Previous IPE

SOLVED PAPERS

MARCH-2023 (AP)

PREVIOUS PAPERS

IPE: MARCH-2023(AP)

Time : 3 Hours **JR.CHEMISTRY** Max.Marks : 60

SECTION-A

I. Answer ALL questions : $10 \times 2 = 20$

1. Name two adverse effects caused by acid rains.
2. What is Lewis acid? Give one example?
3. Give the values of gas constant R in different units.
4. What happens when magnesium metal is burnt in air?
5. How many number of moles of glucose are present in 540 grams of glucose.
6. What are the 'ΔH' sign conventions for exothermic and endothermic reactions?
7. Write the conformations of ethane.
8. State and explain the Hess's law of constant Heat summation.
9. Why is gypsum added to cement?
10. What is Chemical Oxygen Demand (COD)?

SECTION-B

II. Answer any SIX of the following Questions. $6 \times 4 = 24$

11. Write a few lines on the utility of hydrogen as a fuel.
12. Explain the difference in properties of diamond and graphite on the basis of their structure.
13. State Fajan's rules and give suitable examples.
14. Deduce (a) Graham's law and
    (b) Dalton's law of partial pressures from kinetic gas equation.
15. Discuss the application of Le-Chatelier's principle for the industrial synthesis of Ammonia.
16. Chemical analysis of a carbon compound gave the following percentage composition by weight of the elements present, carbon = 10.06% , hydrogen = 0.84 % , chlorine = 89.10% . Calculate the empirical formula of the compound.
17. Give two methods of preparation of diborane.
18. Explain the formation of Coordinate Covalent bond with one example.

SECTION-C

III. Answer any TWO of the following Questions. $2 \times 8 = 16$

19. Describe two methods of preparation of Ethane. Give any three reactions of ethane.
20. What are the postulates of Bohr's model of hydrogen atom? Discuss the importance of this model to explain various series of line spectra in hydrogen atom.
21. Write an essay on s,p,d and f block elements.

RAPIDBULLET.Q

IPE AP MARCH-2023
ANSWERS

SECTION-A

1. Name two adverse effects caused by acid rains.

A: 1) Acid rains reduce the **life of buildings** and historical monuments .

2) Acid rains decrease the **fertility of soil** by reducing the pH values of the soil.

3) Acid rains decrease quality of **drinking water** .

4) Acid rains decrease the **productivity of fish** in water.

---

2. What is Lewis acid? Give one example?

A: 1)**Lewis acid:** An electron pair acceptor is called Lewis acid.

2) **Ex:** BF_3, CO_2, H^+

---

3. Give the values of gas constant R in different units.

A: Different units of Gas constant 'R' :

R = 0.0821 L. atm. K^{-1} mol^{-1}

= 8.314×10^7 ergs. K^{-1} mol^{-1}

= 8.314 J. K^{-1} mol^{-1}

= 1.987 cal. K^{-1} mol^{-1}

---

4. What happens when magnesium metal is burnt in air?

A: 1) When Magnesium is burnt in air, it burns with dazzling light and gives MgO and Mg_3N_2.

2) $2\ Mg + O_2 \rightarrow 2\ MgO$; $3\ Mg + N_2 \rightarrow Mg_3N_2$

BABY BULLET-Q

5. How many number of moles of glucose are present in 540 grams of glucose.

A: Weight of glucose= 540 g

GMW of glucose ($C_6H_{12}O_6$) = 180

Number of moles = $\frac{\text{Weight of the substance}}{\text{G M W of the substance}} = \frac{540}{180} = 3.$

---

6. What are the 'ΔH' sign conventions for exothermic and endothermic reactions?

A: 1) ΔH = –ve ⇒ Exothermic reactions (System looses heat energy).

2) ΔH = +ve ⇒ Endothermic reactions (System gains heat energy).

---

7. Write the conformations of ethane.

A: Conformational isomers are due to rotation along C-C single bond in alkanes.

