

C 4362

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Name.....

Reg. No.....

**SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2021**

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

Time : Two Hours

Maximum : 60 Marks

Section A (Short Answers)

Answer at least eight questions.

Each question carries 3 marks.

All questions can be attended.

Overall Ceiling 24.

1. Give the statement of first law of thermodynamics and its mathematical formulation.
2. Define term unit cell and space lattice.
3. A crystal plane makes intercepts of $(1/2a, 1/2b, c)$. What are miller indices of plane ?
4. Define average velocity and most probable velocity.
5. Write down van der Waals equation for n moles of real gas and explain the terms.
6. Define term vapour pressure of a liquid. How does it depend on temperature ?
7. What are the factors that influence viscosity of a liquid ?
8. State and explain Boyle Vant Hoff law.
9. What are strong electrolytes ? Give two examples.
10. The cell constant of a cell is 0.5 cm^{-1} . The resistance of an electrolyte solution taken in cell is 50 ohms. Calculate conductivity of solution.
11. What is meant by standard electrode potential ?
12. What are buffer solutions ? Give two examples.

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph)

Answer at least five questions.

Each question carries 5 marks.

All questions can be attended.

Overall Ceiling 25.

13. Define enthalpy and free energy. How is enthalpy change in process related to free energy change? Under what condition would a process for which $\Delta H = +$ and $\Delta S = -$ ve take place spontaneously?
14. Diethyl ether boils at 35°C . Its heat of vaporization at its boiling point is 27.2 KJ mol^{-1} . Calculate entropy of vaporization?
15. At what temperature would hydrogen gas molecules have same average speed as Helium atoms at 300 K .
16. State and explain second law of thermodynamics. Explain criterion for spontaneous process in terms of entropy change.
17. Describe how osmotic pressure of solution can be measured experimentally.
18. What do you understand by surface tension of liquids and what is the unit? Explain term interfacial surface energy. Explain surface tension on basis of intermolecular attraction.
19. What are fuel cells? Explain the electrode and cell reaction in a $\text{H}_2 - \text{O}_2$ fuel cell. List advantage of fuel cell.

(5 × 5 = 25 marks)

Section C (Essay)

Answer any one question.

The question carries 11 marks.

20. Give reasons for deviation of real gases from ideal behavior.
21. (a) Derive Ostwald's dilution law and mention its limitations.
(b) Explain why an aqueous solution of potassium acetate is basic while that of ammonium nitrate is acidic.

(1 × 11 = 11 marks)

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SECOND SEMESTER B. Sc. DEGREE EXAMINATION

CBCSSUG - CHEMISTRY

CHE2C02; Complementary Course: II

PHYSICAL CHEMISTRY

Time: Two Hours

Maximum: 60 Marks

Scheme

(Answer questions up to 20 marks. Each question carries 2 marks)

1. The first law of thermodynamics states that energy can neither be created nor destroyed but can be transformed from one form to another. $\Delta E = q + W$
2. Unit cell is the fundamental unit from which entire crystal is constructed and space lattice is a three dimensional infinite array of points each of which is surrounded in an identical way by its neighbor.
3. (2 2 1)
4. Average velocity is arithmetic mean of different velocities of gas molecules. $\langle C \rangle = (C_1 + C_2 + C_3 + \dots + C_n)/n = (8RT/nM)^{1/2}$ and most probable velocity is defined as velocity possessed by maximum number of molecules. $C_{MPV} = (2RT/M)^{1/2}$.
5. $[P + (n^2a/V^2)][V-nb] = nRT$. Explain terms.
6. Vapour pressure of a liquid can be defined as the pressure of vapour in equilibrium with a liquid at a given temperature. As temperature increase V.P also increases as more molecules attain energy to escape from surface.
- ~~7. The factors that affect viscosity of a liquid increase in temperature decrease viscosity, presence of other colloidal substance increases viscosity. Higher molecular mass, branching of alkyl chain, intermolecular H-bonding increase viscosity.~~
8. Boyle-Vant Hoff law states that temperature remaining constant, osmotic pressure of a solution is directly proportional to its molar concentration.
9. Strong electrolytes undergoes complete dissociation at moderately high concentration. examples. HCl, NaOH.
10. Ans: $0.01 \text{ohm}^{-1} \text{cm}^{-1}$
11. The reduction potential of an electrode at standard conditions measured relative to normal hydrogen electrode is called standard electrode potential.
12. The solution that resist change in its p H on adding small amount of acids or bases is called buffer solution. Eg. CH_3COOH and CH_3COONa .

Section B (Paragraph)

(Answer questions up to 30 marks. Each question carries 5 marks)

13. Enthalpy is the heat content of a system, $H=E + PV$ (1.5 marks). Free energy is the maximum amount of energy available with it that can be converted into useful work. $\Delta G = \Delta H - T\Delta S$ (1.5 marks). A process for which $\Delta H = +$ and $\Delta S = -ve$ ΔG is +ve nonspontaneous (2 mark).
14. $\Delta S_{vap} = (\Delta H / Q) = 88.31 \text{JK}^{-1} \text{mol}^{-1}$. Equation-1 mark, correct substitution-2 marks, correct ans.- 1mark, unit- 1 mark.

15. Av. Speed = $(8RT/\pi M)^{1/2}$ MPV = $(2RT/M)^{1/2}$ Ans : 150 K correct equation 1 mark each, correct substitution 1 mark each correct ans. 1 mark each.
16. According to second law of thermodynamics, for an irreversible process, entropy change of the universe, sum total of entropy changes of the system and surroundings is positive. Illustrate and explanation (4 marks). $\Delta S_{\text{universe}} = \Delta S_{\text{system}} + \Delta S_{\text{surrounding}} > 0$ with explanation (1 mark)
17. osmotic pressure of solution can be measured experimentally by Berkeley and Hartley's method explain Diagram -1 mark, principle, working and explanation -4 marks
18. Surface tension of liquid is defined as the work required to increase the surface area by one unit. Unit of S.T is Jm^{-2} or Nm^{-1} (2 marks). The work required to enlarge the surface of separation between two immiscible liquids or liquid and vapour phase is called interfacial surface energy (1 mark). Greater the intermolecular forces greater is the S.T surface tension on basis of intermolecular attraction. As temperature increases S.T decreases. (2 marks).
19. fuel cells is a galvanic cell in which energy of a fuel oxidation reaction is directly converted to electrical energy. (1 mark) At anode: $2\text{H}_2 + 4\text{OH}^- \rightarrow 4\text{H}_2\text{O} + 4\text{e}^-$ (oxidation). At cathode: $\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \rightarrow 4\text{OH}^-$ (Reduction). Net reaction: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ (3 marks)
List advantage of fuel cell. 1. High efficiency 2. Very light 3. since no direct combustion pollution free (1 mark)

Section C (Essay)

~~Answer any one. Each question carries 10 marks~~

- ~~20. Reasons for deviation (3 marks) volume correction & pressure correction (4marks). Vander Waals equation & Vander Waals constant (3 marks).~~
21. (a) Derivation of $K_a = [c\alpha^2/c(1-\alpha)]$, explain terms (3+2 marks) and its limitations: it applies only to weak electrolyte (1 marks) (b) give equation or explanation for both in aq. Solution (3 marks). Acetic acid and KOH, KOH being strong base, solution is basic. Ammonium hydroxide and nitric acid, nitric acid being strong medium acidic. With proper explanation (4 marks).