Previous IPE

SOLVED PAPERS

MARCH-2019 (AP)

PREVIOUS PAPERS

IPE: MARCH-2019(AP)

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

SECTION-A

I. Answer ALL questions : **10 × 2 = 20**

1. What is Plaster of Paris? Write its uses.
2. What Agro chemicals are responsible for water pollution?
3. Name the common components of photo chemical smog.
4. Potassium carbonate cannot be prepared by Solvay process. Why?
5. What is the effect of pressure on a gaseous chemical equilibrium?
6. What are Extensive and Intensive properties?
7. State the 3rd law of thermodynamics.
8. Calculate the amount of Carbon dioxide that could be produced when one mole of Carbon is burnt in 16 g of dioxygen.
9. Calculate the ratio of kinetic energies of 3 g of H_2 and 4g of O_2 at a given temperature.
10. Write IUPAC names of the following compounds:

a) $(CH_3)_2C(C_2H_5)_2$ b) $CH_3-CH_2-\underset{\displaystyle CH_2-CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

SECTION-B

II. Answer any SIX of the following Questions. **6 × 4 = 24**

11. Deduce (a) Charles' law (b) Graham's law of diffusion from kinetic gas equation.
12. Balance the following redox reaction in basic medium by ion - electron method:

$MnO^-_{4(aq)} + I^-_{(aq)} \rightarrow MnO_{2(S)} + I_{2(S)}$

13. What is a conjugate acid - base pair ? Write the conjugate acid and conjugate base of each of the following : a) OH^- b) HCO^-_3
14. Explain the following with suitable examples:

a) Electron deficient hydrides b) Ionic hydrides

15. Explain the structure of diborane.
16. What do you understand by a) Allotropy b) Inert pair effect
17. Describe any two methods of preparation of Ethane.
18. Write the reactions of Ethylene with the following: a) Ozone b) Cold, dilute alk. $KMnO_4$

SECTION-C

III. Answer any TWO of the following Questions. **2 × 8 = 16**

19. a) What are postulates of Bohr's model of Hydrogen atom?

b) State Hund's rule and Aufbau principle.

20. Write an essay on s,p,d and f- block elements.
21. a) Explain the hybridisation involved in SF_6

b) State Fajan's Rules and give suitable examples

IPE AP MARCH-2019
ANSWERS

SECTION-A

1. What is Plaster of Paris? Write its uses.

Plaster of Paris: Calcium sulphate semi hydrate [$CaSO_4.\frac{1}{2}H_2O$] is called as Plaster of Paris.

Uses of Plaster of paris:

(1) Surgical bandages for bone fracture

(2) Making white chalks.

(3) Making **casts** for statues, roofs, toys etc.

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2. What Agro chemicals are responsible for water pollution?

A: Fertilizers, insecticides, herbicides, fungicides etc are responsible for water pollution.

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3. Name the common components of photo chemical smog.

A: **Components of photochemical smog:** Ozone, nitric oxide, formaldehyde, acrolein and PAN

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4. Potassium carbonate cannot be prepared by Solvay process. Why?

A: 1) The Solvay process cannot be extended for the manufacture of K_2CO_3.

2) Because $KHCO_3$ is more soluble in water unlike $NaHCO_3$. So it cannot be isolated.

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5. What is the effect of pressure on a gaseous chemical equilibrium?

A: 1) If the number of moles of gaseous products is equal to the number of moles of gaseous reactants ($\Delta n=n_P-n_R=0$) then pressure has no effect on the equilibrium.

2) If $\Delta n\neq 0$ then

(a) Increase of pressure, shifts the position of equilibrium in the direction of decreasing the number of moles.

Ex: $N_{2(g)}+3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, $\Delta n<0$

(b) Decrease of pressure, shifts the position of equilibrium in the direction of increasing the number of moles.

Ex: $PCl_{5(g)} \rightleftharpoons PCl_{3(g)}+Cl_{2(g)}$, $\Delta n>0$

6. What are intensive and extensive properties ? **[AP 15,19]**

A: Intensive properties : The properties which do not depend on the total amount of substance are called intensive properties.