Conformations of ethane: Free rotation about C-C single bond in ethane gives an infinite number of conformers. Out of these, Eclipsed and Staggered conformations are most significant.

---

8. State and explain the Hess's law of constant Heat summation.

A: **Hess Law:**'The total heat change in a chemical reaction is the same, whether the chemical reaction takes place in one step or several steps'.

---

9. Why is gypsum added to cement?

A: 1) Gypsum is added to cement to increase the setting time.

2) So, the process of setting of the cement becomes slow and cement gets sufficiently hardened.

---

10. What is Chemical Oxygen Demand (COD)?

A: **1) Chemical Oxygen Demand (COD):** It is the 'amount of oxygen required' to oxidise organic substances present in the polluted water.

2) It is used to measure the 'degree of pollution of water'.

BABY BULLET-Q

SECTION-B

11. Write a few lines on the utility of hydrogen as a fuel.

A: 1) Hydrogen has high 'Heat of combustion'. When compared to any other fuels like methane, L.P.G etc. Hence it is used for industrial purposes.

2) Pollutants in combustion of hydrogen will be less than petrol. The only pollutants will be the oxides of nitrogen and it can be minimised by injecting small amount of water into the hydrogen cylinder.

3) Hydrogen is used as a rocket fuel.

4) Hydrogen is used in fuel cells for generating electrical energy.

5) Atomic hydrogen and oxy hydrogen torches are used for welding and cutting metals.

---

12. Explain the difference in properties of diamond and graphite on the basis of their structure.

A:

Diamond	Graphite
1) Diamond is the hardest material.	1) Graphite is soft.
2) It is a rigid 3 dimensional polymer.	2) It is a 2 dimensional polymer.
3) Carbon undergoes sp^3 hybridisation.	3) Carbon undergoes sp^2 hybridisation.
4) Each carbon is bonded to 4 other carbon atoms 'Tetrahedrally'.	4) Each carbon is bonded to 3 other carbon atoms to form 'Hexagonal rings'.
5) Carbon atoms are held by strong covalent bonds.	5) Hexagonal layers of carbons are held by weak Vander Waal's forces.
6) C – C bond length is 1.54 Å and bond angle is $109^0 28^1$.	6) C – C bond length is 1.42 Å and bond angle is 120^0.
7) It is a bad conductor of electricity.	7) It is a good conductor of electricity .

BABY BULLET-Q

13. State Fajan's rules and give suitable examples.

A: Fajan's rules:

1) 'Covalent character' **increases** with **increase in the size of Anion**.

   Ex: Bigger I^- has more covalent character than Br^-

2) 'Covalent character' **increases** with **decrease in the size of Cation**.

   Ex: Smaller Li^+ has more covalent character than Na^+

3) Covalent character increases with increasing charge of either Cations or Anions.

4) Cations with 'Pseudo inert gas configuration' favour 'covalent bonds'.

   Ex: $ZnCl_2$ is Covalent.

5) Cations with 'inert gas configuration' form Ionic bonds. **Ex:** $CaCl_2$ is ionic.

---

14. Deduce (a) Graham's law and
(b) Dalton's law of partial pressures from kinetic gas equation.

A: (a) Graham's law: "The **rate of diffusion** (r) of a gas is inversely proportional to the square root of its **density**(d)", at constant temperature and pressure.

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

From kinetic gas equation, $PV = \frac{1}{3}mnu_{rms}^2 = \frac{1}{3}Mu_{rms}^2$ ($\because$ mn=M, total mass of gas)

$\Rightarrow u_{rms}^2 = 3\frac{PV}{M} = \frac{3P}{d}, \left(\because d = \frac{M}{V}\right)$

$\Rightarrow u_{rms}^2 \propto \frac{1}{d} \Rightarrow u_{rms} \propto \frac{1}{\sqrt{d}}$

But RMS velocity, $u_{rms} \propto r$.

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

Thus Graham's law is derived.

