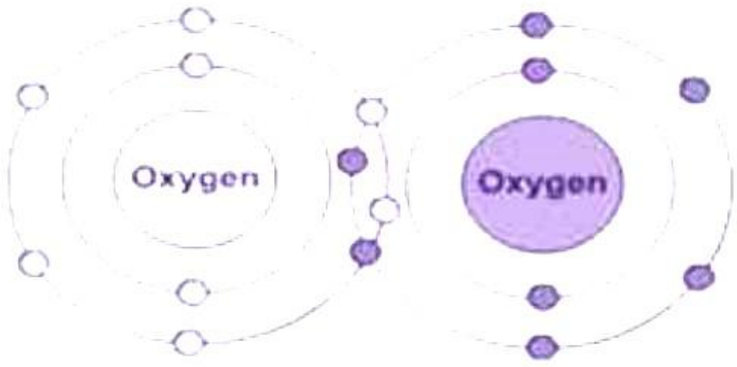
1. Household detergents – Chemical cleaning organic substances.
2. Industrial waste – Waste from industrial sources that contain harmful toxic chemicals.
3. Domestic sewage – Waste water from household activities which contain both organic and inorganic materials
4. Offshore oil drilling – Exploring of oil and gas below the ocean floors releases drilling fluids and causes oil spills which result in the pollution of marine water.
5. Agricultural wastes – Residues of agricultural work such as pesticides, fertilisers, etc. pollute water.
6. Thermal pollution – Elevated water temperatures decrease oxygen levels, kill marine organisms and affect ecosystem composition.

iv.

(a) False. The constant temperature at which a liquid changes into a solid by giving out heat energy, is called the freezing point of that liquid.
(b) False. Ice at 273 K is more effective in cooling a substance than water at 273 K.
(c) True. Liquid flows easily because its particles are able to slide over one another due to weak inter particle forces of attraction.

Solution 5

(i) Bonding between two oxygen atoms: A double covalent bond is formed by sharing two pairs of electrons between two oxygen atoms, each contributing two electrons.



(ii)

(a) Thermal decomposition: A decomposition reaction brought about by heat.

$$2KClO_3 \xrightarrow{\text{Heat}} 2KCl + 3O_2 \uparrow$$

(b) Electrical decomposition: On passing an electric current through acidulated water, water produces two volumes of hydrogen gas and one volume of oxygen gas.

$$2H_2O_{(l)} \xrightarrow{\text{Electric Current}} 2H_{2(g)} + O_{2(g)}$$

(iii)

(a) Zinc is the most preferred metal in the laboratory preparation of hydrogen.

(b) Dilute sulphuric acid.

Conc. nitric acid, even in its dilute form, is not used in the preparation of hydrogen from metals because it is a powerful oxidising agent. Oxygen formed due to its decomposition oxidises hydrogen to give water, thus defeating the purpose of the reaction.

Conc. Sulphuric acid is not used in the preparation of hydrogen as it will produce sulphur dioxide.

(c) The gas is collected by the downward displacement of water.

Common drying agents such as fused calcium chloride, caustic potash stick and phosphorous pentoxide remove water vapour.

(iv)

(a) $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

(b) $Na_2SO_4(aq) + BaCl_2 \rightarrow BaSO_4(s) + 2NaCl(aq)$

Similarity: A reaction in which ions of the reactants exchange places to form two new compounds, hence both the reactions are double displacement reactions.

Difference: The reaction (a) is just double displacement where there is no precipitation. While reaction (b) is a type of double decomposition or precipitation where an insoluble solid ($BaSO_4$) formed.

Solution 6

(i)

		Valency	Formula
(a)	Ammonium ion	+1	NH_4^+
(b)	Cupric ion	+2	Cu^{2+}

(ii) Impacts of acid rain:

(a) Changes the acidity of soil

The acids present in acid rain such as nitric acid, nitrous acid, sulphuric acid and sulphurous acid increase the acidity of soil. It removes calcium and potassium minerals, i.e. the basic ingredients from the soil lose their fertility.

The hydrogen ions H^+ which are added to the soil when acid rain falls to the Earth interact chemically with existing soil minerals.

