BK BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL

ANNUAL EXAMINATION (2024-25)

SUBJECT- CHEMISTRY (043)

Class: XI
Date: /02/2025

ANSWER KEY

Duration: **3 Hrs**
Max. Marks: **70**

General Instructions:

SECTION-A **(16 X 1=16 Marks)**

1. (a) $KMnO_4$
2. (c) Magnetic quantum number
3. (b) Double covalent bond
4. (b) But-3-en-2-ol
5. (a) Exothermic reaction
6. (c) C_3H_8
7. (c) Chlorine
8. (b) - 4
9. (c) Kelvin
10. (c) 20, 17, 17
11. (a) the reaction occurs faster
12. (b) $[C]^c[D]^d/[A]^a[B]^b$
13. (a)
14. (a)
15. (c)
16. (d)

SECTION-B **(5 X 2=10 Marks)**

17. **Empirical formula:** The simplest whole-number ratio of atoms in a compound (e.g., CH_2 for ethene).

    (i) **Molecular formula:** The actual number of atoms in a molecule (e.g., C_2H_4 for ethene).

18. (i) +7 (ii) +6
19. Increase in oxidation number and Decrease in Oxidation number
20. A homogeneous equilibrium is a chemical reaction where all of the reactants and products are in the same phase:

    Explanation

In a homogeneous equilibrium, the concentrations of the reactants and products are the same in all phases. The rate of reaction is constant throughout the solution, and depends on the amount of reactants present.

21. Conformation refers to the many arrangements of atoms in space that occur when molecules rotate around the axis of their bonds. Ethane has an infinite number of conformations, but two main conformations are particularly stable: staggered and eclipsed:

- **Staggered conformation**

  The most stable conformation, where the hydrogen atoms on the two carbon atoms are as far apart as possible. The dihedral angle is 60 degrees.

OR

Convert the Following (i) HNO3 and H2SO4 (ii) Ni/H2

SECTION-C **(7 X 3=21 Marks)**

22. **Answer:**

Kp=Kc·(RT)Δn

Derivation of Relation between K_p kc

To derive the K_p and K_c relationship, let us suppose there is a reversible reaction,

qQ(g) + rR(g) ⇌⇌ ***sS(g) +tT(g)***

Here, q moles of reactant Q reacts with r moles of reactant R to produce s moles of reactant S and t moles of reactant T.

To derive the relation between K_p and K_c for a general equilibrium reaction, we get

K_c = (S)s(T)t(Q)q(R)r(S)s(T)t(Q)q(R)r -------- 1)

Now we know that K_p formula in terms of partial pressure can be written as:

K_p = P(S)sP(T)tP(Q)qP(R)rP(S)sP(T)tP(Q)qP(R)r ------- 2)

For an ideal gas we have

PV = nRT

P = (n/V)RT = CRT

Here, C refers to the concentration

Therefore,

- P_q = [Q]RT
- P_r = [R]RT
- P_s = [S]RT
- P_t = [T]RT

Now, substituting the P_Q, P_R, P_s, P_t in equation 2

We get,

K_p Therefore K_p and K_c relation can be denoted as,

$K_p = K_c(RT)^{\triangle\triangle n}$

Where $\triangle\triangle n$ = **no. of moles** of gaseous products - no. of moles of gaseous reactants for balanced equations

R = 0.082062 L.atom.K^{-1} mol^{-1}

To derive the relation between K_p and K_c, when there is no change in the no. of gas molecules, n = 0

$K_p = K_c$

Hence, generally, the relationship between K_p and K_c can be represented as:

$K_p = K_c\ (RT)^{\triangle\triangle n}$

$K_c = K_p\ (RT)^{-\triangle\triangle n}$

22. Balanced equation:
MnO4−+5Fe2++8H+→Mn2++5Fe3++4H2OMnO$_4^-$ + 5Fe^{2+} + 8H^+ → Mn^{2+} + 5Fe^{3+} + 4H_2OMnO4−
+5Fe2++8H+→Mn2++5Fe3++4H2O.