BABY BULLET-G

b) Dalton's law of partial pressures:

1) "The total pressure(P) exerted by a mixture of non - reacting gaseous mixture is equal to the sum of the partial pressures of all component gases at constant temperature and volume".

2) Consider a gas in a vessel of volume V. Let m_1, n_1, u_{1rms} denote the mass, number of moles and RMS velocity of molecules.

From the kinetic gas equation,the pressure of the gas $p_1 = \frac{1}{3}\frac{m_1 n_1 u_{1rms}^2}{V}$

3) If the gas is replaced by another gas in the same vessel, with m_2, n_2, u_{2rms} as mass, number of moles and RMS velocity of molecules, then its pressure $p_2 = \frac{1}{3}\frac{m_2 n_2 u_{2rms}^2}{V}$

4) Now $P = \frac{1}{3}\frac{m_1 n_1 u_{1rms}^2}{V} + \frac{1}{3}\frac{m_2 n_2 u_{2rms}^2}{V}$

$\therefore P = p_1 + p_2$

Hence Dalton's law is derived.

---

15. Discuss the application of Le-Chatelier's principle for the industrial synthesis of Ammonia.

A: I) Le-Chatelier's principle : If a **chemical reaction at equilibrium,** is subjected to **'a change'** in temperature, pressure or concentration, then the equilibrium shifts in the direction, which nullifies the change .

II) Synthesis of Ammonia - Haber's process :

1) Formation of Ammonia: N_2 and H_2 are synthesized directly in the ratio 1:3 to produce NH_3.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g);\ \Delta H = -92kJ$$

2) This reaction is reversible and exothermic. Also it leads to a **decrease in volume**.

3) So, **Le-Chatelier principle** is applicable.

4) Effect of Temperature: As the reaction is exothermic, low temperature is favoured.

5) Effect of Pressure: As the reaction leads to decrease in volume, high pressure is favoured.

6) Optimum Conditions:

(a) Low Temperature : **725-775 K**

(b) High Pressure : **200-300 atm**

(c) High concentrations: **Pure N_2 and H_2** .

7) Catalyst : **Finely divided iron**

8) Promoter : **Mo**

BABY BULLET-Q

16. Chemical analysis of a carbon compound gave the following percentage composition by weight of the elements present, carbon = 10.06% , hydrogen = 0.84 % , chlorine = 89.10% . Calculate the empirical formula of the compound.

A: **Step 1:** Percentage composition of the elements present in the compound.

C	H	Cl
10.06	0.84	89.10

Step 2: Dividing by the respective atomic weights of the elements

$\frac{10.06}{12}$	$\frac{0.84}{1}$	$\frac{89.10}{35.5}$
= 0.84	= 0.84	= 2.51

Step 3: Dividing by the smallest number.

$\frac{0.84}{0.84}$	$\frac{0.84}{0.84}$	$\frac{2.51}{0.84}$
=1	=1	=3

Step 4: Multiplication by a suitable integer to get whole number ratio.

(1 x 1)	(1 x 1)	(3 x 1)
=1	=1	=3

∴ The empirical formula of the compound is $C_1H_1Cl_3 = CHCl_3$.

---

17. Give two methods of preparation of diborane.

A: **I) Preparation of Diborane:**

1) Industrial method of preparation:

Boron trifluoride is treated with lithium hydride at 450K, to form Diborane.

$$2BF_3 + 6LiH \xrightarrow{450K} B_2H_6 + 6LiF$$

2) Laboratory method:

a) Boron trichloride is treated with lithium aluminium hydride in the presence of dry ether to form Diborane.

$$4BCl_3 + 3LiAlH_4 \xrightarrow{\text{dry ether}} 2B_2H_6 + 3LiCl + 3AlCl_3$$

b) Boron trichloride and hydrogen are subjected to silent electric discharge to form Diborane.

$$2BCl_3 + 6H_2 \xrightarrow[\text{or Cu - Al catalyst at } 45^\circ C]{\text{electric discharge}} B_2H_6 + 6HCl$$

BABY BULLETIQ

18. Explain the formation of Coordinate Covalent bond with one example.

A : 1) **Coordinate covalent bond:** It is covalent bond formed by sharing of two electrons donated by one of the bonded atoms.

