

C 43160

(Pages : 2)

Name.....

Reg. No.....

**SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2023**

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

(2019—2022 Admissions)

Time : Two Hours

Maximum : 60 Marks

Section A (Short Answers)*Answer questions up to 20 marks.**Each question carries 2 marks.*

1. State first law of thermodynamics and give its mathematical expression.
2. What is a spontaneous process ? Mention the criteria for spontaneity in terms of free energy.
3. Define surface tension ? What is the effect of temperature on surface tension of a liquid.
4. What are colligative properties ? Give one example.
5. Define specific conductance of an electrolyte solution. Explain the variation of specific conductance with dilution.
6. Give any *four* advantages of conductometric titrations.
7. Write down Bragg's equation and explain the terms involved.
8. What is meant by electrode potential? What is the value of electrode potential for Standard Hydrogen electrode ?
9. How does temperature and pressure influence the solubility of gases in liquids ?
10. Write any four postulates of kinetic molecular theory of gases.
11. If the pressure and temperature of 6 litres of a gas is doubled, what would be its volume ?
12. Define RMS velocity and give its mathematical expression derived from Maxwell equation.

[Ceiling of marks : 20]

Turn over

Section B (Paragraph)

Answer questions up to 30 marks.

Each question carries 5 marks.

13. What are fuel cells ? Describe the functioning of $H_2 - O_2$ fuel cell.
14. (a) Account for the entropy change of the universe for a reversible process with suitable explanation.
(b) Calculate the entropy change in melting of 1 Kg of ice at $25^\circ C$. Heat of fusion of ice is $334.72 Jg^{-1}$.
15. Briefly explain the principle of conductometric titration with reference to weak acid-strong base titration.
16. Explain Maxwell distribution of molecular velocities using suitable diagram.
17. What are miller indices? Determine the miller indices for a plane when the intercepts along the axis are : (i) $2a, 3b$ and $2c$; and (ii) $1a, 2b$ and $3c$.
18. Explain the determination of molecular mass using any one of the colligative properties.
19. Write a short note on non-stoichiometric defects in crystals.

[Ceiling of marks : 30]

Section C (Essay)

*Answer any **one** question.*

The question carries 10 marks.

20. (a) Describe buffer solutions with an example each for acidic and basic buffer. Explain the buffer action of acetic acid/sodium acetate buffer.
(5 marks)
- (b) State Kohlrausch's law and explain any two applications of the law. (5 marks)
21. (a) Write a short note on various symmetry elements in crystals. (5 marks)
- (b) Write down the van der Waals equation and explain the terms. Give a detailed account for the deviation of real gases from ideal behaviour.
(5 marks)

[1 × 10 = 10 marks]

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(Pages : 4)

Name.....

Reg. No.....

**SECOND SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
APRIL 2023**

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

(2017—2018 Admissions)

Time : Three Hours

Maximum : 64 Marks

Section A (One Word)*Answer all questions.**Each question carries 1 mark.*

1. A system which can neither exchange energy nor matter with its surrounding is called _____.
2. For a reversible process, entropy change of the universe is _____.
3. For a process involving only pressure-volume work, the internal energy change is equal to the heat absorbed or evolved at constant _____.
4. At constant temperature, the _____ of a given mass of gas varies inversely with volume.
5. The most probable velocity of a gas increases with increase in _____.
6. Amorphous substances are _____ because they exhibit same value of any property in all directions.
7. Surface tension of a liquid _____ with in temperature.
8. A _____ solution resists changes in pH even on addition of small amounts of acids or bases.
9. Give an example for a reference electrode.
10. Specific conductance of an electrolyte solution _____ with increase in dilution.

(10 × 1 = 10 marks)

Section B (Short Answer)*Answer any seven questions.**Each question carries 2 marks.*

11. State the second law of thermodynamics.
12. Define enthalpy and write down its mathematical expression.

Turn over

13. Define root mean square velocity. How does it vary with temperature.
14. Write any *two* postulates of kinetic molecular model of gases.
15. Identify the crystal systems
- (i) $a = b = c$ and $\alpha = \beta = \gamma = 90^\circ$.
 - (ii) $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^\circ$.
16. Define vapour pressure.
17. What are colligative properties? Give an example.
18. State Kohlrausch's law and write its mathematical expression.
19. Represent the electrochemical cell in which the following overall cell reaction takes place
 $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$.
20. What are fuel cells? Write down the net cell reaction of a $\text{H}_2 - \text{O}_2$ fuel cell.

