C 4361 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2021

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

Time : Two Hours Maximum : 60 Marks

Section A (Short Answers)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. What is Photoelectric effect ?
2. Explain de Broglie's concept of matter waves with evidences.
3. Give expression for radius of Bohr orbit, velocity and energy of an electron in a hydrogen atom explain terms involved.
4. Explain term linear operator.
5. What is meant by well-behaved wave function ?
6. Draw angular distribution plots of *p* orbitals.
7. What is bonding molecular orbital ?
8. What is the % of s character in sp, sp^2 and sp^3 hybrid orbitals ?
9. What is the appropriate trial function for hydrogen molecule in V. B theory?
10. What is meant by normalization of wave function?
11. What is the type of hybridization and geometry in (1) NH_4^+ ; (2) $SiCl_4$.
12. Why is hyrid orbitals better oriented than a pure orbital ?

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. The threshold frequency of a metal is $4.412 \times 10^{-14}\ S^{-1}$. Calculate the K.E of photoelectron ejected when light of wavelength 4000 Å falls on surface of metal, $h = 6.626 \times 10^{-34}$Js.

14. Describe atomic spectrum of hydrogen atom.

15. Calculate the ground state energy of an electron confined in 1D box of length 0.2 m and calculate energy in $n = 4$ level, $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.626 \times 10^{-34}$Js.

16. Draw radial probability distribution curves of 2s and 2p orbitals.

17. Illustrate and explain LCAO applied for heteronuclear diatomic molecules ?

18. Explain Born-Oppenheimer approximation.

19. What is the type of hybridization in the formation of BH_3 ? Discuss.

(5 × 5 = 25 marks)

Section C (Essay)

Answer any **one** *question.*
The question carries 11 *marks.*

20. State and explain postulates of quantum mechanics.

21. (a) Bonding of O_2 is better explained in molecular orbital theory than in valence band theory. Explain.

    (b) Explain the criteria for formation of molecular orbitals from atomic orbitals.

(1 × 11 = 11 marks)

C 22062 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2022

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

(2021 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A (Short Answers)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Explain how the shape of p orbitals are deduced on the basis of angular wave functions.
2. Calculate the short and long wavelength limits of the Balmer series in the spectrum of hydrogen atom.
3. Explain the characteristics of curves for the emission of radiations from a black body at different temperatures.
4. Demonstrate photoelectric effect on the basis of quantum theory.
5. What is Hamiltonian operator ?
6. What is the significance of ψ and ψ^2 ?
7. On the basis of MOT, show that the existence of stable Be_2 molecule is not possible.
8. Describe sp^3 hybridization with a suitable example.
9. What is variation principle ?
10. Write down the common features among VBT and MOT.
11. Comment on the magnetic property of C_2 molecule.
12. Illustrate the combination of two p_x atomic orbitals to form molecular orbitals.

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Derive the time independent Schrodinger wave equation.

14. Deduce the expression for energy of an electron in n^{th} orbit. Calculate the energy of electron in hydrogen atom in ground state.

15. Write the postulates of quantum mechanics.

16. What is valence bond theory ? Explain with an example.

17. Explain why hydrogen forms diatomic molecule while helium remains monoatomic.

18. Illustrate the hybridization and geometry of PCl_5 and IF_7.

19. Explain the experiment which led to the discovery of spin of electrons.

(5 × 5 = 25 marks)

Section C (Essay)

Answer any **one** *question.*
The question carries 11 *marks.*

20. Explain Bohr theory of atom model. Derive the expression for Bohr radius. What are the shortcomings of Bohr theory ?

21. What is meant by bonding and antibonding molecular orbitals ? How are they formed ? Illustrate the concept on the basis of hydrogen molecule ion H_2^+.

(1 × 11 = 11 marks)

C 23850 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS–UG) DEGREE EXAMINATION, APRIL 2022

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

(2019—2020 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A (Short Answers)

Answer questions up to 20 marks.
Each question carries 2 marks.

1. What type of metals are used in photoelectric cells ? Give an example.
2. State de Broglie's relation and explain terms in it.
3. Give any three limitations of Bohr Theory.
4. Explain term Hermitian operator.
5. Give time dependent Schrodinger wave equation.
6. Draw radial probability distribution curve of 2s orbitals.
7. Explain term bond order. Mow is bond order related to bond strength?
8. Draw molecular orbital diagram of He_2^+ and calculate bond order.
9. What is the change in hybridization when : (i) NH_3 changes to NH_4^+ ; and (ii) BF_3 to BE_4^-.
10. Write any two qualities of hybrid orbitals.
11. Write the shape and hybridization of PCl_5 molecule.
12. Hybrid orbitals are stronger than that from a pure orbital. Explain.