23.**(i)** One mole of methane (CH_4) has molecules = 6.022 × 10^{23}
No. of electrons present in one molecule of CH_4 = 6 + 4 = 10
No. of electrons present in 6.022 × 10^{23} molecules of CH_4 = 6.022 × 10^{23} × 10
= 6.022 × 10^{24} electrons

(ii) Step I. Calculation of total number of carbon atoms
Gram atomic mass of carbon (C-14) = 14 g = 14 × 10^3 mg
14 × 10^3 mg of carbon (C-14) have atoms = 6.022 × 10^{23}

$$7 \text{ mg of carbon (C–14) have atoms } = \frac{6{\cdot}022 \times 10^{23}}{(14 \times 10^3 \text{ mg})} \times (7 \text{ mg}) = \mathbf{3{\cdot}011 \times 10^{20}\ atoms.}$$

Step II. Calculation of total number and tatal mass of neutrons
No. of neutrons present in one atom (C-14) of carbon = 14 – 6 = 8
No. of neutrons present in 3-011 × 10^{20} atoms (C-14) of carbon = 3.011 × 10^{20} × 8
= 2.408 × 10^{21} neutrons
Mass of one neutron = 1.675 × 10^{-27} kg
Mass of 2.408 × 10^{21} neutrons = (1.675X10^{-27} kg) × 2.408 × 10^{21}
= 4.033 × 10^{-6} kg.

23. No. of moles of solute per lit of solution and No. of moles of solute per kg of solvent.

24. **Answer:**
Mechanism of methane chlorination:

1. Initiation: Cl2→2Cl•Cl_2 → 2Cl•Cl2→2Cl• (UV light).
2. Propagation:
CH4+Cl•→CH3•+HClCH_4 + Cl• → CH_3• + HClCH4+Cl•→CH3•+HCl
CH3•+Cl2→CH3Cl+Cl•CH_3• + Cl_2 → CH_3Cl + Cl•CH3•+Cl2→CH3Cl+Cl•.
3. Termination: Cl•+Cl•→Cl2Cl• + Cl• → Cl_2Cl•+Cl•→Cl2.

25.

Heat (q) at constant volume is given as,

$q_v = C_v \Delta T = \Delta U$

Heat (q) at constant pressure is given as,

$q_p = C_p \Delta T = \Delta H$

But

$H = U + PV$

For 1 mole of gas, $PV = Rt$

$\therefore H = U + RT$

$\therefore \Delta H = \Delta U + \Delta(RT)$

or $\Delta H = \Delta U + R\Delta T$

$\Delta H - \Delta U = R \Delta T$ .....(1)

Lets substitute values of ΔH and ΔU in eq (1), we get

$C_p \Delta T - C_v \Delta T = R \Delta T$

or

$C_p - C_v = R$

Or

Entropy

A measure of disorder in a system. It's the ratio of heat exchange to absolute temperature. Entropy increases with mass, chemical complexity, and the number of gaseous molecules.

Enthalpy

A measure of the total heat energy in a system at constant pressure. It's the heat absorbed or released when a system changes. Enthalpy can be calculated using the formula

ΔH=ΔU+PΔVcap delta cap H equals cap delta cap U plus cap P cap delta cap V

$\Delta H = \Delta U + P\Delta V$

- **Internal energy**

The total energy of a system, including its kinetic and potential energy. It's the heat energy of a system at constant volume.

26.

Definition – The resonance effect can be defined as a chemical phenomenon that is observed in the characteristic compounds having double bonds in the organic compounds. The organic compounds contain these double bonds in the structures and usually have the overlapping of the p-orbitals on the two adjacent sides of carbon atoms.

Types of Resonance Effects

There are two types of resonance effects, namely, positive resonance effect and negative resonance effect.

