



# Sanjay Ghodawat University, Kolhapur

Established as State Private University under Govt. of Maharashtra. Act No XL, 2017

EXM/P/09/00

2018-19

Year and Program: 2018-19

School of Science

Department of Chemistry

Course Code: CHS 506

Course Title: Physical

Semester – Even (II)

M.Sc-I (Chem)

Chemistry-II

Day and Date: Friday, End Semester Examination

Time: 3 hrs, Max Marks: 100

24/05/2019, Friday

10.30 to 11.00 am

PRN:

Seat No:

Section A Marks out of 20:

Jr. Supervisor Sign:

Student Sign:

## Section A

Instructions: 1) All Questions are compulsory.

2) For MCQs mark tic (✓) for correct answer. No marks for multiple tics (✓).

3) Section A should be submitted to Jr. Supervisor immediately after first 30 min.

### Q.1 Multiple choice questions.

Marks 20 level CO

- |   |   |   |    |   |
|---|---|---|----|---|
| 1 | In the Heisenberg uncertainty principle, which two measurable properties of a particle cannot be observed precisely at the same time? | 1 | L1 | 1 |
|   | a. Position and momentum                      b. Size and speed   |   |    |   |
|   | c. Spin and color                                      d. Energy and torque   |   |    |   |
| 2 | What is the zero point energy in particle in one dimensional box  | 1 | L1 | 1 |
|   | a. $E_{\text{zero point}} = h^2/8ma^2$ b. $E_{\text{zero point}} = -h^2/8ma^2$  |   |    |   |
|   | c. $E_{\text{zero point}} = h/8ma^2$ d. $E_{\text{zero point}} = -h/8ma^2$  |   |    |   |
| 3 | Which of the following is known as the Schrodinger equation   | 1 | L5 | 1 |
|   | a. $E = hv$ b. $E = mc^2$   |   |    |   |
|   | c. $\lambda = h/p$ d. $-\hbar^2/2m \cdot \nabla^2$  |   |    |   |
| 4 | As the concentration increases the thickness of ionic atmosphere -----.   | 1 | L2 | 2 |
|   | a. Decreases                                      b. Increases  |   |    |   |
|   | c. Both a and b                                      d. None of these   |   |    |   |
| 5 | What is final equation of Time of Relaxation of ionic atmosphere?   | 1 | L4 | 2 |
|   | a) $\theta = \frac{0.4 \times 10^{-10}}{cz} \text{sec}$ b) $\theta = \frac{0.6 \times 10^{-10}}{cz} \text{sec}$                       |   |    |   |
|   | c) $\theta = \frac{0.6 \times 10^{-8}}{cz}$ d) None of these  |   |    |   |

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|----|--|---|----|---|
| 6  | Which is the equation for Debye-Huckel limiting law for activity coefficient.  | 1 | L1 | 2 |
|    | a) $\log f_i = Az_i \sqrt{u}$ b) $\log f_i = -Az_i^2 \sqrt{u}$   |   |    |   |
|    | c) $\log f_i = Az_i^2 \sqrt{u}$ d) None of these   |   |    |   |
| 7  | Due to adsorption  | 1 | L4 | 3 |
|    | a. Surface energy increases      b. surface energy becomes zero  |   |    |   |
|    | c. surface energy decreases      d. no change occurs in surface energy   |   |    |   |
| 8  | Which of the following is good adsorbent   | 1 | L2 | 3 |
|    | a. Silica gel      b. Alumina  |   |    |   |
|    | c. Clay      d. All the given  |   |    |   |
| 9  | In Freundlich adsorption isotherm the plot of $\ln a$ versus $\ln c$ is a straight line with slope equal to $n$ and the value of intercept equal to -----.   | 1 | L1 | 3 |
|    | a. $a$ and $b$ b. $n$ and $k$  |   |    |   |
|    | c. $1/a$ d. $\log k$   |   |    |   |
| 10 | Magnitude of adsorption gas is expressed as ----.  | 1 | L3 | 3 |
|    | a. $m/x$ b. $m \cdot \Delta x$   |   |    |   |
|    | c. $x/m$ d. $x + m$  |   |    |   |
| 11 | On which of the following factor adsorption of gas on solid adsorbent depends?   | 1 | L1 | 3 |
|    | a. On temperature      b. On pressure of gas   |   |    |   |
|    | c. On nature of adsorbent      d. All the given  |   |    |   |
| 12 | Which is correct sequence of wave numbers associated with the stretching of the following bonds?   | 1 | L1 | 3 |
|    | a. $C-I > C-Cl < C=O < C \equiv N$   |   |    |   |
|    | b. $C-I > C-Cl > C=O > C \equiv N$   |   |    |   |
|    | c. $C-I > C-Cl > C=O < C \equiv N$   |   |    |   |
|    | d. $C-I < C-Cl < C=O < C \equiv N$   |   |    |   |
| 13 | Which of the following molecule does not produce rotational spectrum?  | 1 | L1 | 3 |
|    | a. $CO_2$ b. $NO$  |   |    |   |
|    | c. $CO$ d. $HCl$   |   |    |   |
| 14 | The first Stokes line and first anti-Stokes lines in the Rotational Raman spectrum of $N_2O$ are displaced from the Rayleigh line by $-2.514 \text{ cm}^{-1}$ and $+2.514 \text{ cm}^{-1}$ respectively. What is rotational constant of $N_2O$ ? | 1 | L1 | 4 |
|    | a. $0.629 \text{ cm}^{-1}$ b. $0.419 \text{ cm}^{-1}$  |   |    |   |
|    | c. $2.514 \text{ cm}^{-1}$ d. $1.207 \text{ cm}^{-1}$  |   |    |   |
| 15 | Which of the following is true about the principal moments of inertia of a linear molecule?  | 1 | L1 | 4 |
|    | a. $I_A > I_B$ and $I_B = I_C$ b. $I_A = I_B = I_C$  |   |    |   |