(7 × 2 = 14 marks)

Section C (Paragraph)

*Answer any four questions.
Each question carries 5 marks.*

21. (i) What are the entropy criteria for a spontaneous and equilibrium process? (3 marks)
- (ii) Calculate the heat of vaporization of water if the entropy of vaporization of one mole of water at 100°C is $110 \text{ JK}^{-1} \text{ mol}^{-1}$. (2 marks)
22. (i) With the help of first law of thermodynamics show that for a process involving only the expansion work, the enthalpy change is equal to the heat added at constant pressure. (3 marks)
- (ii) What is the change in internal energy of a process if 650 J of heat is absorbed by the system while 250 J of work is done on the system? (2 marks)
23. (i) What are real gases and why do they deviate from ideal behaviour? (3 marks)
- (ii) Write down the van der Waals equation and explain the terms. (2 marks)

24. (i) State and explain Henry's law. (2 marks)
- (ii) The solubility of pure oxygen in water at 20°C and 1 atm. pressure is 1.5×10^{-3} mole/litre. Calculate the solubility of oxygen at 20°C and at a pressure of 0.3 atm. (3 marks)
25. Define molar conductance. Explain in detail the variation of molar conductance with dilution for a strong and weak electrolyte. (5 marks)
26. (i) State Ostwald's dilution law. (2 marks)
- (ii) Calculate the ionization constant of ammonium hydroxide at 25°C if it is 5 % ionized in 0.25 M solution at 25°C. (3 marks)
- [4 × 5 = 20 marks]

Section D (Essay)

Answer any **two** questions.

Each question carries 10 marks.

27. (i) Explain in detail the physical significance of free energy and mention the condition of spontaneity and equilibrium based on free energy change. (5 marks)
- (ii) Consider the reaction : $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$. ΔH° and ΔS° for the reaction at 25°C are respectively -92.22 kJ and $-0.1981 \text{ kJmol}^{-1}$. Calculate the free energy change and predict whether the reaction is spontaneous or not. (3 marks)
- (iii) State third law of thermodynamics. (2 marks)
28. (i) Write a note on the different types of liquid crystals and their applications. (5 marks)
- (ii) Calculate the average velocity of CO_2 molecule at 0°C. (3 marks)
- (iii) Define Frenkel defect and give an example. (2 marks)

Turn over

29. (i) Describe the determination of molecular mass of a solute using osmotic pressure method. (5 marks)
- (ii) Write a note on reverse osmosis and its applications (5 marks)
30. (i) What is meant by salt hydrolysis? Explain why a solution of sodium acetate in water is basic. (3 marks)
- (ii) Explain the conductometric titration between weak acid and a strong base. (3 marks)
- (iii) Calculate the EMF of the cell $\text{Zn} / \text{Zn}^{2+}(0.01\text{M}) // \text{Ag}^+(0.1\text{M}) / \text{Ag}$. The standard potential of $\text{Zn} / \text{Zn}^{2+}$ half-cell is 0.76 V and Ag^+ / Ag is + 0.80 V. (4 marks)

[2 × 10 = 20 marks]

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(Pages : 2)

Name.....

Reg. No.....

**SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2024**

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

(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. What is the entropy change of the universe for a reversible process and irreversible process ?
2. Define closed system and isolated system.
3. Write down the van der Waal's equation and explain the terms involved.
4. Define molar conductance of an electrolyte solution. How is it related to specific conductance.
5. Explain the effect of temperature and pressure on viscosity of a liquid.
6. What are buffer solutions ? Give one example each for an acidic and basic buffer.
7. Write the electrode reactions in a Daniell cell.
8. What are fuel cells ? Write down the overall cell reaction of a H_2-O_2 fuel cell.
9. What are anisotropic substances ? Give an example.
10. Explain reverse osmosis and mention one of its application.
11. What are real gases ? Mention the condition at which real gases obey ideal gas equation.
12. Define RMS velocity and most probable velocity.

(Ceiling of marks : 20)

Turn over

Section B (Paragraph)

Answer questions up to 30 marks.

Each question carries 5 marks.

13. Briefly explain Maxwell distribution of molecular velocities using suitable diagram.
14. What are reference electrodes ? Briefly explain the calomel electrode.
15. Write down the van't Hoff equation and explain the terms. Calculate the molar mass of a non-volatile solute if, at 25°C its solution containing 2.5 g dm⁻³ has an osmotic pressure of 1 atm. Given $R = 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$.
16. Define vapour pressure and surface tension of a liquid. Explain the variation of these properties with temperature.
17. Write a short note on stoichiometric point defects in crystals.
18. (a) State first law of thermodynamics and give any *two* limitations of the law.
(b) Mention the condition for equilibrium and spontaneity based on ΔG value.
19. Describe buffer solutions with an example. Explain the buffer action of acetic acid/sodium acetate buffer.