1. **Positive Resonance Effect –** Positive resonance effect occurs when the groups release electrons to the other molecules by the process of delocalisation. The groups are usually denoted by +R or +M. In this process, the molecular electron density increases. For example, -OH, -SH, -OR and -SR.
2. **Negative Resonance Effect –** Negative resonance effect occurs when the groups withdraw the electrons from other molecules by the process of delocalisation. The groups are usually denoted by -R or -M. In this process, the molecular electron density is said to decrease. For example, -NO2, C=O, -COOH and -C≡N.

SECTION-D **(2 X 4= 8 Marks)**

Case Study Based Questions

Read the passage and answer the questions below:

29. (a) 3
(b) 2p
(c) 2
(d) spherical and dumbell

30. (a) sp2 hybridised
(b) ethyne
(c) CnH2n-2

SECTION-E **(3X 5=15 Marks)**

31. (a)
(i) unniluninium,
(ii) ununnilium
(iii) ununquadium
(b)
Na , Mg^{2+}

OR

(a) Use the periodic table to answer the following questions.
(i) C, Si,
(ii) Li, Na
(iii) F, Cl

(b) Due same number of valence electrons in the group.

Zn dust

31. (a) CH2=CH2 + O3→ 2HCHO
(b) hukel rule, planarity,sp2 hybridised

OR

(a) anhydrous Al Cl3 with CH3Cl and CH3COCl
(b) (i) Diagram.
(ii) C6H12
(iii) CH3CHO and HCHO

32.

(*i*) $BeCl_2$ = Cl: Be: Cl.
The central atom has only two bond pairs and there is no lone pair, *i.e.*, it is of the type AB_2. Hence, shape is **linear.**

(*ii*) BCl_3 = Cl :B: Cl.
The central atom has only 3 bond pairs and no lone pair, *i.e.*, it is of the type AB_3. Hence, shape is **triangular planar.**

(*iii*) $SiCl_4$ = Cl:Si:Cl (Cl above Si, Cl below Si)
Bond pairs = 4, lone pairs = 0, *i.e.*, it is of the type AB_4.
Hence, shape is **Tetrahedral.**

(*iv*) AsF_5 = F:As:F (F, F above As, F below As)
Bond pairs = 5, lone pairs = 0, *i.e.*, it is of the type AB_5.
Hence, shape is **Trigonal bipyramidal.**

(*v*) H_2S = H:S:H
Bond pairs = 2, lone pairs = 2, *i.e.*, it is of the type AB_2L_2.
Hence, shape is **Bent/V-shaped.**

(*vi*) PH_3 = H:P:H (H above P)
Bond pairs = 3, lone pair = 1, *i.e.*, it is of the type AB_3L.
Hence, shape is **Trigonal.**

Define Octet rule. Write its significance and limitations.

Answer: Octet rule: Atoms of elements combine with each other in order to complete their respective octets so as to acquire the stable gas configuration.

Significance: It helps to explain why different atoms combine with each other to form ionic compounds or covalent compounds.

Limitations of Octet rule:

- According to Octet rule, atoms take part in chemical combination to achieve the configuration of nearest noble gas elements. However, some of noble gas elements like Xenon have formed compounds with fluorine and oxygen. For example: XeF_2, XeF_4 etc.
  Therefore, validity of the octet rule has been challenged.
- This theory does not account for shape of molecules.

33.Write Lewis dot symbols for atoms of the following elements: Mg, Na, B, O, N, Br.

Answer:

$_{12}Mg$ = 2, 8, 2 ∴ Lewis symbol = $\dot{M}g\cdot$

$_{11}Na$ = 2, 8, 1 ∴ Lewis symbol = $\dot{N}a$

$_{5}B$ = 2, 3 ∴ Lewis symbol = $\cdot\dot{B}\cdot$

$_{8}O$ = 2, 6 ∴ Lewis symbol = $:\ddot{O}:$

$_{7}N$ = 2, 5 ∴ Lewis symbol = $:\dot{N}\cdot$

$_{35}Br$ = 2, 8, 18, 7 ∴ Lewis symbol = $:\ddot{\underset{\cdot\cdot}{B}}r\cdot$

$BeCl_2$, BCl_3

(b) Write the molecular electronic configuration of F_2.

----------ALL THE BEST ----------