2) The atom which **donates** the 'electron pair' is called **donor atom**.

3) The other atom which **accepts** the 'electron pair' is called **acceptor atom**.

4) The donor atom must be having 'one or two lone pairs of electrons', while the acceptor atom has 'vacant orbitals'.

5) The Coordinate bond is represented by an arrow mark from donor to acceptor (A → B)

6) Formation of ammonium ion (NH_4^+) :

Ammonium ion is formed by the union of NH_3 molecule with H^+ ion.

In NH_3 molecule, the central 'N' atom has one lone pair of electrons and H^+ ion has empty orbital. Hence, N atom donates its lone pair to the empty orbital of H^+ion. Thus a coordinate covalent bond is formed between N and H^+.

$$H_3N: \rightarrow \square H^+ = \overset{\oplus}{N}H_4$$

BABY BULLET-Q

SECTION-C

19. a) Describe the methods of preparation of Ethane.

b) Explain the chemical properties of Ethane with equations.

A: a) Preparation of Ethane(C_2H_6) :

1) Wurtz reaction :

Methyl iodide is heated with **sodium** metal in the presence of dry ether to form **ethane**.

$$2CH_3I + 2Na \xrightarrow{\text{dry ether}} C_2H_6 + 2NaI$$

Methyl iodide — Ethane

2) Decarboxylation :

Sodium propionate is heated with **sodalime** to form **ethane**.

$$\underset{\text{Sodium propionate}}{C_2H_5COONa} + NaOH \xrightarrow[\Delta]{CaO} \underset{\text{Ethane}}{C_2H_6} + Na_2CO_3$$

3) Kolbe's electrolysis:

Aqueous **potassium acetate on electrolysis** forms **ethane.**

$$2CH_3COOK + 2H_2O \rightarrow \underbrace{C_2H_6\uparrow + 2CO_2\uparrow}_{\text{At anode}} + \underbrace{2KOH + H_2\uparrow}_{\text{At cathode}}$$

b) Chemical Properties of Ethane :

1) Action with Chlorine:

Ethane reacts with **chlorine** in the presence of sunlight to form **ethyl chloride**.

$$C_2H_6 + Cl_2 \xrightarrow[\text{or uv light}]{\text{sun light}} C_2H_5Cl + HCl$$

2) Action with Nitric acid :

Ethane reacts with conc.nitric acid vapours at 400^0C to form **nitroethane.**

$$C_2H_6 + HNO_3 \xrightarrow[\Delta]{400^0C} \underset{\text{Nitroethane}}{C_2H_5NO_2} + H_2O$$

3) Action with Oxygen :

Ethane on combustion with oxygen forms **CO_2** and **H_2O.**

$$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

BABY BULLET-Q

20. What are postulates of Bohr's model of hydrogen atom? Discuss the importance of this model to explain various series of line spectra in hydrogen atom.

A: I) Postulates of Bohr's model :

1) Electron in an atom revolve around the nucleus in certain fixed **circular paths** called **orbits.**

2) Each orbit has **fixed amount of energy**. So these orbits are also called **energy levels**.

These orbits are denoted by 1,2,3,4,..... (or) K, L, M, N.....

3) As long as an electron revolves around the nucleus in a fixed orbit it **does not emit** (or) **absorb energy**. So these orbits are also called as **Stationary orbits**.

4) **Angular momentum** of revolving electron is **quantised** and is an integral multiple of $\frac{h}{2\pi}$.
$\therefore mvr = \frac{nh}{2\pi}$. Here, m= mass of electron, v= velocity, r= radius and h= Planck's constant

5) Energy is emitted (or) absorbed when electron jumps from one orbit to another orbit.

