

Answer six questions taking any three questions from each section

SECTION: A

- 1 (a) State and explain Faraday's laws of electrolysis. Describe experiments by which the first law can be verified. 3+2
- (b) State and explain the principle of independent ionic migration. 2
- (c) Equivalent conductance at infinite dilution of NaCl, HCl and CH₃COONa are 126.45, 426.16 and 91.0 S cm² eq⁻¹, respectively. Find the equivalent conductance of acetic acid at infinite dilution. 1.75
- 2 (a) Define chemical equilibrium. Why chemical equilibrium is called a dynamic equilibrium? 1+2
- (b) State and explain the law of mass action. 2
- (c) State and explain Le Chatelier's principle. Discuss its application to the following:
 (i). N₂(g) + 3H₂(g) ⇌ 2NH₃(g) ΔH = -5.56 KJ
 (ii). 2SO₂(g) + O₂(g) ⇌ 2SO₃(g) ΔH = -5.78 KJ 3.75
- 3 (a) What do you understand by the rate of a reaction? Mention the factors that affect the rate of a reaction. 1+1
- (b) What is meant by order of a reaction? Derive integrated rate equation for first order reaction. 1+3
- (c) What is meant by the energy of activation and how is it determined? 2.75
- 4 (a) Define physical adsorption and chemical adsorption. Distinguish between physical adsorption and chemical adsorption. 2+2
- (b) Write down Langmuir assumptions of adsorption and deduce an expression for Langmuir's monolayer adsorption isotherm. 3.25
- (c) Explain the terms: colloids and crystalloids. 1.5

SECTION: B

- 5 (a) Derive an expression for the radius of nth orbit of H-atom. 3
- (b) Find out the frequency in terms of wave numbers (\bar{v}) for the 2nd spectral line of Lyman series. Given that R_H = 1.097 × 10⁷ m⁻¹. 2
- (c) State and explain the 'Hund's rule of maximum multiplicity' with suitable example. 2
- (d) What are quantum numbers? What is the subshell designation for each of the following cases? 1.75
 (i) n=2, l=0; (ii) n=5, l=1 and (iii) n=4, l=3.
- 6 (a) What are s and p block elements? Mention the main characteristics of s and p block elements? 3
- (b) Define ionization energy. The first ionization energy of nitrogen is higher than that of oxygen-explain. 3
- (c) What is ionic bond? What are the conditions for the formation of ionic bonds? 2.75
- 7 (a) What is 'octet rule'? Draw the Lewis (or electron-dot) structure of the following molecules/ion: PH₃, SiCl₄, NO, SO₄²⁻. 1.75
- (b) Draw the MO energy level diagram for O₂ molecule and explain why it is paramagnetic? Find out its bond order. 3
- (c) Explain why H₂O is liquid whereas H₂S is gas at NTP. 2
- (d) Deduce the shape of BeCl₂ and PF₅ molecules with the help of hybridization concept. 2
- 8 (a) What are lanthanides? Discuss their position in the periodic table? 1.75
- (b) Write the ground state electronic configuration of the following metals/ions: Cr(24), Cu(29), Co²⁺(27), Ni²⁺(28). 2
- (c) Explain any two of the following: 5
 (i). Cu²⁺ complexes are colored while those of Zn²⁺ are colorless;
 (ii). Transition metals show variable oxidation states;
 (iii). Fe³⁺ is more stable than Fe²⁺.

Department of Computer Science and Engineering**B.Sc. Engg. Part-I Odd Semester Exam - 2015****Course: CHEM1111 (Physical and Inorganic Chemistry)****Full Marks: 52.5 Time: 3 Hours****(Answer any 6 questions not taking more than 3 from each group)**

