

Reg. No. : .....

Name : .....

I Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.)  
 Examination, October 2021  
 (2018 Admission Onwards)

## CHEMISTRY

## CHE1C.01 : Theoretical Chemistry – I

Time : 3 Hours

Max. Marks : 60

## SECTION – A

Answer **all** questions in **one** word or sentence. **Each** question carries **1** mark : (8×1=8)

- Which of the following functions is acceptable ?  
 a)  $\psi = x$       b)  $\psi = x^2$       c)  $\psi = \sin x$       d)  $\psi = e^{-x}$
- What are eigenfunctions ?
- The energy of a particle in a box is found to be  $9 h^2/8 m a^2$ . Find out the value of principle quantum number.
- Write the equation for energy of a rigid rotor.
- Write down the perturbation term for helium atom.
- What is associate Legendre polynomial ?
- What are Slater type orbitals ?
- Define basis set.

## SECTION – B

Answer **any eight** questions in **two** or **three** sentences. **Each** question carries **2** marks : (8×2=16)

- Explain Hermitian operator.
- Evaluate the commutator  $[d/dx, d^2/dx^2]$ .

P.T.O.



11. State and explain expectation value postulate of quantum mechanics.
12. What is a well behaved wave function ?
13. Write down the wave function corresponding to the energy  $6h^2/8ma^2$ .
14. Verify that  $\psi = A\sin kx + B\cos kx$  is a general solution for a particle in a one dimensional box of infinite potential wall.
15. What are Hermite polynomials ? Find out the values of first two Hermite polynomials.
16. Discuss the significance of quantum numbers  $n, l$  and  $m$ .
17. Using atomic units write the complete Hamiltonian for electronic motion in hydrogen atom in spherical polar coordinates.
18. Mention the problem facing by many electron system. How it can be solved ?
19. What is a spin orbital ?
20. Give the determinantal wave functions of a 3 electron system.

## SECTION - C

Answer **any four** questions in short paragraph. **Each** question carries **3** marks : **(4×3=12)**

21. Explain black body radiation.
22. Consider the wave function  $\psi = A \sin kx$ . Find the eigenvalue of this function for the operator  $d^2/dx^2$ .
23. Draw the molecular orbital diagram of CO molecule.
24. How do you apply Huckel theory to allyl system ?
25. What do you mean by self-consistent field method ?
26. Calculate the ground state energy of butadiene molecule using particle in a box model. (C-C single and double bond lengths are  $1.54 \text{ \AA}$  and  $1.34 \text{ \AA}$  respectively)
27. What are Laguerre polynomials ?
28. Draw the radial plot of  $P_x$  orbital.



SECTION - D

Answer either **a** or **b** of **each** question. **Each** question carries **6** marks : **(4×6=24)**

29. a) Discuss the postulates of quantum mechanics.

OR

b) Explain the method of variation applied to Helium atom.

30. a) What are antisymmetric wave functions ? Construct the Slater determinant of a system with four electrons.

OR

b) What is VBT ? Apply VBT to hydrogen molecule.

31. a) Discuss semi empirical and abinitio method used in computational chemistry.