- c.  $I_A = 0$ , and  $I_B = I_C$       d.  $I_A = I_B$  and  $I_C = 0$
- 16 Which of the following transitions between energy levels is an allowed transition?      1      L5      4  
 a.  $J=1 \rightarrow J=3$       b.  $J=0 \rightarrow J=2$   
 c.  $J=0 \rightarrow J=1$       d.  $J=0 \leftarrow J=2$
- 17 The different types of energies associated with a molecule are ----.      1      L1      4  
 a. Electronic energy      b. Vibrational energy  
 c. Rotational energy      d. All of the mentioned
- 18 The transition zone for the Raman spectra is ---.      1      L4      4  
 a. between vibrational and rotational levels  
 b. between electronic levels  
 c. between magnetic levels of nuclei  
 d. between magnetic levels of unpaired electrons
- 19 Which of the following must change for the mode to be Raman active?      1      L3      4  
 a. Volume      b. Dipole moment  
 c. Polarizability      d. concentration
- 20 The normal modes of vibrations of OCS molecule are ---.      1      L6      4  
 a. 1      b. 2  
 c. 3      d. 4

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11 to 1.30 pm

PRN:

Seat No:

Section A Marks Out of 80

## Section B

		Marks	level	CO
Q.2	Answer the following questions (Solve any Two)	12		
a)	Derive an expression for Linear angular momentum for a diatomic linear molecule with the help of quantum mechanics.	6	L2	1
b)	Derive an expression for the electron in a three-dimensional box.	6	L2	1
c)	Write any six postulates of Quantum mechanics.	6	L2	1
Q.3	Answer the following questions (Solve any Two)	12		
a)	Derive an expression for Debye-Huckel theory of Interionic attraction for ionic atmosphere.	6	L3	2
b)	Evaluate the Debye-Huckel Onsagar conductance equation and the Validity of the Debye-Huckel Onsagar equation.	6	L3	2
c)	Explain in detail forms of the activity coefficient in very dilute solutions.	6	L3	2
Q.4	Answer the following questions (Solve any Two)	12		
i)	Derive an expression for Langmuir adsorption isotherm in surface chemistry.	6	L2	3

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ii)	Explain and derive Gibbs adsorption isotherm equation for adsorption from solutions.	6	L2	3
iii)	Discuss in detail factors affecting on critical micelle concentration (cmc).	6	L2	3
b)	<b>Answer the following questions (Solve any Four)</b>	16		
i)	Explain in detail micellization process and reverse micelle with proper diagram.	4	L2	3
ii)	At 0°C and 1 atm pressure, the volume of nitrogen gas required to form a monolayer on a sample of charcoal is 155.5 cm <sup>3</sup> g <sup>-1</sup> of charcoal. Calculate the surface area per gram of charcoal. Area of cross-section of N <sub>2</sub> molecule is 0.160 (nm) <sup>2</sup> .	4	L4	3
iii)	A sample of chloroform rose to a height of 3.67 cm at 20°C in a capillary tube having an inside radius of 0.01 cm. What is the surface tension of chloroform at this temperature? The density of chloroform is 1.476 g/cm <sup>3</sup> .	4	L4	3
iv)	Discuss in detail Capillary rise method for the determination of surface tension.	4	L4	3
v)	Write a note on types of adsorption isotherms with diagram.	4	L4	3
Q.5 a)	<b>Answer the following questions (Solve any Two)</b>	16		
i)	Explain in brief about antistokes line, stokes line and Rayleigh scattering line in the Rotational Raman spectra of diatomic molecules. If in such spectrum the successive stokes lines are separated by 7.655 cm <sup>-1</sup> , then what is rotational constant of molecule?	8	L3	4
ii)	Write an expression for the rotational energy level of a non-rigid rotator and obtain an expression for the energy absorbed for transition from lower energy level of quantum number J to higher level of quantum number J+1.	8	L3	4
iii)	What is an anharmonic oscillations of molecule? Construct energy level diagram for anharmonic oscillator and discuss	8	L3	4

production of vibrational spectrum of diatomic molecule. What information do you get from the analysis of the spectrum?

- |   |           |    |   |
|---|-----------|----|---|
| <b>b) Answer the following questions (Solve any Three)</b>  | <b>12</b> |    |   |
| i) Calculate the wave length of radiation required to excite CO molecule from $J=2$ to $J=3$ rotational level. Given that the rotational constant of molecule is $1.932 \text{ cm}^{-1}$ .                    | 4         | L5 | 4 |
| ii) Draw schematic diagram of IR spectrometer and describe the source of IR and IR detector.  | 4         | L5 | 4 |
| iii) What are the conditions for the molecule to be IR active? Show with neat structural diagrams that all possible vibration modes of $\text{H}_2\text{O}$ molecule are IR active.                           | 4         | L5 | 4 |
| iv) The diatomic molecule HCl has a B value of $10.593 \text{ cm}^{-1}$ and centrifugal distortion constant 'D' of $5.3 \times 10^{-4} \text{ cm}^{-1}$ . Estimate the vibrational frequency of HCl molecule. | 4         | L6 | 4 |

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