Ex: Density, viscosity, specific heat, temperature, pressure, vapour pressure etc.

Extensive properties : The properties which depend on the total amount of substance are called extensive properties.

Ex: Mass, Volume, Internal energy, enthalpy, entropy, heat capacity, refractive index etc.

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7. State third law of thermodynamics. **[AP 19][TS 16]**

A: Third law of thermodynamics :

"The entropy of a pure and perfectly crystalline substance approaches zero when the temperature approaches absolute zero." Mathematically, $S_T = \int_0^T \frac{Cp}{T}.dT$

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8. Calculate the volume of O_2 at STP required to completely burn 100ml of acetylene.

A: The balanced equation is $2C_2H_2 + 5\,O_2 \rightarrow 4CO_2 + 2H_2O$

2 moles 5moles

2×22400 ml at STP gives 5×22400 ml at STP

100 ml of C_2H_2 gives ..... ?

Volume of O_2 required at STP= $5\times22400\times\frac{100}{2\times22400} = 250\text{ml}$

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9. Calculate the ratio of kinetic energies of 3g of hydrogen and 4g of oxygen at given temperature.

A : $\frac{\text{Kinetic energy of } H_2}{\text{Kinetic energy of } O_2} = \frac{(3/2)n_{H_2}RT}{(3/2)n_{O_2}RT} = \frac{n_{H_2}}{n_{O_2}}$ [$\because$ T is constant]

$$= \frac{3\text{g of } H_2}{2} : \frac{4\text{g of } O_2}{32} = \frac{3}{2} : \frac{1}{8} = \frac{3}{2}\times\frac{8}{1} = \frac{12}{1} = 12:1$$

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10. Write IUPAC names of the following compounds:

a) $(CH_3)_2C(C_2H_5)_2$ **b)** $CH_3-CH_2-\underset{\displaystyle CH_2-CH_3}{\overset{|}{CH}}-CH_2-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-CH_3$

A: (a) 3,3 Dimethylpentane (b) 3 Ethyl 5 Methyl heptane

SECTION-B

11. Deduce (a) Charles' law (b) Graham's law of diffusion from kinetic gas equation.

A: (a) Charle's Law:

From kinetic gas equation $PV = \frac{1}{3}mnu_{rms}^2 \Rightarrow PV = \frac{2}{3} \times \frac{1}{2}mnu_{rms}^2$

$\Rightarrow PV = \frac{2}{3}KE$ ....(iii), $\left(\because KE = \frac{1}{2}mnu_{rms}^2\right)$

From kinetic gas theory,

$KE \propto T \Rightarrow KE = kT$ -------(iv)

From (iii)&(iv), $PV = \frac{2}{3}kT \Rightarrow \frac{V}{T} = \frac{2}{3} \times \frac{k}{P}$

If pressure(P) is kept constant, then $\frac{V}{T}$ = constant .

Thus, Charles' law is derived.

(b) 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.

12. Balance following equation in Basic medium by ion-electron method.

$MnO_4^- + I^- \rightarrow MnO_2 + I_2$

A: 1) Skeleton ionic equation: $\overset{+7}{MnO_4^-} + \overset{-1}{I^-} \rightarrow \overset{+4}{MnO_2} + \overset{0}{I_2}$

2) **Oxidation half reaction** | **Reduction half reaction**

$I^- \rightarrow I_2$ | $MnO_4^- \rightarrow MnO_2$

3) Balance the atoms other than O and H

$2I^- \rightarrow I_2$ | $MnO_4^- \rightarrow MnO_2$

4) Balance of oxygen atoms

$2I^- \rightarrow I_2$ | $MnO_4^- \rightarrow MnO_2 + 2H_2O$

5) Balance of hydrogen atoms

$2I^- \rightarrow I_2$ | $MnO_4^- + 4H_2O \rightarrow MnO_2 + 2H_2O + 4OH^-$

6) Balance of charges

$2I^- \rightarrow I_2 + 2e^-$ | $MnO_4^- + 2H_2O + 3e^- \rightarrow MnO_2 + 4OH^-$

