END SEMESTER EXAMINATION (REGULAR/RETEST) 2023

CHEMISTRY-1

Question 1: Fill in the blanks (1×5=5)

(a)In the titration between Sulphuric acid and Sodium carbonate _____ is used as an indicator.
Ans: In the titration between Sulphuric acid and Sodium carbonate **Methyl Orange** is used as an indicator.

(b)E.C.E value of copper is _____.
Ans: E.C.E value of copper is **3.295×10^{-7}kg/c or 0.0003296 g/c.**

(c)The acidity of $Al(OH)_3$ is _____.
Ans: The acidity of $Al(OH)_3$ is **Amphoteric.**

(d)Pi bond is _____ than sigma bond.
Ans: Pi bond is **Weaker** than sigma bond.

(e)p^H+p^{OH} = _____.
Ans: p^H+p^{OH} = **14.**

Question 2: Choose the correct answers : 1×5=5
(a) $MgCl_2$ conatin—
(i)Ionic bond (ii) Covalent bond (iii) Dative bond (iv) Hydrogen bond
Ans: (i) Ionic bond.

(b) At N.T.P 32 grams of So_2 occupies----
(i) 11.2 litre (ii) 22.4 litre (iii) 44.8 litre (iv) 1 litre
Ans: (ii) 22.4 litre.

(c) The outermost electron of sodium atom has principal quantum number
(i) 1 (ii) 2 (iii) 3 (iv) 4
Ans: (iii) 3.

(d) Conjugate acid of HSO_4^- is
(i) SO_3^{2-} (ii) SO_4^{2-} (iii) H_2SO_4 (iv) H_2SO_3
Ans: (iii) H_2SO_4.

(e)The catalyst used in the manufacture of Ammonia by the Haber's process is
(i) Iron (ii) Nitric oxide (iii) Vanadium pentoxide (iv) Molybdenum.
Ans: Molybdenum.

Question 3: Match the following columns: 1×5=5

Column-1	Column-2
(a) S-orbitals	1) Most electronegative element
(b) Sludge and Scale formation	2) Semi-conductor
(c) Fluorine	3) Spherically symmetrical
(d) $KMnO_4$	4) Boiler trouble
(e) Germanium	5) Strong oxidizing agent

Ans:

(a) S – orbitals ---------- (1) Spherically symmetrical
(b) Sludge and Scale formation----------(2) Boiler trouble
(c) Fluorine---------(3) Most electronegative element
(d) $KMnO_4$----------(4) Strong oxidizing agent
(e) Germanium-------(5) Semi-conductor

Question 4. (a) State and explain Boyle's law and Charle's law. 2+2=4
Ans:
Boyle's Law:
Boyle's Law states that at constant temperature, the volume (V) of a given mass of gas is inversely proportional to its pressure (P). Mathematically, this can be expressed as: $PV = k$

where k is a constant for a given amount of gas at a fixed temperature.

Charles' Law:

Charles' Law states that at constant pressure, the volume (V) of a given mass of gas is directly proportional to its absolute temperature (T). This can be mathematically represented as:

$V/T = k$

where k is a constant for a given amount of gas at a fixed pressure.

(b)State Avogadro's hypothesis. At 25℃ temperature and 500 mm pressure the volume of a definite mass of a gas is 1000 ml. Calculate the volume of the gas at N.T.P. 1+3=4.

Ans: Avogadro's hypothesis states that equal volumes of all gases at the same temperature and pressure contain the same number of molecules.

We can use the combined gas law to calculate the volume of the gas at NTP .The combined gas law state that : $P_1V_1/ T_1=P_2V_2/T_2$.

Here, P_1= 500 mm
V_1= 1000 ml
T_1= 25° C = 298K
P_2= 760 (Pressure at NTP)
T_2= 273 K (Temperature at NTP)

Putting these values into the equation, we get :

$P_1V_1/ T_1= P_2V_2/ T_2$
$=>500\times1000/298 = 760\times V_2/273$

Solving for V_2 , we get :

$V_2=(500\times1000\times273)/(760\times298)$
$=>V_2$= 605.4 ml.

