

C 42921

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Name.....

Reg. No.....

**SECOND SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
APRIL 2023**

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

(2017—2018 Admissions)

Time : Three Hours

Maximum : 64 Marks

Section A (One Word)*Answer all questions.**Each question carries 1 mark.*

1. A system which can neither exchange energy nor matter with its surrounding is called _____.
2. For a reversible process, entropy change of the universe is _____.
3. For a process involving only pressure-volume work, the internal energy change is equal to the heat absorbed or evolved at constant _____.
4. At constant temperature, the _____ of a given mass of gas varies inversely with volume.
5. The most probable velocity of a gas increases with increase in _____.
6. Amorphous substances are _____ because they exhibit same value of any property in all directions.
7. Surface tension of a liquid _____ with in temperature.
8. A _____ solution resists changes in pH even on addition of small amounts of acids or bases.
9. Give an example for a reference electrode.
10. Specific conductance of an electrolyte solution _____ with increase in dilution.

(10 × 1 = 10 marks)

Section B (Short Answer)*Answer any seven questions.**Each question carries 2 marks.*

11. State the second law of thermodynamics.
12. Define enthalpy and write down its mathematical expression.

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13. Define root mean square velocity. How does it vary with temperature.
14. Write any *two* postulates of kinetic molecular model of gases.
15. Identify the crystal systems
- (i) $a = b = c$ and $\alpha = \beta = \gamma = 90^\circ$.
 - (ii) $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^\circ$.
16. Define vapour pressure.
17. What are colligative properties? Give an example.
18. State Kohlrausch's law and write its mathematical expression.
19. Represent the electrochemical cell in which the following overall cell reaction takes place
 $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$.
20. What are fuel cells? Write down the net cell reaction of a $\text{H}_2 - \text{O}_2$ fuel cell.

(7 × 2 = 14 marks)

Section C (Paragraph)

*Answer any four questions.
Each question carries 5 marks.*

21. (i) What are the entropy criteria for a spontaneous and equilibrium process? (3 marks)
- (ii) Calculate the heat of vaporization of water if the entropy of vaporization of one mole of water at 100°C is $110 \text{ JK}^{-1} \text{ mol}^{-1}$. (2 marks)
22. (i) With the help of first law of thermodynamics show that for a process involving only the expansion work, the enthalpy change is equal to the heat added at constant pressure. (3 marks)
- (ii) What is the change in internal energy of a process if 650 J of heat is absorbed by the system while 250 J of work is done on the system? (2 marks)
23. (i) What are real gases and why do they deviate from ideal behaviour? (3 marks)
- (ii) Write down the van der Waals equation and explain the terms. (2 marks)

24. (i) State and explain Henry's law. (2 marks)
- (ii) The solubility of pure oxygen in water at 20°C and 1 atm. pressure is 1.5×10^{-3} mole/litre. Calculate the solubility of oxygen at 20°C and at a pressure of 0.3 atm. (3 marks)
25. Define molar conductance. Explain in detail the variation of molar conductance with dilution for a strong and weak electrolyte. (5 marks)
26. (i) State Ostwald's dilution law. (2 marks)
- (ii) Calculate the ionization constant of ammonium hydroxide at 25°C if it is 5% ionized in 0.25 M solution at 25°C. (3 marks)
- [4 × 5 = 20 marks]

Section D (Essay)

Answer any **two** questions.

Each question carries 10 marks.

27. (i) Explain in detail the physical significance of free energy and mention the condition of spontaneity and equilibrium based on free energy change. (5 marks)
- (ii) Consider the reaction : $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$. ΔH° and ΔS° for the reaction at 25°C are respectively -92.22 kJ and $-0.1981 \text{ kJmol}^{-1}$. Calculate the free energy change and predict whether the reaction is spontaneous or not. (3 marks)
- (iii) State third law of thermodynamics. (2 marks)
28. (i) Write a note on the different types of liquid crystals and their applications. (5 marks)
- (ii) Calculate the average velocity of CO_2 molecule at 0°C. (3 marks)
- (iii) Define Frenkel defect and give an example. (2 marks)

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29. (i) Describe the determination of molecular mass of a solute using osmotic pressure method. (5 marks)
- (ii) Write a note on reverse osmosis and its applications (5 marks)
30. (i) What is meant by salt hydrolysis? Explain why a solution of sodium acetate in water is basic. (3 marks)
- (ii) Explain the conductometric titration between weak acid and a strong base. (3 marks)
- (iii) Calculate the EMF of the cell $\text{Zn} / \text{Zn}^{2+}(0.01\text{M}) // \text{Ag}^+(0.1\text{M}) / \text{Ag}$. The standard potential of $\text{Zn} / \text{Zn}^{2+}$ half-cell is 0.76 V and Ag^+ / Ag is + 0.80 V. (4 marks)

[2 × 10 = 20 marks]