7) Equalizing of electrons

$6I^- \rightarrow 3I_2 + 6e^-$ | $2MnO_4^- + 4H_2O + 6e^- \rightarrow 2MnO_2 + 8OH^-$

8) Adding the two half reactions

$$6I^- \rightarrow 3I_2 + 6e^-$$
$$2MnO_4^- + 4H_2O + 6e^- \rightarrow 2MnO_2 + 8OH^-$$

$$2MnO_4^- + 6I^- + 4H_2O \rightarrow 2MnO_2 + 3I_2 + 8OH^-$$ This is the balanced equation.

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13. What is a conjugate acid - base pair ? Write the conjugate acid and conjugate base of each of the following :a) OH^- b) HCO_3^-

A: 1) Conjugate acid-base pair: An acid-base pair which differ only by proton is called conjugate acid base pair.

Ex : $H_2O(l) + NH_3(aq) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

$Acid_1$ $Base_2$ $Acid_2$ $Base_1$

2) In the above reaction, H_2O & OH^- and NH_4^+ & NH_3 are conjugate acid-base pairs.

3) Some other examples:

Species	Conjugate acid	Conjugate base
OH^-	H_2O	O^{2-}.
H_2O	H_3O^+	OH^-.
HCO_3^-	H_2CO_3	CO_3^{2-}

14. Explain the following with suitable examples:

a) Electron deficient hydrides b) Ionic hydrides

A: a)Electron deficient compounds of hydrogen:

These compounds have less number of electrons than required for conventional Lewis structure. Elements of group-13 form such compounds.

Ex: B_2H_6 (Diborane)

b) Ionic hydrides:

1) Ionic hydrides are formed by the combination of H_2 with highly electropositive s-block metals.
2) These are stoichiometric compounds.
3) But hydrides such as LiH, BeH_2, MgH_2 due to polymeric structure have covalent nature.

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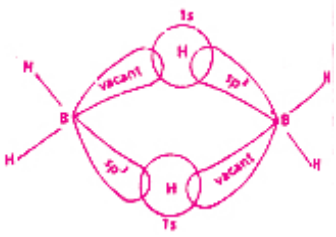
15. Explain the structure of diborane (B_2H_6). How is it prepared?

A: I) Structure of diborane:

A) Hybridisation:

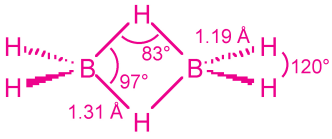
1) In diborane, Boron undergoes sp^3 hybridisation to form 4 sp^3 hybrid orbitals.
2) Out of 4 orbitals, 3 orbitals contain one electron each and the fourth orbital is vacant.
3) The two sp^3 hybrid orbitals of each Boron atom form 2 sigma bonds with two H atoms.



4) Overlapping of vacant orbital of one Boron, 1s orbital of hydrogen and sp^3 orbital of another Boron forms a B–H–B bridge bond.
5) This bridge bond is known as Banana bond (or) Tau bond.

B) Spatial Structure:

6) According to Electron diffraction theory, diborane has two coplanar BH_2 groups.
7) The four hydrogen atoms present in BH_2 groups are called **terminal hydrogens**(H_t).
8) The remaining 2 hydrogen atoms are called **bridge hydrogens** (H_b)
9) These 'two bridge hydrogens' are perpendicular to the plane of the BH_2 groups.
10) One bridge hydrogen lies above the plane and the other lies below the plane.



16. What do you understand by (a) Allotropy (b) inert pair effect

A: **(a) Allotropy:** The phenomenon of existence of an element in different physical forms having same chemical properties is called allotropy.

Crystalline allotropes of carbon are (a) Diamond (b) Graphite

(b) Inert pair effect: The reluctance of 'ns' pair of electrons to take part in bond formation is known as inert pair effect.

Ex: Lead exhibits +2 oxidation state as stable oxidation state due to inert pair effect (instead of +4 state).