(Ceiling of marks : 30)

Section C (Essay)

*Answer any **one** question.*

The question carries 10 marks.

20. a) State and explain Kohlrausch's law.
(5 marks)
- b) Briefly explain conductometric titrations with reference to any two types of acid- base titrations.
(5 marks)
21. a) Write down the postulates of kinetic molecular theory of gases. Explain for the deviation of real gases from ideal behaviour.
(5 marks)
- b) What are non-stoichiometric defects in crystals. Explain any *two* non-stoichiometric defects in detail.
(5 marks)

[1 × 10 = 10 marks]

C 6132

(Pages : 3)

Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION
MAY 2016

(UG—CCSS)

Core Course—Chemistry

CH 2B 03—THEORETICAL CHEMISTRY

Time : Three Hours

Maximum : 30 Weightage

Section A

I. Answer *all* twelve questions. Each question carries a weightage of $\frac{1}{4}$.

1 The geometry of IF_7 molecule is:

- (a) Octahedral (b) Square pyramidal
(c) Pentagonal bipyramid (d) Trigonal bipyramid.

2 The bond order of CO molecule is:

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

3 The value of Rydberg constant is :

- (a) $1.0967758 \times 10^7 \text{ cm}^{-1}$. (b) $1.0967758 \times 10^8 \text{ cm}^{-1}$.
(c) $1.0967758 \times 10^7 \text{ m}^{-1}$. (d) $1.0967758 \times 10^8 \text{ m}^{-1}$.

4 The species O_2^+ is isoelectronic with :

- (a) NO. (b) N_2 .
(c) CO. (d) CO^+ .

5 Which of the following does not exist ?

- (a) He_2^+ . (b) H_2 .
(c) He_2 . (d) H_2^+ .

6 Which among the following has a distorted geometry ?

- (a) CH_4 . (b) PCl_5 .
(c) BH_3 . (d) NH_3 .

Turn over

- 7 The hybridization of S in SF_6 is :
- (a) sp^3d . (b) sp^3d^3 .
(c) sp^3d^2 . (d) dsp^2 .
- 8 The energy gap between valence band and conduction band is called _____.
- 9 The phenomenon of photoelectric effect establishes the _____ nature of light.
- 10 The Schrodinger wave equation for particle in one dimensional box is _____.
- 11 The condition for orthogonality is _____.
- 12 The Fermi level of conductors lies in the _____ band.

(12 × ¼ = 3 weightage)

Section B

II. Answer *all* nine questions. Each question carries a weightage 1.

- 13 What is Born-Oppenheimer approximation ?
- 14 Derive de Broglie relation.
- 15 What are eigen function and eigen values of an operator ?
- 16 Arrange O_2 , O_2^+ , O_2^- , O_2^{2-} in the increasing order of their bond order.
- 17 Name the different spectral series in Hydrogen spectrum.
- 18 What is the magnetic behaviour of oxygen molecule ? Give reason.
- 19 Calculate the radius of the second orbit of hydrogen atom.
- 20 Give the values of quantum numbers for the outermost electrons in the ground state of Potassium atom.
- 21 What is meant by a well behaved wave function ?

(9 × 1 = 9 weightage)

Section C

III. Answer any *five* questions. Each question carries a weightage 2.

- 22 State and explain the postulates of quantum mechanics.
- 23 Differentiate bonding and antibonding molecular orbitals.
- 24 Explain the radial probability distribution curves of 2s and 2p orbitals.

- 25 Explain photoelectric effect based on quantum theory of radiation.
- 26 How will you explain the conductivity of metals on the basis of band theory ?
- 27 Describe the potential energy diagram for the formation of H_2 molecule.
- 28 Explain sp^2 and sp^3 type of hybridizations with suitable example.

(5 × 2 = 10 weightage)

Section D

IV. Answer any *two* questions. Each question carries a weightage of 4.

- 29 (i) Draw the molecular orbital diagram of nitrogen molecule and calculate the bond order.
(ii) Explain the geometry of PCl_5 based on the hybridisation.
- 30 Set up and solve the Schrodinger wave equation for a particle in three dimensional box and get expression for the wave function and energy.
- 31 (i) Write the important limitations of Bohr model of atom and give the Sommerfeld modification of the model.

(ii) Calculate the uncertainty in locating the position of an electron moving with a speed of 300 ms^{-1} accurate up to 0.001 %.

