(c) X-ray powder diffraction angles from Y crystal were observed at 20.26°, 29.30°, 36.82°, 43.82°, 50.70°, 58.80°, 66.30° and other angles using radiation of wavelength 1.54Å . Considering the density of Y to be 10.24 g cm^{-3} find the atomic weight of Y. 3

Ex/SC/CHEM/UG/TH/07/2023

B. Sc. Chemistry Examination, 2023

(3rd Semester, CBCS)

CHEMISTRY (CORE)

Paper: Core/Chem/Th/07

Time : Two Hours Full Marks : 40

(20 marks for each unit)

Use a separate answer script for each unit.

UNIT - 3071 - P

1. With a given minimum expenditure of work, the greater is the amount of heat extracted from the colder reservoir, the better is the refrigerator – Justify. 3

2. For a closed system, the thermodynamic condition for a change to be spontaneous when carried out at constant volume and temperature and capable of only $P–V$ work is that $\triangle A < 0$. 3

3. Derive the expression of the internal pressure of a gaseous system from the relevant fundamental equation of thermodynamics. Prove that the internal pressure exists for a van der Waals gas. $1\frac{1}{2}+1\frac{1}{2}$

4. What happens to the melting point of ice on increasing the pressure ? Justify your answer through derivation of the appropriate equation for fusion equilibrium. 4

5. Starting from the necessary thermodynamic proof of Le Chatelier's principle, show what will happen to the advancement ξ of a gas phase reaction at equilibrium and at constant temperature if the volume of reaction is positive. 4

6. Assuming the relation

$$\ln K_P = -1.04 - \frac{1088}{T} + \frac{1.51 \times 10^5}{T^2}$$ valid for a particular reaction, calculate the changes in standard free energy and standard enthalpy of the reaction at 400 K. 3

UNIT - 3072 - P

7. Answer any ***two*** questions :
   (a) Arrive Wien's displacement law from the Planck's equation of black-body radiation. 3
   (b) Examine whether the operator $\left(d^2/dx^2\right)$ is Hermitian or not. 3
   (c) Explain Bohr correspondence principle considering the particle in 1-D box model. 3

8. Answer any ***two*** questions :
   (a) For particle of mass *m* moving freely in a 1-D box of length *l* with infinite potential energy walls calculate the average value of energy considering the trial function $\psi = x(l-x)$. Compare this energy with the true gound state energy of the system. 3+1
   (b) Given $\left[\hat{X}, \hat{p}_x\right] = i\hbar$ evaluate $\hat{A}$ & $\left[\hat{X}, \hat{A}\right]$ where $\left[\hat{X}, \hat{p}_x^{\,2}\right] = \hat{A}$. 2+2
   (c) (i) Show that 'zero point energy' of a freely moving particle in a one dimensional box is a consequence of Heisenberg's uncertainly principle. (i) Find the Compton wavelength of proton. 3+1

9. Answer any ***two*** questions :
   (a) NaBr and RbBr have the same crystal structure. X-ray diffraction, however, indicates RbBr to be a simple cubic while the other is face-centred cubic lattices : Explain. 3
   (b) For a cubic lattice show that the interplanar distance (d_{hkl}) is given by $d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$ a = unit cell length. 3