

MAHATMA GANDHI UNIVERSITY
CBCSS BSc PROGRAMME IN CHEMISTRY

Fifth semester

Core Course: CH5 B03-States of Matter

Model Question paper

Time:3 Hrs

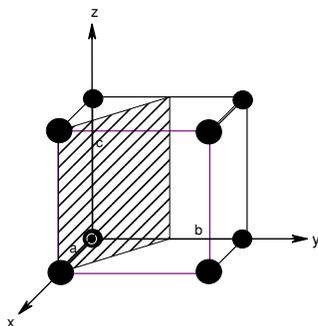
Total Weightage:25

Section A

(Answer all questions. A bunch of four questions carries a weightage of 1)

Questions 1-4 (Select the correct answer from among the choices given)

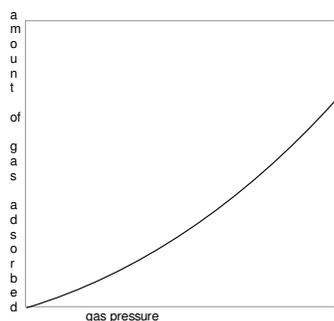
1. The critical volumes of four gases A, B, C and D respectively are 0.01L, 0.04L, 0.03L & 0.02L respectively. The gas with highest van der Waals constant, b is;
(a) B; (b) A; (c) D; (d) C
2. For a given sample of gas, the correct order of molecular velocity expressions is;
(a) most probable velocity > root mean square velocity > average velocity
(b) root mean square velocity > most probable velocity > average velocity
(c) average velocity > most probable velocity > root mean square velocity
(d) root mean square velocity > average velocity > most probable velocity
3. Pressure correction is accommodated in the van der Waals equation to account for;
(a) Intermolecular attractive force existing in real gases at low P and high T
(b) Intermolecular attractive force existing in real gases at high P and low T
(c) Molecular volume is not negligible for real gases at low P and high T
(d) Molecular volume is not negligible for real gases at low T and high P
4. The hkl indexing for the shaded lattice plane with intercepts, $1a$, $\frac{1}{2}b$, ∞c will be;



- (a) $(1\ 2\ \infty)$
- (b) $(1\ \frac{1}{2}\ \infty)$
- (c) $(1\ 2\ 0)$
- (d) $(\infty\ \frac{1}{2}\ 1)$

Questions 5-8 (Fill in the blank space with an appropriate word/term)

5. In NaCl crystal, sodium ions are caged in expanded -----voids set by the FCC lattice of chloride ions.
6. In.....point group, the elements are identity, proper rotational elements(C_3^1 , C_3^2) and three vertical plane reflections.
7. Colourful $KMnO_4$, $K_2Cr_2O_7$, $CuSO_4 \cdot 5H_2O$ crystals belong tocrystal system.
8. The following model of gas adsorption over a solid adsorbent, deviating from Langmuir model, is attributed toadsorption of gas molecules.



Questions 9-12 (In this bunch of four questions, two statements are given, former, an *assertion* which is labeled as **A** and the latter, a *reason* statement, labeled as **R**. Going through the following instructions, mark the correct choice.)

- (a) If **A** and **R** are correct and if **R** is the correct reason for **A**
 - (b) If **A** and **R** are correct and if **R** is not the correct reason for **A**
 - (c) If **A** is correct, **R** is not correct
 - (d) If **A** is not correct, **R** is correct
 - (e) If **A** and **R** are not correct.
9. Assertion **A**: CO_2 gas couldn't be liquefied at $50^\circ C$ taking compression as the means.
Reason **R**: Gases cannot be liquefied above their critical temperature by applying pressure.
(a); (b); (c); (d); (e)
 10. Assertion **A**: Non-stoichiometric NaCl crystals appear yellow in colour
Reason **R**: Excess chloride ions entrapped in NaCl lattice act as colour centres.
(a); (b); (c); (d); (e)
 11. Assertion **A**: Smectic liquid crystals do flow like true liquids.
Reason **R**: Smectic liquid crystals glide in layers
(a); (b); (c); (d); (e)
 12. Assertion **A**: A cubic atomic solid is expected to show maximum density if it crystallizes in BCC arrangement.
Reason **R**: Close packing efficiency is in the order, $BCC > FCC > \text{Primitive Cubic}$.
(a); (b); (c); (d); (e)

Questions 13-16 (Examine the following statements and find whether *true* or *false*)

- Boyle temperature of a gas is the temperature at which its second virial coefficient vanishes.
- The total energy of vibration per molecule per vibrational degree of freedom is $\frac{1}{2} kT$
- Coefficient of gas viscosity is directly proportional to square root of temperature in absolute scale.
- About S_3 axis, there can be only one *genuine improper rotation* operation possible.

Section B

(Answer any five questions. Each question carries a weightage of 1)

- At what temperature does a plot of gas volume against temperature in $^{\circ}C$ cut the temperature axis?
- Express the meaning of mean free path.
- Mention the principle behind the Claude's method of liquefaction of gases.
- What are the parameters correlated in Freundlich adsorption isotherm?
- Why do X-ray wavelets get diffracted while encountering lattice particles in crystals?
- Compute the effective number of α -iron metal kernels per unit cell, if it has BCC lattice.
- Which are the elements combined in C_{2v} point group?
- Express the Poiseuille's law applied in the viscosity measurement of liquids by Ostwald method.

Section C

(Answer any four questions. Each question carries a weightage of 2)

- Express the Maxwell's law of distribution of molecular velocity and draw the major conclusions.
- Derive the Virial equation of state and get an expression for Boyle temperature in terms of van der Waals constants.
- Illustrate any two group properties making use of suitable example.
- With a radius ratio of 0.40, which is the preferred lattice arrangement for ZnS crystal? Give unit cell sketch to support the answer.
- How could you differentiate between NaCl and KCl crystals by X-ray diffraction studies?
- Choosing an appropriate example, explain the thermographic behavior of a liquid crystal.

Section D

(Answer any two questions. Each question carries a weightage of 4)

- Derive the van der Waal equation of state making volume and pressure corrections in the ideal gas equation and express the critical constants in terms of van der Waal constants.
- Derive the Bragg's equation and show how the expression is made use in Bragg X-ray single crystal diffraction and Powder methods of crystal study.
- Derive the Langmuir adsorption isotherm and also mention how the BET equation is handy in the determination of surface area of adsorbents.