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Group A

- ~~COLLISION~~
- 1.(a) What is meant by molar conductance? Describe a method of determining molar conductance of an electrolyte. 1+3
- (b) Describe the calomel reference electrode and give half-cell reaction when it is coupled with a standard hydrogen electrode. 3
- (c) Calculate the EMF of the cell: $Zn|Zn^{2+} (0.001M) \parallel Ag (0.1M) |Ag$. The standard potential of $Ag^+|Ag$ half-cell is 0.08 V and $Zn|Zn^{2+}$ is -0.76 V. 1.75
- 2.(a) What is meant by chemical equilibrium? Discuss briefly the various factors which influence the equilibrium constant of a reaction. 3
- (b) Deduce the relationship between K_c and K_p for reaction $aA + bB \leftrightarrow cC + dD$. 3
- (c) Explain zero order reaction with an example. A reactant is 50% consumed in 4 minutes at a given temperature. How much of the reactant will remain after one hour? 2.75
- 3.(a) Discuss the Langmuir theory of adsorption and derive expression for Langmuir monolayer adsorption isotherm. 3
- (b) Discuss the origin of charge on colloidal particles. What is meant by electric double layer? 2+1
- (c) What is meant by coagulation? Discuss how the electrolyte affects the behavior of lyophobic sols. 2.75
- 4.(a) Write down the integrated rate equation for zero and first order reaction and express graphically. 2.75
- (b) Explain why
 i. Molar conductance increases with dilution, whereas specific conductance decreases.
 ii. The adsorption processes are always exothermic.
 iii. Absolute electrode potential of single electrode never is measured. 2x3

Group B

- 5.(a) State the postulates of Bohr's atomic theory. What are the inadequacies of Bohr's theory? 2+2
- (b) Calculate the frequency of electromagnetic radiation emitted by the hydrogen atom in the electron transition from $n=4$ to $n=3$. Given that $R_H = 1.097 \times 10^7 m^{-1}$ and $\hbar = 6.626 \times 10^{-34} Js$. 2
- (c) The n quantum number of an atomic orbital is 6. What are the possible values of l ? What are the possible values of m_l if the l quantum number is 5? 1.75
- (d) State whether each of the following sets of quantum numbers is permissible for an electron in an atom. If a set is not permissible, explain why. 1
- (i) $(1, 0, +1/2, +1/2)$ and (ii) $(3, 2, 1, 1)$.

- 6.(a) What is meant by disintegration rate of radioelements? What is the unit of radioactive decay constant? Give example of two radioactive elements. 2.25
- (b) State and explain Pauli's exclusion principle with suitable example. 2.5
- (c) How does atomic radius change as you move (a) from left to right across the period and (b) from top to bottom in a group? 2
- (d) What is meant by electron affinity? Arrange the following elements in order of their increasing electron affinity: F, Na, Cl, K, Br and I. 2
- 7.(a) Define covalent bond. What is hybridization of atomic orbitals? Discuss the shape of PCl_5 molecule with the help of hybridization concept. 4
- (b) What is Octet rule? Discuss deviation of this rule with example. 2.75
- (c) Explain why the melting point of p-nitrophenol is higher than that of o-nitrophenol. 2
- 8.(a) Draw the MO energy level diagram of O_2^+ and O_2^- ions. Find out the bond orders and predict the stabilities of the ions. 3
- (b) What are transition elements? Describe general characteristics of transition elements. 3
- (c) Which of the following species exhibit paramagnetic behavior? Ti^{4+} , $[\text{Ni}(\text{CN})_4]^{2-}$, Co^{3+} and Ni. 1
- (d) Describe some important use of lanthanides. 1.75

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. (Engg.) Part-I Odd Semester Examination- 2014
Course: CHEM-1111 (Physical and Inorganic Chemistry)

Full Marks: 52.5

Time: 03 hours

(Answer SIX questions taking any THREE from each group)

Part-A

- 1.(a) What is cell constant? How is it determined? 4.75
 (b) State and explain the principle of independent ionic migration. Explain the relation $\lambda_+^0 + \lambda_-^0 = \Lambda^0$. 4
2. (a) What is meant by transport number? Will the transport number of Cl^- ion be the same in HCl , LiCl , KCl ? If not, explain how the transport number will change and why? 5
 (b) What do you understand by the chemical equilibrium constant? Define the equilibrium constants K_p , K_c and K_x . 3.75
- 3.(a) What is meant by order and molecularity of a reaction? Differentiate between order and molecularity of a reaction. 4.25
 (b) Derive integrated rate equation for a second order reaction. Show that the half-life of a second order reaction is inversely proportional to the initial concentration of the reactant. 4.50
- 4.(a) Deduce an expression for Langmuir's monolayer adsorption isotherm. How the surface area is calculated using Langmuir's adsorption isotherm? 4.25
 How do the colloidal particles acquire electrical charge? How can you prove that the colloidal particles are electrically charged? 4.50

