

**B.Sc. CHEMISTRY
FIRST SEMESTER
PHYSICAL CHEMISTRY
BSC – 102 [SPECIAL REPEAT]
(USE OMR FOR OBJECTIVE PART)**

**SET
A**

Duration: 3 hrs.

Full Marks: 70

Time : 30 min.

Marks : 20

(Objective)

Choose the correct answer from the following:

1X20=20

- Phenolphthalein changes color in
 - Acids
 - Alkalis
 - Water
 - Salt solutions
- What is the main purpose of acid-base titration?
 - To test if reactants react
 - To calculate the concentration of unknown analyte
 - To calculate the concentration of known analyte
 - To test quality of reactants
- Electrolytes when dissolved in water dissociate into their constituent ions. The degree of dissociation of an electrolyte increases with
 - Increasing concentration of the electrolyte
 - Decreasing concentration of the electrolyte
 - Decreasing temperature
 - Presence of a substance yielding a common ion
- Which will not affect the degree of ionization
 - Temperature
 - Concentration
 - Type of solvent
 - Current
- Which of the following is equal to the pK_a of a weak acid?
 - Its relative molecular mass
 - The pK_b of its conjugate base
 - The pH of a solution containing equal amounts of the acid and its conjugate base
 - The equilibrium concentration of its conjugate base
- Which of the following relationship is true in water at 25°C?
 - [H⁺]=[H₂O]
 - [OH⁻]=[H₂O]
 - K_w> 10⁻¹⁴
 - [H⁺]=[OH⁻]
- A solution of HCl with a concentration of 4×10⁻⁴ molL⁻¹ has a pH of
 - 2.67
 - 3.21
 - 3.40
 - 4.31
- A buffer solution comprises which of the following?
 - A weak acid in solution
 - A strong acid in solution
 - A weak base in solution
 - A weak acid and its conjugate base in solution

9. The pH for the solution of salt hydrolysis of NH_4Cl is given by
- $\text{pH} = \frac{1}{2} (\text{pK}_w - \text{pK}_b - \log C)$
 - $\text{pH} = \frac{1}{2} (\text{pK}_w + \text{pK}_b + \log C)$
 - $\text{pH} = \frac{1}{2} (\text{pK}_a + \text{pK}_w - \text{pK}_b)$
 - None of the above
10. The solubility product expression for $\text{Sn}(\text{OH})_2$ is
- $[\text{Sn}^{2+}][\text{OH}^-]$
 - $[\text{Sn}^{2+}]^2[\text{OH}^-]$
 - $[\text{Sn}^{2+}][\text{OH}^-]^2$
 - $[\text{Sn}^{2+}][2\text{OH}^-]^2$
11. The surface tension of a liquid vanishes roughly ___ above the critical temperature (fill in the blank)
- 4°C
 - 5°C
 - 6°C
 - 7°C
12. η and ϕ are the viscosity and fluidity of a liquid respectively then
- $\eta = 1/\phi$
 - $\eta = 1/\phi^2$
 - $\eta = \phi^2$
 - $\eta = 1/2\phi$
13. A crystal having unit cell dimensions $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^\circ$ is
- cubic
 - tetragonal
 - orthorhombic
 - hexagonal
14. The total number of space groups in a crystal is
- 7
 - 14
 - 32
 - 230
15. Relationship between orientational order of solids, liquids and liquid crystals is
- solid > liquid > liquid crystal
 - solid > liquid crystal > liquid
 - liquid > liquid crystal > solid
 - solid < liquid crystal < liquid
16. The Boyle's law states that
- the volume of a gas is inversely proportional to the pressure of a gas at a constant temperature
 - The volume of a gas is directly proportional to the temperature at constant pressure
 - None of the above
 - Both are correct
17. According to kinetic theory of gases, the energy per mole of a gases is equal to
- RT
 - 1.5 RT
 - 0.5 RT
 - Cannot defined
18. Kinetic energy of a gad depend upon its
- Molecular mass
 - Atomic mass
 - Equivalent Mass
 - None of the above
19. Which of the following statement is true regarding gases?
- gases are highly incompressible
 - gases exert equal pressure on each and every direction
 - its volume and shape is fixed
 - gases have the highest density among the 3 States of matter

20. For an ideal gas, the value of compressibility factor, Z is equal to
- 0
 - 1
 - 2
 - None of the above

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(Descriptive)

Time : 2 hrs. 30 mins.

Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. a. Calculate the temperature at which the root mean square velocity, the average velocity and the most probable velocity of oxygen gas all are equal to 1500 m/s. 3+3+4
=10
- b. What is heat of vaporisation? How is it related to Trouton's rule? Boiling point of a liquid is 76°C. Estimate its heat of vaporisation assuming it obeys Trouton's rule.
- c. Discuss in detail the phenomenon of hydrolysis of salts. Illustrate your answer taking examples of the salt of a weak acid and strong base.
2. a. Describe 'Hole' theory with respect to liquid viscosity. What do you understand by Reynolds number? 4
- b. What is the molar solubility, s , of $Ba_3(PO_4)_2$ in terms of K_{sp} . Write two difference between solubility product and ionic product. Explain two uses of buffer in analytical chemistry. 2+2+2
=6
3. a. State the principle of equipartition energy. 3+4+3
=10
- b. How a gas can be liquefied. Explain. What is critical temperature and critical pressure of a gas?
- c. Write the virial equation of state of a real gas. Why real gases show deviations from ideal behaviour.
4. a. starting from the basic postulates of the kinetic theory of gases, derive the kinetic gas equation. 4+1+5
=10
- b. Using the kinetic gas equation, derive Avogadro's Law.

- c. 50ml of a solution of CH_3COOH (0.1 M) is being titrated against standard (0.125 M) solution of NaOH . Calculate pH values of the titration solution of 30, 40, 50 ml of NaOH solution.
5. a. What do you mean by acid-base indicators? How to select an indicator for an acid-base titration? Write four limitations of indicators. Explain the action of Phenolphthalein. 2+2+2+2
=8
- b. Explain graphically how the adsorption varies with pressure at a constant temperature. 2
6. a. Explain why a solution of a weak acid and its salt behaves as buffer. Explain the term of buffer range. Calculate pH before and after the addition of 0.01 mole of NaOH to 1 liter of a buffer solution of 0.1 M CH_3COOH and 0.1 M CH_3COONa . ($\text{pK}_a=1.75\times 10^{-5}$). 2+2+3=7
- b. The surface tension of water is $72.8 \text{ dynes cm}^{-1}$. Calculate the energy required to disperse one spherical drop of radius 3.0 mm into spherical drops of radius $3.0 \times 10^{-3} \text{ mm}$. 3
7. a. Derive Bragg's equation for X-ray diffraction. KNO_3 crystalizes in orthorhombic form with unit cell dimensions $a = 542 \text{ pm}$, $b = 917 \text{ pm}$ and $c = 645 \text{ pm}$. Calculate the angle of diffraction from (111) plane by a X-ray of wave length 154.1 pm . 4+4+2
=10
- b. Differentiate between vacancy and interstitial defects. Differentiate between Frenkel and Schottky defects.
- c. What is director of a liquid crystal. How Nematic liquid crystal differ from Smectic liquid crystal.
8. a. Define the terms solubility and solubility product of a substance. Explain giving at least four examples of the use of the concept of solubility product in qualitative analysis. 2+4=6
- b. The solubility product of CaF_2 is 3.45×10^{-11} . If 2.0 ml of 0.10 M solution of NaF is added to 128 ml of $2\times 10^{-5} \text{ M}$ solution of $\text{Ca}(\text{NO}_3)_2$, will CaF_2 precipitate? 4

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