

**FYUP-B.Sc. (HONS.) CHEMISTRY PROGRAMME
JAMIA HAMDARD**

III SEMESTER Examination December 2024

PAPER CODE: BCH-DSC 301

Title: BASICS OF PHYSICAL CHEMISTRY

(Write your Roll No. at the top immediately on receipt of this question paper)

Time: 2.5 Hours

Maximum Marks: 60

Note: Attempt all the questions marks of each question given in parenthesis. All parts of a question must be attempted in continuation. Start answer of a fresh question on a new page. Cite examples and draw labelled diagrams wherever necessary.

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SECTION A

Attempt **All** of the following:

(15 x 1 = 15) Marks

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|---|-----|-----|-----|
| 1. _____ is a measure of the total energy in a system, and its change represents the heat exchanged at constant _____. | 1/2 | 1/2 | 1/2 |
| 2. Helmholtz free energy (A) is used to measure the maximum useful work at constant _____ and _____. | 1/2 | 1/2 | 1/2 |
| 3. The Third Law of Thermodynamics states that the entropy of a perfect crystal at absolute zero is _____. | 1/2 | 1/2 | 1/2 |
| 4. The smallest repeating unit in a crystal lattice that reflects the overall symmetry of the structure is called a _____. | 1/2 | 1/2 | 1/2 |
| 5. The law of _____ describes that the indices of crystal faces are simple whole numbers. | 1/2 | 1/2 | 1/2 |
| 6. The percentage of space filled by atoms in a given structure is called _____. | 1/2 | 1/2 | 1/2 |
| 7. Vapor pressure increases with _____ because more molecules have enough energy to escape the liquid phase. | 1/2 | 1/2 | 1/2 |
| 8. The radial distribution function provides insight into how _____ varies with distance from a reference particle in a liquid. | 1/2 | 1/2 | 1/2 |
| 9. Viscosity is the measure of a liquid's resistance to _____. | 1/2 | 1/2 | 1/2 |
| 10. Gibbs free energy (G) is defined as _____, and it represents the maximum reversible work that a system can perform at constant _____ and _____. | 1/2 | 1/2 | 1/2 |
| 11. Surface tension _____ with an increase in temperature due to weaker intermolecular forces. | 1/2 | 1/2 | 1/2 |
| 12. The mean free path is the average distance a gas molecule travels between collisions, and it is _____ proportional to the gas pressure. | 1/2 | 1/2 | 1/2 |
| 13. Collision cross-section (σ) can be calculated from the gas viscosity (η), and it represents the effective area for _____ between gas molecules. | 1/2 | 1/2 | 1/2 |
| 14. What is collision frequency? | 1/2 | 1/2 | 1/2 |
| 15. What are Miller indices? | 1/2 | 1/2 | 1/2 |

SECTION B

Attempt **any two** of the following:

(2x10=20) Marks

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|---|-----|-----|-------|
| 1. Compare the variation of viscosity with temperature for liquids and gases. What causes the difference in their behavior? | 5/6 | 5/6 | 5/6/7 |
| 2. What are the causes of deviation from ideal gas behavior? Explain the concepts of compressibility factor and Van der Waals equation. | 5/6 | 5/6 | 5/6/7 |
| 3. What is Bragg's law, and how is it used in X-ray diffraction to determine the crystal structure? Explain the underlying principles. | 5/6 | 5/6 | 5/6/7 |
| 4. Define Gibbs free energy and Helmholtz free energy. Derive the expressions for both and explain their significance in thermodynamic processes. | 5/6 | 5/6 | 5/6/7 |

SECTION C

Attempt the following:

(5x5=25) Marks

1. Explain the cleansing action of detergents and how it relates to surface tension and micelle formation. 5/6 5/6 5/6/7

OR

Calculate the interplanar spacing (d) in a crystal lattice if the X-ray wavelength (λ) used in a diffraction experiment is 0.154 nm, and the angle of diffraction (θ) is 30 degrees.

2. Explain the First Law of Thermodynamics and derive the expression for work done during the isothermal expansion of an ideal gas in a reversible process. 4/5/6 4/5/6 4/5/6

OR

Explain the concept of point defects in crystalline solids. Differentiate between Frenkel and Schottky defects, and discuss their effects on the properties of solids.

3. Explain the Second Law of Thermodynamics and its relation to entropy. How is the change in entropy calculated for reversible and irreversible processes? 5/6 4/5/6 4/5/6/7

OR

Determine the surface tension of a liquid using the capillary rise method. A capillary tube with a radius of 0.5 mm is immersed in the liquid, and the liquid rises to a height of 2.0 cm.

4. What are the causes of deviations from ideal gas behavior? How is collision diameter related to the behavior of real gases? 3/4/5 3/4/5/6 3/4/5

OR

Discuss the classification of solids based on different binding forces. Explain the differences between molecular, ionic, covalent, and metallic solids, giving examples of each.

5. Discuss the concept of standard enthalpy of formation and explain its significance in chemical thermodynamics. Also, differentiate between integral and differential enthalpy of solution. 3/4/5 3/4/5 3/4/5

OR

Describe the concept of Bravais lattices and explain how they relate to crystal symmetry. Provide examples of different types of Bravais lattices.