(2 × 4 = 8 weightage)

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 hybrid 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 $4.412 \times 10^{14} \text{ S}^{-1}$. Calculate the K.E of photoelectron ejected when light of wavelength 4000 \AA falls on surface of metal, $h = 6.626 \times 10^{-34} \text{ Js}$.
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, $m_e = 9.1 \times 10^{-31} \text{ kg}$, $h = 6.626 \times 10^{-34} \text{ Js}$.
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)

SECOND SEMESTER B. Sc. DEGREE EXAMINATION
CBCSSUG - CHEMISTRY
CHE2B02; Core Course II
THEORETICAL AND INORGANIC CHEMISTRY- II

Time: Two Hours

Maximum: 60 Marks

Scheme

1. The phenomenon of ejection of electrons from the surface of a metal when light of suitable frequency falls on it is called photoelectric effect. Visible light eject electron from Cs metal.
2. According to de Broglie's concept, matter of extremely small mass has wave-particle dual character. The wave character is evidenced by diffraction.
3. $r = n^2 h^2 \epsilon_0 / \pi m Z e^2$, $V = Ze^2 / 2n h \epsilon_0$, $E_n = - m e^4 Z^2 / 8 \epsilon_0^2 h^2 n^2$
4. An operator is said to be linear for any two functions f and g , $A[c_1 f(x) + c_2 g(x)] = c_1 [A f(x)] + c_2 [A g(x)]$. Eg. Operator (d/dx) is linear operator.
5. Well-behaved wave function must be single valued, finite, continuous and quadratically integrable.
6. Angular distribution plots of P_x , P_y , P_z orbitals in respective x , y , z axis with opposite sign on each dumb bell
7. Bonding molecular orbital is formed by the addition of the wave functions of the atomic orbitals. $\Psi_{MO} = \Psi_A + \Psi_B$
8. ~~$sp = 50\%$, $sp = 33.33\%$, $sp = 25\%$.~~
9. $\Psi = (1 - \lambda)\Psi_{\text{covalent}} + \lambda \Psi_{\text{ionic}}$
10. $\int \Psi \Psi^* dx = 1$
11. (1) sp^3 , tetrahedral (2) sp^3 , tetrahedral.
12. Overlapping of hybrid orbitals give stronger bonds with energetically more favorable orientations. Hybrid orbitals are equivalent in terms of size, shape and energy.

Section B (Paragraph)

(Answer questions up to 30 marks. Each question carries 5 marks)

13. Ans. 2.046×10^{-19} J
14. Atomic spectrum of hydrogen atom is line spectrum, fingerprints of elements. It consists of several series of lines appearing in different regions of electromagnetic spectrum. Diagram of hydrogen spectrum mentioning Lyman, Balmer, Paschen, Brackett and Pfund series. Appearance of each series in which all areas of spectrum.
15. $E_{(2s)} = 1.507 \times 10^{-18}$ J, $E_{(n=4)} = 2.412 \times 10^{-19}$ J
16. $2s = 2-0-1 = 1$ node and $2p = 2-1-1 = 0$ node, in a plot of $4n^2 R_{\infty}^2$ against r (A).
17. LCAO principle. for a diatomic molecule AB, if the electron is close to nucleus A. and has little influence of nucleus B. MO resembles the AO of A. //rly vice versa ie overall wave function of a molecule linear combination of atomic orbitals. $\Psi_{MO} = C_1 \Psi_A + C_2 \Psi_B$ C_1 and C_2 are constants. weightage coefficient for functions Ψ_A and Ψ_B . Illustrate with an example.

18. According to Born-Oppenheimer approximation nuclei being massive than electrons, nuclear motions are much slower than electron motions. For evaluating electronic motion nuclei considered as fixed in space so that internuclear distance remains constant. Instead of solving molecular wave equation for moving electrons and nuclei, we first solve it for moving electrons in a fixed nuclear configuration and then solve equation for nuclear motion by considering electronic energy derived in previous step as P.E for nuclear motion. On applying Born-Oppenheimer approximation we write the total wave function as product of electronic and nuclear wave function. $\Psi_{\text{total}} = \Psi_e \Psi_n$
19. Equation for hybrid orbitals $\Psi_{sp^2(1)}$, $\Psi_{sp^2(2)}$ and $\Psi_{sp^2(3)}$ and $\Psi_{sp^2(1)} = 1/\sqrt{3}\Psi_s + \sqrt{2/3}\Psi_{px}$; $\Psi_{sp^2(2)} = 1/\sqrt{3}\Psi_s - 1/\sqrt{6}\Psi_{px} + 1/\sqrt{2}\Psi_{py}$; $\Psi_{sp^2(3)} = 1/\sqrt{3}\Psi_s - 1/\sqrt{6}\Psi_{px} - 1/\sqrt{2}\Psi_{py}$