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17. Describe any two methods of preparation of Ethane.

a) Preparation of ETHANE(C_2H_6) :

1) Decarboxylation: Ethane is prepared by heating **sodium propionate** with **sodalime** (Sodalime is a mixture of NaOH &CaO)

$$C_2H_5COONa + NaOH \xrightarrow[\Delta]{CaO} C_2H_6 + Na_2CO_3$$

2) Wurtz reaction : Ethane is prepared by **heating methyl iodide** with **sodium** metal in the presence of dry ether. **[AP 17][TS 15]**

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

3) Kolbe's electrolysis: Ethane is obtained by the **electrolysis** of aqueous potassium acetate (or aqueous sodium acetate). **[TS 15]**

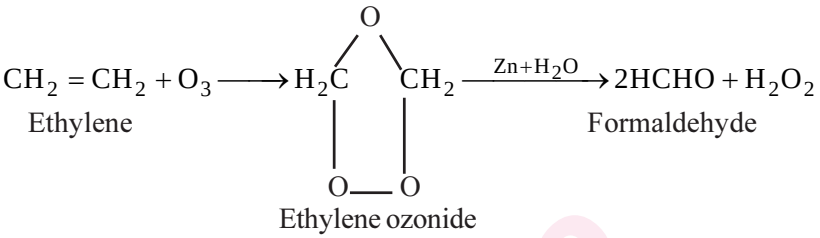
$$2CH_3COOK + 2H_2O \rightarrow \underbrace{C_2H_6 + 2CO_2}_{\text{At anode}} + \underbrace{2KOH + H_2}_{\text{At cathode}}$$

18. Write the reactions of Ethylene with the following:

a) Ozone **b) Cold, dilute alk. $KMnO_4$** **[☞P 282(32)]**

A: **(a) Action with Ozone (Ozonolysis):** Ethylene reacts with ozone to form unstable ozonide.

This undergoes hydrolysis in the presence of Zinc to form Formaldehyde.



Ethylene ozonide

b) Action with cold dil. alk. $KMnO_4$: Ethylene reacts with cold dil .alk.$KMnO_4$ (Baeyer 's reagent) at 273K to form Ethylene glycol.

$$CH_2 = CH_2 \xrightarrow[\text{alk.}KMnO_4]{\text{Cold.dil}} CH_2OH - CH_2OH$$

Ethylene Ethylene glycol

SECTION-C

19. a) What are postulates of Bohr's model of Hydrogen atom?
b) State Hund's rule and Aufbau principle.

A: a) 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

b) Hund's rule: 'In degenerate orbitals pairing of electrons takes place only after the filling up of available orbitals with one electron each'.

Auf - bau principle: 'In the ground state of the atoms, the orbitals are filled with electrons, in their increasing order of energies'.

20. 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.

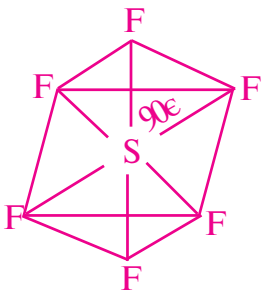
IV) f-block elements :

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.

21. a) Explain the hybridisation involved in SF_6

b) State Fajan's Rules and give suitable examples

A: a) I) sp^3d^2 hybridisation: One s-orbital, three p-orbitals and two d-orbitals mix together to form six sp^3d^2 hybrid orbitals .



II) Structure of SF_6 molecule:

1) In SF_6, the central atom is S(16).

2) It's ground state E.C is $[Ne]3s^23p^4$

It's excited state E.C is $[Ne]\,3s^1 3p_x^1 3p_y^1 3p_z^1 3d^1_{(x^2-y^2)} 3d^1_{z^2}$

3) In its excited state, the central S atom undergoes sp^3d^2 hybridisation.

4) Central S forms 'six sp^3d^2 hybrid orbitals', each with one electron.

5) 'Six sp^3d^2 hybrid orbitals' of S overlap axially with p orbital of six F atoms to form six σ bonds.

6) Shape of SF_6 is Octahedral and the bond angles are 90° and 180°.

b) 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.