(c) Balance the following equation (any one):

(i) $C_2O_4^{2-} + MnO_4^- + H^+ \rightarrow CO_2 + Mn^{2+} + H_2O$ (By ion electron method)

Ans:

$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2-} + C0_2 + H_2O$

Splitting into two half reactions :

Reduction half-reaction :

$MnO_4^- \rightarrow Mn^{2+}$

Oxidation half-reaction:

$C_2O_4^{2-} \rightarrow 2C0_2$

Balance each half-reaction:

Reduction:

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

Oxidation:

$C_2O_4^{2-} \rightarrow 2C0_2 + 2e^-$

Equalize electrons :

Multiply the reduction half by 2 :

$2MnO_4^- + 16H^+ + 10e^- \rightarrow 2Mn^{2+} + 8H_2O$

Multiply the oxidation half by 5 :

$5C_2O_4^{2-} \rightarrow 10C0_2 + 10e^-$

Combine half-reactions:

$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

(ii) $HNO_3 + S \rightarrow NO_2 + H_2SO_4 + H_2O$ (By partial equation method)

Ans:

Oxidation half-reaction:

$S + 2H_2O \rightarrow H_2SO_4 + 2H^+ + 2e^-$

Reduction half – reaction :

$HNO_3 + 2H^+ + 2e^- \rightarrow NO_2 + H_2O$

Combined balanced reaction :

$S + 2HNO_3 + 2H_2O \rightarrow H_2SO_4 + 2N0_2$

Question 5: (a) What are the limitations of a chemical equation ? 2

Ans:

1. A Chemical equation does not indicate the physical state of reactants and products.
2. It does not provide information about the reaction conditions like temperature, pressure or catalyst .

(b) What is a decinormal solution ? What volume of 0.1 N NaOH is required to neutralize 30 ml of 0.25(N) HCl solution ? 4

Ans:

A Solution with a normality of 0.1N is called a decinormal solution .

Now, using neutralization formula ,

$N_1V_1 = N_2V_2$

Where, $N_1 = 0.1N$; $V_1 = ?$; $N_2 = 0.25N$; $V_2 = 30$ ml

Substituting values:

$0.1 \times V_1 = 0.25 \times 30$

$V_1 = \frac{0.25 \times 30}{0.1}$

$V_1 = 75$ ml

(c) Discuss the Bronsted-Lowry concept of acids and bases with suitable examples. 3

Ans:

According to Bronsted-Lowry concept:

Acid: A substance that donates a proton (H^+).

Base: A substance that accept a proton (H^+).

Examples:

1. $HCl + H_2O \rightarrow H_3O^+ + Cl^-$

   HCl is the acid (proton donor), and H_2O is the base (proton acceptor).

2. $NH_3 + H_2O \rightarrow NH_4^+ + 0H^-$

   NH_3 is the base (proton acceptor),and H_2O is the acid (proton donor).

(d) Differentiate between Orbit and Orbital. 2

Ans:

Orbit	Orbital
1. A fixed circular path in which electrons revolve around the nucleus. 2. Described by Bohr's atomic model.	1. A region in space where the probability of finding an electron is maxium. 2. Described by quantum mechanical models.

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6. (a) State and explain Aufbau principle.Write the electronic configuration of Cr and Mn. 4

Ans: The **Aufbau Principle** states that electrons fill atomic orbitals starting with the lowest energy level

orbitals, which is determined by both the principal quantum number (n) and the azimuthal quantum number (l).

In simpler terms, electrons will occupy orbitals in the order of their energy, with 1s being filled first, followed by 2s, 2p, 3s, 3p, and so on. This principle helps explain the electron configuration of atoms and ensures the most stable arrangement of electrons.

Electronic configuration of Cr and Mn :

Cr: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4\ 4s^1\ 3d^5$

Mn: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

(b)What is electron affinity ? What variation is in electron affinity across the periodic table? 3

Ans: Electron Affinity:

Electron affinity is the amount of energy released or absorbed when an electron is added to a neutral atom in the gas phase to form a negatively charged ion.

