

Bankim Sardar College

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Semester-IV

B.Sc(Hons)

Subject- Chemistry

Paper Code: CEMA-CC-4-9-TH

2020

**Group –A(Answer Question No.1) (10 marks)**

**1. i) Phase rule states that**

(a)  $F=C-P+1$  (b)  $F=C-P+2$  (c)  $F=C-P$  (d)  $F=P-C$

**ii) Elevation of boiling point is**

(a) an extensive property (b) an intensive property (c) a colligative property  
(d) both of (b) and (c)

**iii) A mixture of benzene and ethanol will**

(a) behave ideally  
(b) show negative deviation  
(c) show positive deviation  
(d) cannot be predicted

**iv) The number of components in the dissociation equilibrium of  $PCl_5$  is**

(a) 1  
(b) 2  
(c) 3  
(d) 4

**v) Two commuting operators will always have a**

- (a) common eigenfunction
- (b) common set of eigenfunctions
- (c) common factor
- (d) common multiple

**vi) When a system is present in its eigenstate corresponding to an operator,**

- (a) eigenvalue is the expectation value
- (b) expectation value is zero
- (c) eigenvalue is less than expectation value
- (d) eigenvalue is greater than expectation value

**vii) A one dimensional quantum system will always show a degeneracy equal to**

- (a) 0
- (b) 1
- (c) 2
- (d) 3

**ix) KCl has a**

- (a) Simple cubic lattice
- (b) Face centered cubic lattice
- (c) Body centered cubic lattice
- (d) None of these

**x) Inadequacy of Einstein's equation of specific heat is due to**

- (a) consideration of monochromatic oscillator
- (b) consideration of polychromatic oscillator

(c) existence of cut-off frequency

(d) None of these

**Group B – Answer Question No 2 (30 marks)**

2.i) (a) Give an example of a buffer solution. Write down the Henderson equation for this buffer solution explaining the terms involved. [2+3]

(b) In the experiment for determination of pH of unknown solution (buffer), by colour matching method, what indicator do you use? [2]

(c) State and explain Nernst distribution law. [3]

2.ii) (a) What do you understand by pseudounimolecular reaction? Explain with example. [2]

(b) What sort of light is used in a polarimeter? What is the source of the light? [2]

(c) Explain the principle behind the kinetic study of inversion of cane sugar using a Polarimeter. (Mathematical relation/derivation not required) [2]

(d) How will the phenol water phase diagram look like? [2]

(e) Name one system that has lower CST and one that has both upper and lower CST. [2]

2.iii) (a) Draw the pH- metric titration curve for the titration of a dibasic acid against NaOH. From this curve explain how you will determine  $pK_1$ ,  $pK_2$  and equivalence point. [2+2+2+2]

(b) Write down the electrochemical cell used in a pH-meter [2]

**Group C – Answer Question No 3 (20 marks i.e., 10 questions of 2 marks each) and any 6 from question No 4,5,6,7,8,9,10,11 (5 marks each i.e., total 30 marks)**

3.i) Why do four phases of Sulphur cannot co-exist in equilibrium?

ii) Define Van't Hoff's factor.

iii) Give two arguments in favor of the statement that Azeotropes are not compounds.

iv) Why is consumption of tobacco more harmful in the form of cigarette than that in the form of hookah?

v) During photoelectric emission, the electrons are ejected from outermost orbit of the atom-Justify or criticize.

vi) Find out the following commutator  $\left[\frac{\partial}{\partial x}, \frac{\partial^2}{\partial x^2}\right]$ .

vii) A free particle can never show any quantization- Justify or criticize.

viii) Qualitatively state how will the wavefunctions change if the boundaries of a particle in a box with infinite potential are placed at  $x = -\frac{L}{2}$  to  $x = +\frac{L}{2}$  instead of from  $x = 0$  to  $x = L$ .

ix) How is Miller index more superior than Weiss index?

x) State Steno's law.

4. i) Why does increase in pressure reduce cooking time?

ii) Deduce the integrated form of Clausius Clapeyron equation for solid-liquid equilibrium. (2+3)

5. i) Show that the chemical potential of the solution is expressed as

$$\mu_i(\text{solution}) = \mu_i^* + RT \ln x_i,$$

where the symbols bear their usual meaning.

ii) What is the degree of freedom of a single component system? (4+1)

6. i) A solution containing 0.011 kg of barium nitrate in 0.1 kg of water boils at  $100.46^{\circ}$  C. Calculate the degree of ionization of the salt. [ $K_b(\text{water}) = 0.52 \text{ kg-K/mol}$ ]

ii) What is reverse osmosis? (3+2)

7. i) If the wave function for a system is an eigenfunction of the operator associated with the observable  $A$ , show that  $\langle A^n \rangle = \langle A \rangle^n$

ii) What do you mean by a parity operator? Explain its significance for a particle moving in quadratic potential. (2+3)

8. i) Prove that If  $\psi_1$  and  $\psi_2$  are the eigenfunctions of the operator  $A$  with distinct eigenvalues, then  $c_1\psi_1 + c_2\psi_2$  is not an eigenfunction of the operator  $A$ ,  $c_1$  and  $c_2$  being constants.

ii) Prove that the operator  $i(d/dx)$  is Hermitian. (2+3)

9. Light of wavelength  $2000 \text{ \AA}$  falls on a metallic surface. If the work function of the surface is  $4.2 \text{ eV}$ , what is the kinetic energy of the fastest photoelectrons emitted? Also calculate the stopping potential and the threshold wavelength for the metal. (5)

10. Derive Bragg's law. What do you mean by order of reflection in the Bragg's law? (4+1)

11. i) The energy eigenvalue and the corresponding eigenfunction for a particle of mass  $m$  in a one-dimensional potential  $V(x)$  are  $E = 0$ ,  $\psi(x) = \frac{A}{a^2+x^2}$ . Deduce the potential  $V(x)$ .

ii) Under what condition can you convert Schrodinger equation into its time independent form? (4+1)