Section B (Paragraph)

Answer questions up to 30 *marks.*
Each question carries 5 *marks.*

13. Calculate K. E of electron emitted from surface of potassium metal by light of wavelength 3000 Å. The threshold frequency of potassium is $5 \times 10^{14} S^{-1}$ and $h = 6.626 \times 10^{-34} Js$.
14. Discuss how Bohr Theory explains formation of line spectrum of hydrogen atom.
15. A particle is confined in a 3D box with sides a = b = 1.5c. : (a) Write expression for wave function and energy ; and (b) Predict the degeneracy of first four energy levels.

Turn over

16. What are Laplacian and Hamiltonian operators ?

17. Describe LCAO method for constructing molecular orbitals. Sketch molecular orbitals formed by combination of two *s* orbitals and two *p* orbitals.

18. Mention features that distinguish bonding and antibonding molecular orbitals.

19. Explain orbital hybridization on basis of quantum mechanical principles.

Section C (Essay)

Answer any **one**.
The question carries 10 *marks.*

20. Discuss briefly concept of particle in ID box. Using Schrödinger equation predicts its energy and wave function.

21. (a) Compare valence band theory and molecular orbital theory.

    (b) Draw molecular orbital diagram of NO and calculate B.O.

(1 × 10 = 10 marks)

C 43159 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2023

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

(2019—2022 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A (Short Answers)

Answer any questions up to 20 *marks.*
Each question carries 2 *marks.*

1. State Heisenberg uncertainty principle.
2. What is the work function for photo electric effect ?
3. Derive de Broglie's relationship.
4. Write the Rydberg relation for hydrogen spectrum. Calculate the wave number of second line in Baimer series.
5. Write any *four* postulates of Bohr model of hydrogen atom.
6. What are eigen functions and eigen values ?
7. Write the Schrodinger wave equation of hydrogen atom using spherical polar co-ordinates.
8. Draw the potential energy diagram for H_2 molecule formation.
9. What is Hamiltonian operator ?
10. Calculate the bond order of N_2 molecule.
11. What is Hybridization ?
12. Draw the shapes of PCl_5 and IF7 molecules.

[Ceiling of marks: 20]

Turn over

Section B (Paragraph)

Answer questions up to 30 *marks.*
Each question carries 5 *marks.*

13. Draw the molecular orbital diagram of CO molecule. Calculate its bond order ?

14. Define LCAO of central atom. Explain sp hybridization of BeH_2 and sp^2 hybridization of BH_3 using LCAO approximation.

15. Derive an expression for energy for a particle in a one dimensional box.

16. What is Born Oppenheimer approximation ? What is its significance ?

17. Briefly describe the importance of variation theorem in quantum mechanics.

18. Describe Stern-Gerlach experiment. What is its significance in determining atomic structure ?

19. Derive the expression to determine Bohr radius and energy of electron in the K shell (n = 1) of hydrogen atom.

[Ceiling of marks : 30]

Section C (Essay)

Answer any **one** *question.*
The question carries 10 *marks.*

20. Write the postulates of quantum mechanics. Derive time independent Schrodinger wave equation for particle in one dimensional box. Draw the radial probability distribution curves of 1*s*, 2*s* and 2*p* orbitals.

21. What is quantum mechanical concept of chemical bonding ? Explain bonding in following species

    (a) H_2 molecule using VB theory.

    (b) H_2^+ ion using MO theory.

(1 × 10 = 10 marks)

D 103739 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2024

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

(2019—2023 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A (Short Answers)

Answer questions up to 20 *marks.*
Each question carries 2 marks

1. Derive the de Broglie equation.
2. State and explain Einstein's photoelectric equation.
3. Write any *four* demerits of Bohr's theory of the atom.
4. How are matter waves different from electromagnetic waves ?
5. What is blackbody radiation ?
6. What is meant by a well-behaved wave function ?
7. Write the values of all four quantum numbers *n, l, m* and *s* for the two electrons present in the 2*s* orbital of nitrogen atom.
8. Explain the term Hermitian operator.
9. What is Born-Oppenheimer approximation ?
10. What are antibonding molecular orbitals ?
11. Predict the hybridization and geometry of PCl_5 and IF_7.
12. Write the co-efficients of the atomic orbitals involved in *sp* hybridization.

(Ceiling of marks : 20)

Turn over

Section B (Paragraph)

Answer questions up to 30 *marks.*
Each question carries 5 *marks.*

13. The kinetic energy of a moving electron is 4.55×10^{-25} Joules. Calculate its wave length.

14. Discuss the atomic spectra of hydrogen using Bohr's model.

15. Compare the radial distribution plots of 1*s*, 2*s* and 2*p* orbitals.

16. Give the postulates of quantum mechanics.

17. Draw the MO diagram of CO molecule. Calculate the bond order and explain its magnetic behaviour.

18. Describe the LCAO method of constructing molecular orbitals. Illustrate the combination of *s*-*s* and *p*-*p* orbitals.

19. Discuss the salient features of hybridization.

(Ceiling of marks : 30)

Section C (Essay)

Answer any **one** *question.*
The question carries 10 *marks.*

20. Give the complete solution of particle in a one-dimensional box.

21. Compare VB and MO theories of chemical bonding.

(1 × 10 = 10 marks)