Variation in Electron Affinity Across the Periodic Table:

1. **Across a Period**: As you move from left to right across a period, electron affinity generally becomes more negative, meaning atoms are more likely to accept an electron.
2. **Down a Group**: As you move down a group, electron affinity becomes less negative, meaning atoms are less likely to accept an electron due to increased atomic size and weaker attraction to the nucleus.

(c)What is an ionic bond ? Explain with example. Write at leas two important characteristics of an ionic bond. 4

Ans: n ionic bond is formed when one atom donates an electron to another atom, resulting in the creation of ions. This bond typically occurs between a metal and a non-metal. The metal atom loses one or more electrons, becoming a positively charged ion (cation), while the non-metal atom gains those electrons, becoming a negatively charged ion (anion). The oppositely charged ions attract each other, forming an ionic bond.**Example:**
In sodium chloride (NaCl), sodium (Na) loses one electron to form Na^+, and chlorine (Cl) gains that electron to form Cl^-. The Na^+ and Cl^- ions are held together by an ionic bond.

Characteristics of Ionic Bond :

1. **Formation of Ions:** Ionic bonds involve the transfer of electrons from one atom to another, leading to the formation of positively charged (cation) and negatively charged (anion) ions.
2. **Strong Attraction:** The ionic bond is held together by a strong electrostatic force between the oppositely charged ions, making ionic compounds generally have high melting and boiling points.

Question 7: **(a)What is a catalyst ? Write its important characteristics. 3**

Ans: A **catalyst** is a substance that increases the rate of a chemical reaction without being consumed in the process. It works by lowering the activation energy required for the reaction to occur.

Important Characteristics of a Catalyst:

1. **Speeding Up Reactions**: Catalysts accelerate the rate of chemical reactions, enabling them to occur more quickly or under milder conditions (e.g., lower temperature or pressure).
2. **Unchanged in the Process**: Catalysts are not consumed or permanently altered during the reaction, meaning they can be used repeatedly.
3. **Specificity**: Catalysts are often specific to certain reactions, meaning a catalyst for one reaction may not work for another. This specificity is due to the interaction between the catalyst and reactants, often through a specific active site.

(b) What do you mean by p^H OF A solution ? Calculate the p^H of 0.001(M) NaOH solution ?

Ans: The pH **of a** solution is a measure of its acidity or basicity, expressed as the negative logarithm (base 10) of the concentration of hydrogen ions ($[H^+]$) in the solution:

$pH = -\log_{10}[H^+]$

For acidic solutions, the pH is less than 7; for neutral solutions, the pH is 7; and for basic solutions, the pH is greater than 7.

pH of 0.001 M0.001 \, M0.001M NaOH solution:

1. $[OH^-]=10^{-3}M$

2.$[H^+]= 10^{-11}/10^{-3}=10^{-11}M$
3. $p^H = - \log (10^{-11}) = 11$
Ans; $p^H = 11$.

(c) State and explain Faraday's first and second law of electrolysis ? 4

Ans: Faraday's Laws of Electrolysis;

1st law:The mass (m) of a substance deposited or liberated at an electrode during electrolysis is directly proportional to the quantity of charge (Q) passed through the electrolyte.

$m \propto Q$ Or $m= Z.Q$

Where:
m = mass of the substance (in grams)
Q= charge (in coulombs)
Z = electrochemical equivalent (constant for a given substance).

2nd law: When the same amount of charge is passed through different electrolytes, the masses of the substances deposited are proportional to their equivalent weights (E).

$m_1/m_2 = E_1/E_2$

Where:
m_1, m_2 = masses of substances deposited
E_1,E_2 = equivalent weights of the substances.

Question 8: (a) How long will it take to deposite 5 grams of zinc if a current of 10 ampere is passed through a $ZnSO_4$ solution ? 3

Ans: Mass of zinc deposited (m) = 5 g

Current (I) = 10 A

Electrochemical equivalent (Z) for zinc = Equivalent weight of zinc ÷ Faraday's constant
Equivalent weight of zinc (E) = 65.38 ÷ 2 = 32.69 g/equiv (as zinc has a valency of 2)
Faraday's constant (F) = 96500 C/equiv

Z= $\frac{E}{F}$ = 32.69/96500 = 0.000339 g/c.