20. Section C (Essay)

Answer any one. Each question carries 10 marks

21. 1. Wave function describes complete physical state of a system. 2. for every system, possible wave functions are obtained by solving time dependent Schrodinger wave equation. 3. for wave function to be acceptable as a function it is continuous, finite, single valued and quadratically integrable. 4. To every observable in classical mechanics, there corresponds a linear Hermitian operator in quantum mechanics. 5. The only values that can result from measurement of an observable 'A' will be eigen values satisfying eigen value equation. 6. The average value of any observable corresponds to an operator, when a large number of measurements are involved and given by: $\langle A \rangle = \int \Psi A \Psi^* dx$. (6 postulates with correct explanation and expression)
22. (a) O_2 is paramagnetic and better explained in molecular orbital theory than in valence band theory. Explain in detail. (b) The molecular orbitals, $\Psi_{MO(\sigma)}$ formed by combination of atomic orbital functions of same sign represents the interaction of electron waves in phase and their consecutive interference, to give a phase whose amplitude is the sum of those of Ψ_A and Ψ_B at every point. //rly $\Psi_{MO(\sigma)}$ formed by the combination of AO functions of opposite sign represents the interaction of electron waves out of phase and their destructive interference to give whose amplitude id the difference of those of Ψ_A and Ψ_B at every point.

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 43159

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**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 H₂ molecule formation.
9. What is Hamiltonian operator ?
10. Calculate the bond order of N₂ molecule.
11. What is Hybridization ?
12. Draw the shapes of PCl₅ 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 $1s$, $2s$ and $2p$ 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.....

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**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 $2s$ 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 1s, 2s and 2p 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)

C 5599

(Pages : 3)

Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2016

(CUCBCSS—UG)

Core Course—Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

Time : Three Hours

Maximum : 80 Marks

Section A (One word)

*Answer all questions.
Each question carries 1 mark.*

1. P-orbitals are _____ shaped.
2. Give the electronic configuration of Cr _____.
3. According to modern periodic law, the physical and chemical properties of elements are periodic functions of their _____.
4. Atomic radii of elements _____ along a period.
5. Arrange O_2 , O_2^+ and O_2^- in the increasing bond order.
6. The unit of dipole moment is _____.
7. _____ is the hybridization state of carbon in ethyne.
8. The shape of XeF_4 molecule is _____.
9. Among C_2 , B_2 and N_2 the paramagnetic species is _____.
10. The band theory is used to explain the bonding in _____.

(10 × 1 = 10 marks)

Section B (Short Answer)

*Answer any ten questions.
Each question carries 2 marks.*

11. Ortho nitro phenol is more volatile than Para nitro phenol. Why ?

Turn over

12. Sketch the shapes of all the d-orbitals.
13. Write any *four* factors that influence the ionization energy of an element.
14. Define Eigen value and Eigen function.
15. Write the Schrodinger wave equation. Explain the terms.
16. What is meant by effective nuclear charge ?
17. Arrange the halogens in the increasing order of electron affinity and justify the order.
18. Write the Born-Lande equation and explain the terms.
19. Give any *two* of the Fajan's rules.
20. What is meant by polarity of a covalent bond ? How is it measured ?
21. Mention the different modes by which the vander Waal's forces originate.
22. Write the free electron theory of metallic bond.

(10 × 2 = 20 marks)

Section C (Paragraph)

*Answer any five questions.
Each question carries 6 marks.*

23. Explain the diagonal relationship of elements with example
24. Compare the radial distribution curve of 1S, 2S and 2P orbitals.
25. Obtain the solution of Schrodinger wave equation for a particle in a one dimensional box.
26. What is meant by Lattice energy of an ionic compound ? Explain the Born- Haber cycle in determining the lattice energy of NaCl crystal.
27. Draw the resonating structures of : (i) Carbonate ion ; (ii) Nitrate ion.
28. Give the MO configuration of CO and NO and discuss their bond order and magnetic behaviour.
29. Discuss the, SP^3d and SP^3d^2 hybridisations with suitable example.
30. Explain the Pauling and Mulliken scales of Electro negativity.