Part-B

- 2011/8
 Colloid
- 5.(a) Derive an expression for the radius of nth orbit of H-atom. 3.75
 (b) Calculate the radius of 1st orbit of He^+ ion. Given that the Bohr radius is $0.529 \times 10^{-10} \text{ m}$. 2
 (c) State and explain the 'Hund's rule of maximum multiplicity' with suitable example. 3
- 6.(a) What are quantum numbers? What is the subshell designation for each of the following cases? 2.75
 (i) $n=2, l=0$; (ii) $n=5, l=1$ and (iii) $n=4, l=3$.
 (b) Define covalent radius. Explain why the atomic radius of the elements decreases from left to right in a period whereas it increases on moving down in a group. 3
 (c) Define ionization energy. The first ionization energy of N-atom is higher than that of O-atom. 3
 Explain why.
- 7.(a) What is ionic bond? What are the conditions for the formation of ionic bonds? 2.75
 (b) Draw the MO energy level diagram for O_2 molecule and explain why it is paramagnetic. Find out its bond order. 3
 (c) Distinguish between sigma (σ) and pi (π) bonds. 3
- 8.(a) What is metallic bond? Discuss the electron-pool theory to explain the bonding in metals. 3.75
 (b) Explain any two of the following: 2 × 2.5
 (i) Cu^{2+} complexes are coloured while those of Zn^{2+} are colourless.
 (ii) Transition metals are capable of forming complex compounds;
 (iii) Most of the transition metals/ions form paramagnetic compounds.

Answer six questions taking any three from each Section

Section: A

- | | | |
|---|---|-------------------|
| 1 | a) What is meant by molar conductance? How does molar conductance vary with electrolyte concentration for (a) strong electrolytes and (b) for weak electrolytes?
b) Explain the conductometric behavior of a system where a strong acid is titrated with a strong base.
c) Define galvanic cell and electrolytic cell. Write cell reactions for the following electrochemical cells:
i. $\text{Cd} \text{Cd}^{2+} \parallel \text{KCl} \text{Hg}_2\text{Cl}_2 \text{Hg}$
ii. $\text{Pb} \text{PbSO}_4(\text{s}) \text{SO}_4^{2-} \parallel \text{Cu}^{2+} \text{Cu}$ | 3.75
2
3 |
| 2 | a) Mention three characteristics of chemical equilibrium. Why chemical equilibrium is called a dynamic equilibrium?
b) Discuss the application of Le Chatelier's principle to the following reactions:
i. $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \quad \Delta H = -5.56 \text{ KJ}$
ii. $2\text{SO}_3 \rightleftharpoons 2\text{SO}_2 + \text{O}_2 \quad \Delta H = +5.78 \text{ KJ}$
c) For the dissociation of water: $\text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g})$ at 1773K the value of K_p is 1.87×10^{-6} atm. Assuming ideal behavior of gases, calculate the value of K_c . | 2.50
4
2.25 |
| 3 | a) Define half-life period of a reaction. Show that the half-life of a first order reaction is independent of the initial concentration.
b) Discuss the factors which affect the adsorption of a gas on a solid adsorbent.
c) Deduce an expression for Langmuir's monolayer adsorption isotherm. How the surface area is calculated using Langmuir's adsorption isotherm? | 3.25
2
3.50 |
| 4 | a) Explain the terms: electrophoresis and electro-osmosis.
b) How do colloidal particles gain stability?
c) Define the term 'coagulation'. Explain Hardy-Schulze rule for coagulation. | 3
2.5
3.25 |