$H_2SO_4 + H^+ \rightleftharpoons 2\,H^+ + SO_4^{2-}$

(b) Affects water bodies and marine organisms

The water of lakes and rivers becomes acidic and may no longer support aquatic life.

(iii)

	Points	The similarity of hydrogen with alkali metals [Group 1 (IA)]	The similarity of hydrogen with halogens [Group 17 (VIIA)]
(a)	**Electronic configuration**	Electronic configuration = 1. Thus, 1 electron in the outermost valence shell. Example: H = **1**; Li = 2, **1**; Na = 2, 8, **1**; K = 2, 8, 8, **1**	One electron is less than the nearest noble gas. Example: H = 1 (He = 2) F = 2, 7 (Ne = 2, 8) Cl = 2, 8, 7 (Ar = 2, 8, 8)
(b)	**Ion formation**	Electropositive character exhibited. $H - 1e^- \rightarrow H^{1+}$ $Li - 1e^- \rightarrow Li^{1+}$ $Na - 1e^- \rightarrow Na^{1+}$	Electronegative character exhibited. $H + 1e^- \rightarrow H^{1-}$ $F + 1e^- \rightarrow F^{1-}$ $Cl + 1e^- \rightarrow Cl^{1-}$
(c)	**Valency**	Electrovalency of one exhibited. H^{1+}, Li^{1+}, Na^{1+}	Electrovalency and covalency exhibited. Hydrogen forms NaH (electrovalent) CH_4 (covalent) Chlorine forms NaCl (electrovalent) CCl_4 (covalent)

(iv)

Let the initial volume of gas (V_1) = x

Initial temperature of gas (T_1) = 0°C

= 0 + 273 K = 273K

Final volume (V_2) = $\frac{x}{6}$

Final temperature $(T)_2$ =?

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

$$\frac{x}{T_1} = \frac{x}{6 \times T_2}$$

$$T_2 = \frac{273x}{6 \times x} = 45.5 \text{ K}$$

= 45.5 – 273

= –227.5°C

Solution 7

(i)

(a) K^+ $Cr_2O_7^{2-}$

K_2 Cr_2O_7

= $K_2Cr_2O_7$

(b) Pb^{2+} CrO_4^{2-}

Pb_1 $(CrO_4)_1$

= $PbCrO_4$

(c) Ca^{2+} CO_3^{2-}

Ca_2 $(CO_3)_2$

= $CaCO_3$

(ii) Solubility of a solute in a particular solvent at a particular temperature is the maximum amount of a solute in a gram that can be dissolved in 100 grams of a solvent at that temperature.

Factors Affecting Solubility:

1. Size of solute particles: The smaller the size of solute particles, the greater will be the solubility of that solute.
2. Stirring: It brings more of the solvent in contact with the solute, thus, increasing the rate of the formation of the solution.
3. Temperature: The solubility of a solid solute increases with an increase in temperature.
   i. Solubility of a gas solute decreases with an increase in temperature.
   ii. The solubility of a gas solute increases with an increase in pressure.

(iii)

(a) Charles' law: Pressure remaining constant, the volume of a given mass of a dry gas increases or decreases by 1/273 of its volume at 0 °C for each 1 °C increase or decrease in temperature respectively.

(b) Mathematical expression for Charles' law:

Let V_0 be the volume of a fixed mass of a gas at 0 °C, and let V be its volume at temperature t °C at constant pressure. Then, according to Charles' law,

$$V = V_0 + \frac{V_0}{273}t \quad (\text{when P is constant})$$

$$V = V_0\left(1 + \frac{t}{273}\right) = V_0\left(\frac{273 + t}{273}\right)$$

For a given mass of a gas,

$$\frac{V_0}{273} = \text{constant}$$

$$\therefore V = k \times T \,(\text{where k is constant})$$

$$\text{or } V \alpha T \text{ and } \frac{V}{T} = k$$

Charles' law may be restated as the volume of a given mass of dry gas is directly proportional to its absolute (Kelvin) temperature if the pressure remains constant.

Suppose, a gas occupies V_1 cm^3 at T_1 temperature and V_2 cm^3 at T_2 temperature, then by Charles' law,

$V_1 \alpha T_1$ and $V_2 \alpha T_2$

Or $V_1 = kT_1$ and $V_2 = kT_2$ (k is constant)

$$\frac{V_1}{T_1} = k \text{ and } \frac{V_2}{T_2} = k$$

$$\therefore \frac{V_1}{T_1} = \frac{V_2}{T_2} = k \,(\text{at constant pressure})$$

This is called Charles' law equation.