(5 × 6 = 30 marks)

Section D (Essay)

*Answer any two questions.
Each question carries 10 marks.*

31. (i) Write the important postulates of quantum mechanics.
(ii) What are quantum numbers ? How are they significant ?
32. Write notes on :
- (i) Aufbau Principle.
 - (ii) Hund's rule of maximum multiplicity, and
 - (iii) Pauli exclusion principle.
33. (i) What are the important postulates of VSEPR theory ?
(ii) How is VSEPR theory applied in determining the shapes of NH_3 , H_2O and ClF_3 molecules ?
34. Compare VB and MO theories of Chemical bonding.

(2 × 10 = 20 marks)

C 81768

(Pages : 2)

Name.....

Reg. No.....

SECOND SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, APRIL 2020

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

Time : Three Hours

Maximum : 80 Marks

Section A (One word)

Answer all questions.

Each question carries 1 mark.

1. Give an example of a linear operator.
2. Write the electronic configuration of Cr^{3+} .
3. Arrange the following elements in the increasing order of their ionization energy :
Li, Be, B, C
4. The most electronegative element among Group 16 elements is _____.
5. Sketch the d_z^2 orbital
6. The number of valence electrons in BeF_2 is _____.
7. The hybridization of NH_4^+ is _____.
8. Which among the following is polar : CO_2 , CO, BF_3 ?
9. What is the bond order of H_2^+ ion ?
10. The 4s orbital has _____ number of nodes.

(10 × 1 = 10 marks)

Section B (Short answers)

Answer any ten questions.

Each question carries 2 marks.

11. What is meant by a well-behaved function ?
12. Represent radial distribution function of 2s and 2p orbitals.
13. What are Laplacian operators ? Give an example.
14. Define electron gain enthalpy. Arrange Cl, Br, F, I in the increasing order of electron gain enthalpy.
15. What is diagonal relationship ? Give an example.
16. State Born-Landé equation and explain the terms.

Turn over

17. Write any four properties of ionic compounds.
18. Explain the shape of XeF_2 based on VSEPR.
19. How is percentage of ionic character calculated ?
20. Represent the resonance structure of NO_3^-
21. Compare bonding and anti-bonding orbitals.
22. He_2 molecule does not exist. Why ?

(10 × 2 = 20 marks)

Section C (Paragraph)

*Answer any five questions.
Each question carries 6 marks.*

23. State the postulates of quantum mechanics.
24. Write the Schrödinger wave equation in spherical co-ordinates and explain the terms.
25. Explain Pauling's scale of electronegativity.
26. How elements are divided into s, p, d and f blocks in the periodic table ?
27. State Slaters rule. Mention its applications.
28. Represent Born-Haber cycle of the formation of an ionic compound. Give its significance.
29. Write briefly on band theory of metallic bonding.
30. Distinguish between inter and intramolecular hydrogen bonding taking suitable examples.

(5 × 6 = 30 marks)

Section D (Essays)

*Answer any two questions.
Each question carries 10 marks.*

31. Apply time independent Schrödinger wave equation to a particle in a one-dimensional box.
32. a) What are quantum numbers ? Explain the significance of each.
b) State Fajan's rules. Explain its applications.
33. a) What is hybridization ? Explain the geometry of PCl_5 and IF_7 based on hybridization.
b) Enumerate the limitations of Valence Bond Theory.
34. Draw the MO level diagram of O_2 and O_2^{2-} and compare their bond energy and magnetic property.

(2 × 10 = 20 marks)

C 25892

(Pages : 3)

Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION
APRIL 2017

(UG—CCSS)

Chemistry

CH 2B 03—THEORETICAL CHEMISTRY

Time : Three Hours

Maximum : 30 Weightage

I. Answer *all* the *twelve* questions. Each question carries a weightage of 0.25 :

- 1 The angular momentum of the electron according to the Bohr model is an integral multiple of _____.
- 2 A subshell with $n = 6$ and $l = 3$ is designated as _____.
- 3 Schrödinger wave equation is _____.
- 4 The Laplacian operator is defined by $\nabla^2 =$ _____.
- 5 The number of antibonding electrons in Nitrogen molecule is _____.
- 6 CO has ten bonding electrons and four antibonding electrons. Its bond order is :
(a) 3. (b) 7.
(c) 1. (d) 2.
- 7 Which among the following is paramagnetic?
(a) O_2 . (b) N_2 .
(c) Be_2 . (d) O_2^{2+} .
- 8 Bond order is _____.
- 9 The Fermi level is :
(a) Average of all available energy levels.
(b) Energy level at the top of the valence band.
(c) Highest occupied energy level at $0^\circ C$.
(d) Highest occupied energy level at $0K$.
- 10 What is the hybridization of nitrogen in Ammonia ?