Section: B

- | | | |
|---|---|------|
| 5 | a) Write down the postulates of Bohr's atomic model. | 3.75 |
| | b) State and explain the Pauli exclusion principle. | 2 |
| | c) How many subshells are possible in the third energy shell? What is the maximum number of electrons that can occupy a d subshell? | 2 |
| | d) What is (n+l) rule? | 1 |
| 6 | a) What is periodic law? Discuss classification of the elements on the basis of electronic configuration of their atoms. | 3.75 |
| | b) What is covalent radius? Na^+ is smaller in size than F^- , though both are isoelectronic. | 2.5 |
| | c) Define electron affinity. Explain why the electron affinity of F-atom is higher than that of O-atom. | 2.5 |
| 7 | a) What is covalent band? Illustrate the formation of covalent band. | 2 |
| | b) What is 'Octet rule'? Mention the deviation of this rule with examples. | 2 |
| | c) Define hydrogen bond. Classify the hydrogen bond with examples. | 2 |
| | d) What is meant by hybridization of atomic orbitals? Deduce the shape of BCl_3 and CH_4 molecules with the help of hybridization concept. | 2.75 |
| 8 | a) What are called transition metal? Give the electronic configuration of first series transition metals and explain the deviation of electronic configuration from the general rule if there is any. | 2.75 |
| | b) Explain any two of the following: | 2X2 |
| | i. Transition metals show variable oxidation states. | |
| | ii. Most of the transition metal ions form colored compounds. | |
| | iii. Fe^{3+} is more stable than Fe^{2+} . | |
| | c) What are lanthanides? Write down some of their uses. | 2 |

University of Rajshahi
Department of Computer Science and Engineering
 B. Sc. (Engg), Part-I, Odd Semester Examinations, 2012
 Course: CHEM1111 (Physical and Inorganic Chemistry)

Answer any three questions from each section

Time: 04 (Four) Hours

Full Marks: 52.5

Section A

1. a) State the law of mass action. Give thermodynamic derivation of the law. 0.5+2
 b) Define 'Equilibrium constant'. The state of equilibrium is dynamic in nature - explain. 1.5
 c) Formation of NH_3 proceeds as $\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \rightleftharpoons \text{NH}_3$; $\Delta H = -99.38 \text{ kJ}$ 2+1
 - i. Establish the relation for K_p of the reaction and
 - ii. Discuss the effect of temperature and pressure on the reaction.
- d) The value of K_p for the equilibrium reaction, $\text{H}_2\text{O}(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons 4\text{HCl}(\text{g}) + \text{O}_2(\text{g})$ is 0.035 at 673K. Calculate the value of K_c for the reaction. 1.75
2. a) What is ionic mobility? State and explain the Kohlrausch's law of independent migration of ions. 1+2
 b) Define transference number. Describe a method for determination of transference number. 3
 c) Write down the Debye-Huckel limiting law. 1
 d) Calculate the main activity coefficient of (i) NaCl at molality of 0.01 and (ii) Na_2SO_4 at a molality of 0.001, in aqueous solutions at 25°C. 1.75
3. a) Define absorption and adsorption. Distinguish between physical and chemical adsorption. 1+1
 b) Deduce the BET adsorption equation. How can this equation be used for determination of surface area of the adsorbate? 3+1
 c) Describe the properties of colloidal solution. 1.75
 d) What are 'gels' and 'emulsions'? 1
4. a) Derive a second order rate equation for the reaction: $2\text{A} \rightarrow \text{Product}$. 4
 b) Explain that half-life period depends upon initial concentration of the reactants. 1.75
 c) Calculate the activation energy of a reaction whose rate constant at 27°C gets doubled for 10°C rise in temperature. 3

Section B

5. a) Derive an expression for the radius of an electron in the n^{th} orbit of H-atom. 3
 b) Calculate the radii of fourth orbit in H-atom. Given that, $h = 6.62 \times 10^{-34} \text{ J}\cdot\text{s}$, $m = 9.1 \times 10^{-31} \text{ kg}$, $\pi = 3.14$, $e = 4.8 \times 10^{-10} \text{ esu}$. 2
 c) What are the postulates of Rutherford's of an atom? 2.75
 d) What is electronegativity? 1
6. a) Explain why the valence shell electronic configuration of Cr-atom is $3d^54s^1$ and not $3d^44s^2$. 2.5
 b) Write down the electronic configuration of Cu and Fe^{2+} . 2
 c) Arrange the following elements in the increasing order of their first ionization energy. 3
 - (i) Li, Be, B (ii) N, O, F (iii) C, N, O, F
 d) Define electron affinity. 1.25
7. a) Define ionic, covalent and metallic bonds with examples. What is bond dissociation energy? 3+1
 b) Discuss briefly the valence band theory of covalent bond. 3
 c) Distinguish between sigma and pi-bond. 1.75
8. a) Indicate the different states of hybridization of the following species: 2
 - (i) BeCl_2 (ii) SF_6 (iii) $[\text{Ni}(\text{CN})_4]^{2-}$ (iv) NH_3
 b) What is hydrogen bonding? What is the effect of H-bonding on the physical properties of the compounds in which this bond is present? 4
 c) What is unit cell? 1
 d) Write five orbitals in order of increasing energy starting from 4d. 1.75