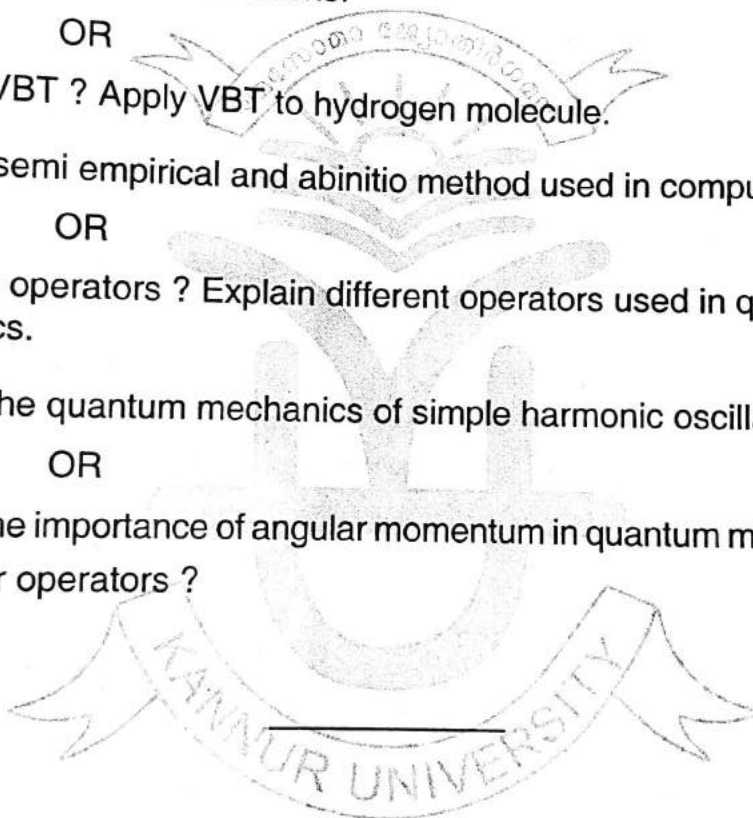
OR

b) What are operators ? Explain different operators used in quantum mechanics.

32. a) Discuss the quantum mechanics of simple harmonic oscillator.

OR

b) Discuss the importance of angular momentum in quantum mechanics. What are ladder operators ?







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I Semester M.Sc. Degree (CBSS – Reg./Supple./Imp.)

Examination, October 2021

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CHEMISTRY

CHE1C.02 : Inorganic Chemistry – I

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one word or one sentence**. Each question carries **1** mark.

1. What do you mean by **standard deviation** ?
2. Name an organic precipitant used for the gravimetric estimation of Nickel (II).
3. Why is pH 10 buffer used in **EDTA titration** ?
4. Classify the following on Lewis acid or Lewis base giving reason :
  - i)  $\text{CO}_2$
  - ii)  $\text{Mg}^{2+}$ .
5. What is **Dosimetry** ?
6. What are **magic numbers** ?
7. Complete the following equation :  
$$\text{B}_2\text{H}_6 + 2\text{NaH} \xrightarrow{\text{diglyme}}$$
8. What are **phosphazines** ? (8×1=8)

SECTION – B

Answer **any eight** questions. Answer in **two or three** sentences. Each question carries **2** marks.

9. What is **distribution law** ? What are the limitations of **distribution law** ?
10. How do you assess the **reliability of results** ?

P.T.O.



11. What do you mean by precipitation from homogeneous solution ? Explain.
12. Is  $\text{OH}^-$  or  $\text{S}^{2-}$  more likely to form insoluble salts with 3+ transition metal ions ?  
Which is more likely to form insoluble salts with 2+ transition metal ions ?
13. What are room temperature molten salts ?
14. What is hydrometallurgy ?
15. Explain the Bethe's notation of nuclear process with example.
16. What do you mean by neutron capture cross section ?
17. Explain spontaneous fission.
18. How is  $\text{S}_4\text{N}_4$  prepared ?  $\text{S}_4\text{N}_4$  is associated with thermochromic property. Why ?
19. The 'STYX' number of  $\text{B}_5\text{H}_9$  is 4120. Explain.
20. Give an account of the structure and bonding in  $(\text{PNCI}_2)_3$ . (8×2=16)

## SECTION - C

Short paragraph questions. Answer any four questions. Each question carries 3 marks.

21. What are the essential requirements for a substance to be used as a metallochromic indicator ?
22. Write a short note on organic precipitants used in gravimetric analysis.
23. Explain symbiosis.
24. Discuss the acid base properties of different substances in sulphuric acid solvent.
25. Explain the principle and working of GM counter.
26. Write a short note on radiolysis of water.
27. By taking a suitable example explain the Jemmis 'mno' rule.
28. Give one method each for the preparation of  $\text{P}_4\text{S}_3$ ,  $\text{P}_4\text{S}_5$  and  $\text{P}_4\text{S}_{10}$ . What are their uses ? (4×3=12)



SECTION – D

Essay type questions. Answer either 'a' or 'b' of each question. Each question carries 6 marks.