Turn over

11 Which of the following species is trigonal bipyramidal ?

- (a) PCl_5 . (b) SF_6 .
(c) XeF_2 . (d) CH_4 .

12 Fermi energy level for intrinsic semiconductor lies :

- (a) At the middle of band gap. (b) Close to conduction band.
(c) Close to valence band. (d) None.

(12 × 0.25 = 3 weightage)

II. Answer all *nine* questions. Each question carries a weightage of 1 :

13 State Heisenberg Uncertainty principle.

14 What is black body radiation ?

15 Define Photoelectric effect.

16 What is de Broglie wavelength of an electron with a velocity of 2×10^7 m/s ?

17 Write any two postulates of quantum mechanics.

18 Write the Rydberg equation and explain the terms.

19 Draw the potential energy diagram for H_2 molecule.

20 Mention the type of hybridization in the following compounds :

- (a) BH_3 . (b) CH_4 .
(c) PCl_5 . (d) BeH_2 .

21 SF_6 molecule is octahedral in shape. Why ?

(9 × 1 = 9 weightage)

III. Answer any *five* questions. Each question carries a weightage of 2 :

22 What is Sommerfeld's modification of Bohr's atomic model ?

23 Apply quantum mechanics to a particle in one dimensional box.

24 Draw and explain the radial probability distribution curves of 2s and 2p orbitals.

25 Differentiate between bonding and antibonding molecular orbitals. Calculate the bond order of O_2^+ ion.

26 Draw the MO diagram of CO molecule.

27 Write briefly on band theory of solids.

28 Explain the hybridization in IF_7 .

(5 × 2 = 10 weightage)

IV. Answer any *two* questions. Each question carries a weightage of 4 :

29 Write the postulates of Bohr theory and derive the Bohr energy equation.

30 What are quantum numbers ? How are they significant ?

31 Compare the VB and MO theories of chemical bonding.

(2 × 4 = 8 weightage)

C 62590

(Pages : 2)

Name.....

Reg. No.....

SECOND SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MAY 2019

B.Sc. Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

Time : Three Hours

Maximum : 80 Marks

Section A

Answer in one word or sentence.

Answer all questions.

1. Hamiltonian operator H' = _____.
2. Wave functions ψ_1 and ψ_2 is said to be orthogonal functions when _____.
3. A 1s orbital has _____ radial nodes.
4. The electronic configuration of Zn^{2+} is $[Ar]$ _____.
5. Li shows diagonal relationship with _____.
6. What is the state of hybridization of S in SF_6 .
7. H_3O^+ has _____ geometry.
8. What is the dipole moment of CO_2 molecule.
9. What is the bond order of NO molecule.
10. Name a compound that shows intermolecular hydrogen bonding.

(10 × 1 = 10 marks)

Section B

Answer any ten questions.

Each question carries 2 marks.

11. Explain the term Linear operator.
12. What is meant by a well behaved wave function ?
13. State and explain Pauli's exclusion principle.
14. Write the designation given to sublevels having (a) $n = 3 ; l = 1$ (b) $n = 4 ; l = 3$.
15. Write the Schrodinger wave equation for hydrogen atom in cartesian co-ordinates.
16. Calculate the effective nuclear charge felt by a 1s electron of nitrogen atom.

Turn over

17. What are the factors which affect the lattice energy of an ionic compound ?
18. What is meant by polar covalent bond ?
19. PCl_5 is a reactive molecule. Explain.
20. Write the molecular orbital configuration of O_2 molecule and calculate its bond order.
21. Write the resonance structures of nitrate ion.
22. What is electronegativity ? Arrange the following elements in the increasing order of electronegativity. F, Cl, Br, I.

(10 × 2 = 20marks)

Section C

Answer any five questions.

Each question carries 6 marks

23. What are Laplacian and Hermitian operators ? Explain.
24. Calculate the ground state energy of an electron in a 1D box of side 1nm. (mass of electron = 9.1×10^{-31} kg ; $h = 6.626 \times 10^{-34}$ Js. Also calculate the wavelength corresponds to spectral transition between the $n = 1$ and $n = 2$ levels.
25. Explain the terms eigen value and eigen function.
26. Define ionization enthalpy of an element. What are the factors affecting it ?
27. Explain the shape of BCl_3 molecule on the basis of VSEPR theory.
28. Draw the MO energy diagram for CO molecule. Calculate the bond order.
29. Distinguish between bonding and antibonding molecular orbitals.
30. Write any two applications of dipole moment measurement for determining molecular structure. Explain with examples.