University of Rajshahi
 Department of Computer Science and Engineering
 B.Sc. Fipp. Part-I Odd Semester, Examination-2013
 Course: CHM 1111 (Physical and Inorganic Chemistry)
 Full Marks: 52.5 Time: 4 Hours

Answer six questions taking any three from each Section

Section: A

- | | | |
|----|---|------------------|
| 1 | a) What is meant by molar conductance? How does molar conductance vary with electrolyte concentration for (a) strong electrolytes and (b) for weak electrolytes? | 3.75 |
| b) | Explain the conductometric behavior of a system where a strong acid is titrated with a strong base. | 2 |
| c) | Define galvanic cell and electrolytic cell. Write cell reactions for the following electrochemical cells:
i. $\text{Cd} \text{Cd}^{2+} \parallel \text{KCl} \text{Hg}_2\text{Cl}_2 \text{Hg}$
ii. $\text{Pb} \text{PbSO}_4(\text{s}) \text{SO}_4^{2-} \parallel \text{Cu}^{2+} \text{Cu}$ | 3 |
| 2 | a) Mention three characteristics of chemical equilibrium. Why chemical equilibrium is called a dynamic equilibrium? | 2.50 |
| b) | Discuss the application of Le Chatelier's principle to the following reactions:
i. $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \quad \Delta H = -5.56 \text{ KJ}$
ii. $2\text{SO}_3 \rightleftharpoons 2\text{SO}_2 + \text{O}_2 \quad \Delta H = +5.78 \text{ KJ}$ | 4 |
| c) | For the dissociation of water: $\text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g})$ at 1773K the value of K_p is 1.87×10^{-6} atm. Assuming ideal behavior of gases, calculate the value of K_c . | 2.25 |
| 3 | a) Define half-life period of a reaction. Show that the half-life of a first order reaction is independent of the initial concentration.
b) Discuss the factors which affect the adsorption of a gas on a solid adsorbent.
c) Deduce an expression for Langmuir's monolayer adsorption isotherm. How the surface area is calculated using Langmuir's adsorption isotherm? | 3.25 |
| 4 | a) Explain the terms: electrophoresis and electro-osmosis.
b) How do colloidal particles gain stability?
c) Define the term 'coagulation'. Explain Hardy-Schulze rule for coagulation. | 3
2.5
3.25 |

Section: B

- | | | |
|---|---|---------------------|
| 5 | a) Write down the postulates of Bohr's atomic model.
b) State and explain the Pauli exclusion principle.
c) How many subshells are possible in the third energy shell? What is the maximum number of electrons that can occupy a d subshell?
d) What is (n+l) rule? | 3.75
2
2
1 |
| 6 | a) What is periodic law? Discuss classification of the elements on the basis of electronic configuration of their atoms.
b) What is covalent radius? Na^+ is smaller in size than F^- , though both are isoelectronic.
c) Define electron affinity. Explain why the electron affinity of F-atom is higher than that of O-atom. | 3.75
2.5
2.5 |
| 7 | a) What is covalent band? Illustrate the formation of covalent band.
b) What is 'Octet rule'? Mention the deviation of this rule with examples.
c) Define hydrogen bond. Classify the hydrogen bond with examples.
d) What is meant by hybridization of atomic orbitals? Deduce the shape of BCl_3 and CH_4 molecules with the help of hybridization concept. | 2
2
2
2.75 |
| 8 | a) What are called transition metal? Give the electronic configuration of first series transition metals and explain the deviation of electronic configuration from the general rule if there is any.
b) Explain any two of the following:
i. Transition metals show variable oxidation states.
ii. Most of the transition metal ions form colored compounds.
iii. Fe^{3+} is more stable than Fe^{2+} .
c) What are lanthanides? Write down some of their uses. | 2.75
2X2
2 |