29. a) Explain the terms distribution coefficient and distribution ratio in solvent extraction. Discuss the principle involved in counter current extraction and its applications.

OR

- b) What are Chelometric titrations? Explain selective masking and demasking techniques in EDTA titration with suitable examples. Discuss the industrial application of masking.

30. a) Write about the merits and demerits of liquid ammonia as a nonaqueous solvent. Explain the properties of alkali metal – liquid ammonia solution.

OR

- b) Explain the theoretical basis of hardness and softness of acids and bases.

31. a) Write the salient features of liquid drop model. How does it explain the nuclear fission reaction?

OR

- b) Explain different types of nuclear reactions. How is reaction rate and reaction cross section related?

32. a) Discuss the importance of icosohedral frame work in understanding the structure of higher boranes and carboranes.

OR

- b) Explain the preparation, structure and properties of  $S_2N_2$  and polythiazyl.

(4×6=24)

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CHEMISTRY

CHE 1C.04 : Physical Chemistry – 1

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one word** or **sentence**. **Each** question carries **1** mark.

1. State Nernst heat theorem.
2. What is meant by chemical potential ?
3. Define thermomolecular pressure difference.
4. Give an example for a ternary system with **one** pair of partially miscible liquids.
5. Give one example each for polarisable and non-polarisable electrode.
6. What do you understand by the term polarization ?
7. Define corrosion.
8. How is IR drop related to current density ? (8×1=8)

SECTION – B

Answer **any eight** questions. Answer in **one** or **two** sentences. **Each** question carries **2** marks.

9. What is meant by residual entropy ? Explain with any one example.
10. State and explain Onsager's reciprocal relation.

P.T.O



11. Draw the general phase diagram of a ternary system with three pairs of partially miscible liquids.
12. Why  $H^+$  ions show abnormal ionic mobility in aqueous solution ?
13. Define hydrogen overvoltage and oxygen overvoltage.
14. What is meant by transfer coefficient or symmetry factor ?
15. Draw polarographic cell assembly.
16. Calculate the mean ionic activity coefficient of 0.01 molal  $CaCl_2$  in water at  $25^\circ C$ .  $A = 0.509$ .
17. What do you mean by exchange current density ?
18. Explain passivation of metals.
19. Draw the polarization diagram for corroding metal when anode area equals one-half of cathode area.
20. Write any two limitations of Pourbaix diagrams. (8×2=16)

SECTION – C

Answer **any four** questions. **Each** question carries **3** marks.

21. Derive an expression for the rate of entropy production for a system with matter and heat transport.
22. Write a note on liquid junction potential.
23. Write Butler-Volmer equation and explain the terms.
24. Draw electrode-electrolyte interface and show inner and outer Helmholtz plane.
25. Write the equation for thickness of ionic atmosphere and explain the terms.
26. What are the advantages of dropping mercury electrode ?
27. How will you establish polarization diagram of corroding metals ?
28. Write a note on Pilling – Bedworth ratio. (4×3=12)





SECTION – D

Answer 'a' or 'b' of each question. Each question carries 6 marks.

29. a) State third law of thermodynamics. How can you determine the absolute entropy of a gas using third law of thermodynamics ?

OR

b) Discuss phase rule for three component system. Draw and discuss the general phase diagram of a 3-component system with two pairs of partially miscible liquids.

30. a) Explain the principle and working of polarography.

OR

b) Derive Debye Huckel limiting law and write Debye-Huckel equation for appreciable concentration.

31. a) Derive Debye Huckel Onsager equation.

OR

b) Derive Tafel equation. Explain the significance of slope and intercept.

32. a) Write an essay on various types of damages due to corrosion.

OR

b) Write notes on:

i) Electrochemical impedance spectroscopy

ii) Cathodic protection.

(4×6=24)

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