(c) Application of Charles' law:
The volume of a given mass of a gas is directly proportional to its temperature, hence density decreases with an increase in temperature. This is the reason why hot air is filled into balloons used for meteorological purposes.

Solution 8

(i)

(a) The physical and chemical properties of the elements are the periodic functions of their atomic numbers.

(b) Group 17

(ii)

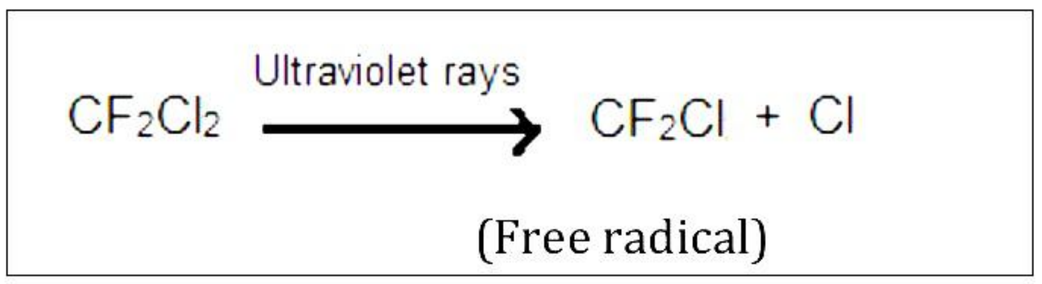
(a) 1 atmosphere = 76 cm. Hg = 760 mm Hg

(b) A decrease in the pressure at a constant temperature increases the volume of a gas.

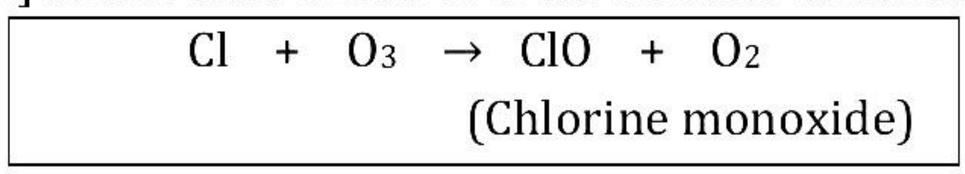
(iii) General methods of preparation of hydrogen by the reaction of metals with cold water form metal hydroxide and liberate hydrogen gas.

	Metal	**Reaction**	**Reason why the method is not preferred**
(a)	Potassium	$2K + 2H_2O \rightarrow 2KOH + H_2\uparrow$	The reaction is violent and exothermic. The heat liberated during the reaction ignites hydrogen.
(b)	Sodium	$2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$	The reaction is violent but comparatively less violent than potassium. Sodium melts into a silvery globule and darts about the water.
(c)	Calcium	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2\uparrow$	The reaction is slightly vigorous, but calcium is quite expensive. Hence, it is economically not viable.

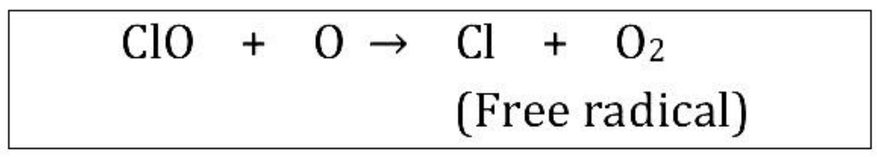
(iv) Excessive use of chlorofluorocarbon is one of the reasons for ozone layer depletion.
It is released by refrigerators and air conditioning systems.
It causes a reduction in the ozone layer that protects us from harmful ultraviolet rays (UV radiations) of the Sun.
The chlorofluorocarbons are decomposed by the ultraviolet rays to highly reactive chlorine which is produced in the atomic form.



The free radical [Cl] reacts with ozone to form chlorine monoxide.



This causes depletion of the ozone layer. Chlorine monoxide then reacts with atomic oxygen to produce more chlorine free radicals.



This free radical destroys ozone, and the process continues depleting the ozone layer.