The energy difference between two orbits is $\Delta E = E_2 - E_1 = h\nu$

Here, E_2= Energy of the higher orbit, E_1= Energy of the lower orbit

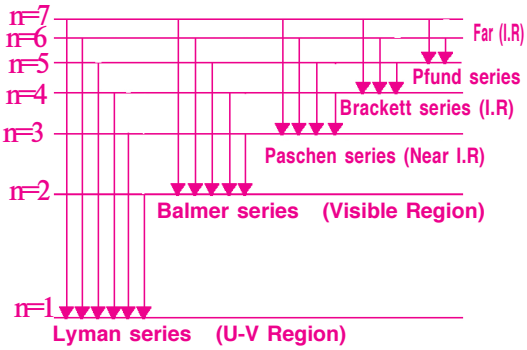
II) Hydrogen spectrum- Bohr's Explanation:

1) When electric discharge is passed through gaseous hydrogen, the electrons in atoms **absorb** energy.

2) Then they **jump** into **higher energy orbits**.

3) In higher orbits, they have **more energy and less stability.**

4) Then the excited electrons **come back** to **lower orbits** in **one** or **multiple steps**.



Hydrogen Spectrum

5) **Energy** is **released** during this process and it appears in the form of **spectral lines.**

6) When an electron jumps from any higher orbit to

i) **n=1** produces spectral lines in the **UV** region.This is named as **Lyman series.**

ii) **n=2** produces spectral lines in the **visible** region.This is named as **Balmer series.**

iii) **n=3,4,5** produces spectral lines in near IR, IR, far IR regions.

These are named as **Paschen** ,**Brackett** and **Pfund** series respectively.

7) From the Rydberg equation, wavenumber $\bar{\nu} = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

BABY BULLET-Q

21. Write an essay on s,p,d and f block elements.

A: All the elements are classified into 4 blocks, depending on the 'entry of differentiating electron' into sub-shells.

They are s-block, p-block, d-block, f-block.

I) s-block elements :

1) In s-block elements, the 'differentiating electron' enters into ns-subshells.
2) Their General Electronic Configuration(GEC) is ns^{1-2} .
3) They are arranged in two groups; group 1 & group 2 .
4) Group 1 elements are called Alkali metals. Their GEC is ns^1.
   Group 2 elements are called Alkaline earth metals. Their GEC is ns^2.
5) They are placed on the **left side** of the periodic table.

II) p-block elements :

1) In p- block elements, the 'differentiating electron' enters into np-subshells.
2) Their GEC is $ns^2\ np^{1-6}$.
3) They are arranged in 6 groups, from group 13 to group 18.
4) i) Group 13 is called **B**oron family. Its GEC is ns^2np^1
   ii) Group 14 is called **C**arbon family. Its GEC is ns^2np^2
   iii) Group 15 is called **N**itrogen family. Its GEC is ns^2np^3
   iv) Group 16 is called **C**halcogen family. Its GEC is ns^2np^4
   v) Group 17 is called **H**alogen family. Its GEC is ns^2np^5
   vi) Group 18 is called **N**oble gas family. Its GEC is ns^2np^6
5) They are placed on the **right side** of the periodic table.

III) d-block elements:

1) In d- block elements, the 'differentiating electron' enters into (n–1)d sub shells.
2) Their GEC is $(n-1)d^{1-10}\ ns^{1\text{ or }2}$.
3) They are arranged in 10 groups, from group 3 to group 12.
4) They are further classified into 3d series, 4d series, 5d series and 6d series.
5) They are placed at the **middle** of the periodic table.

IV) f-block elements :

1) In f- block elements the 'differentiating electron' enters into (n–2)f sub shells.
2) Their GEC is $(n-2)\ f^{1-14}\ (n-1)d^{0\text{ or }1}ns^2$.
3) They are classified into 2 series.
4) They are 4f series - known as **Lanthanide series**, 5f series - known as **Actinide series.**
5) They are placed separately at the **bottom** of the periodic table.

BABY BULLET-Q