Now, m= Z.I.t

Or, t= m/ Z.I

Substituting values we get , t= 24.6 min

(b) What is sterilization of water ? Explain how water is sterilized by using bleaching powder. 4

Ans: **Sterilization of Water:**

Sterilization of water refers to the process of removing or killing harmful microorganisms (such as bacteria, viruses, and protozoa) present in the water to make it safe for consumption and use. This is typically achieved through various chemical, physical, or mechanical methods.

Sterilization of Water using Bleaching Powder:

Bleaching powder**,** chemically known as calcium hypochlorite (Ca(OCl)_2)**,** is commonly used for sterilizing water due to its ability to release chlorine when dissolved in water. Chlorine is a powerful disinfectant that kills harmful microorganisms, thus sterilizing the water.

Process: **1.Dissolution**: When bleaching powder is added to water, it dissolves and releases **chlorine gas**.

$$Ca(OCl)_2+H_2O \rightarrow Ca(OH)_2+Cl_2$$

Chlorine (Cl_2) is highly effective in killing bacteria and other harmful pathogens present in the water.

2.Action of Chlorine: The chlorine reacts with the microorganisms in the water, either destroying their cell walls or disrupting their metabolic processes, which prevents them from multiplying and causing illness.

3.Dosage: The amount of bleaching powder to be used depends on the volume of water and the level of contamination. Typically, a small quantity of bleaching powder is enough to disinfect large quantities of water.

4.Final Treatment: After the chlorine has done its work, the water may be allowed to settle, and any excess chlorine or chemicals are removed, leaving the water safe for use.

(c) What are the main causes of hardness in water? How hardness in water is removed by the permutit method? 4

Ans: Causes of Hardness in water :

1.Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) ions from dissolved minerals.

2.Iron(Fe^{2+}) and other trace ions.

Removal by Permutit Method: Uses ion exchange resins:

- Hard ions (Ca^{2+},Mg^{2+}) are replaced by soft ions (Na^{+} or H^{+}).
- Produces soft water.

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9. (a) What is a salt bridge ? What is its function in an electrochemical cell ? 2

Ans: A salt bridge is the device or system connecting the oxidation and reduction half cells to a galvanic cell, an electrochemical cell.

Function in Electrochemical cell:

1. Maintain electrical neutrality by allowing ion flow.
2. Prevents mixing of solutions in the two half-cells.

(b) Write short notes on any three : 3×3=9

(i) Common ion effect

(ii) Application of electrolysis

(iii) Heisenberg's uncertainity principle

(iv) Co-ordinate covalent bond.

Ans:

(i) Common Ion Effect:

The common ion effect refers to the suppression of the ionization of a weak electrolyte by the addition of a strong electrolyte containing a common ion. For example, adding NaCl to a solution of HCl reduces the dissociation of HCl due to the presence of a common ion, Cl^{-}. It is widely used in controlling the pH of solutions and in salt analysis.

(ii) Applications of Electrolysis:
1.Electroplating: Coating metals with a thin layer of another metal to prevent corrosion or enhance appearance.
2.Purification of Metals: Used in refining metals like copper and aluminum.
3.Production of Chemicals: Manufacturing of substances like chlorine, hydrogen, and sodium hydroxide.

(iii) Heisenberg's Uncertainty Principle:
This principle states that it is impossible to simultaneously determine the exact position and momentum of a particle. It highlights the fundamental limitation of measurement in quantum mechanics.

(iv) Coordinate Covalent Bond:
A coordinate covalent bond is formed when one atom donates a lone pair of electrons to another atom that has an empty orbital. Unlike regular covalent bonds, both electrons in the bond come from the same atom. Example: Formation of the ammonium ion (NH_4^+) where NH_3 donates a lone pair to $H^{+.}$

Thank You!!