(5 × 6 = 30 marks)

Section D

Answer any two questions.

Each question carries 10 marks

31. What are quantum numbers ? Discuss the significance of each quantum number.
32. Explain the terms screening effect and effective nuclear charge. Give the Slaters rule and discuss its application.
33. Illustrate Born-Haber cycle with an example. What are its applications ?
34. What is a hydrogen bond ? What are the effects of hydrogen bonding on the properties of compounds ? Distinguish between inter and intra molecular hydrogen bonds with suitable examples. Describe the unique properties of water on the basis of hydrogen bond.

(2 × 10 = 20 marks)

C 82109

(Pages : 3)

Name.....

Reg. No.....

**SECOND SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)
EXAMINATION, APRIL/MAY 2015**

(UG-CCSS)

Core Course—Chemistry

CH 2B 03—THEORETICAL CHEMISTRY

Time : Three Hours

Maximum : 30 Weightage

I. Objective type questions (Answer all *twelve* questions) :

1 According to John Dalton, atom is regarded as :

- (a) Divisible. (b) Indivisible.
(c) Soft and Smeared out. (d) None of these.

2 One of the following principles is the direct consequence of the dual nature of matter and light :

- (a) Pauli's exclusion principle.
(b) Heizenberg's uncertainty principle.
(c) Aufbau principle.
(d) None of these.

3 The ionization energy for the Hydrogen atom has a value of :

- (a) $+ 1.312 \times 10^6 \text{ J mol}^{-1}$. (b) $- 1.312 \times 10^6 \text{ J mol}^{-1}$.
(c) $+ 1.312 \times 10^6 \text{ J}$. (d) $- 1.312 \times 10^6 \text{ J}$.

4. $\int \psi^* \psi \delta\tau = 0$ is condition for :

- (a) Orthonormality. (b) Orthogonality.
(c) Normalization. (d) None of these.

5 The points where the probability of finding the particle is zero are called :

- (a) Antinodes. (b) Nodes.
(c) Stationary Point. (d) Zero Point.

6 The radial wave function depends on the quantum numbers :

- (a) n and s . (b) n and m .
(c) n and l . (d) m and l .

Turn over

- 7 The following H_2^+ , He_2^+ and O_2 are all :
- (a) Diamagnetic. (b) Paramagnetic.
(c) Unstable. (d) Stable.
- 8 N_2 molecule is diamagnetic due to :
- (a) Unpaired electron. (b) Paired electron.
(c) Bond order zero. (d) None of the above.
- 9 The bond angle in SF_6 is :
- (a) 180° . (b) 120° .
(c) 109° . (d) 90° .
- 10 Bond order is directly proportional to :
- (a) Bond strength.
(b) Bond length.
(c) Both strength and bond length.
(d) None of these.
- 11 If the forbidden band width between valence band and the conduction band is large, then the substance will be an _____.
- 12 For typical semi conductor E_g is _____.

(12 × ¼ = 3 weightage)

II. Short answer type question (Answer all *nine* questions) :

- 13 What is the significance of Sommerfeld's theory ?
- 14 How are matter waves different from electromagnetic waves ? Give *one* difference.
- 15 What is the significance of Schrödinger equation ?
- 16 Why is orbitals are spherically symmetrical ?
- 17 What is LCAO principle ?
- 18 Write down the M O configuration of C_2 molecule.
- 19 What is the geometry of PCl_5 molecule ? Why ?
- 20 What is meant by Fermi level ?
- 21 Write the four quantum numbers of unpaired electron in copper atom in its ground state ?

(9 × 1 = 9 weightage)

III. Short essay or paragraph questions (Answer any *five* questions) :

- 22 Explain the defects of the Bohr atom model.
- 23 Derive the de Broglie relation.
- 24 What are the conditions that a wave function must meet for it to be an acceptable wave function ?
- 25 Sketch the radial probability distribution curves for 3s and 3p.
- 26 Apply M O theory to CO molecule. Draw the diagram.
- 27 Illustrate the formation of bonding and anti bonding Π molecular orbitals.
- 28 Explain the electrical property of metals using Fermi model.

(5 × 2 = 10 weightage)

IV. Essay Questions (Answer any *two* questions) :

- 29 (a) Give the important postulates of Bohr's atomic theory.
(b) Discuss how Bohr theory explains the formation of the line spectrum of hydrogen.
- 30 Explain the time independent Schrödinger wave equation: How it is applied to particle in an one dimensional box ?
- 31 Compare and contrast V B and M O theory.

(2 × 4 = 8 weightage)

C 82417

(Pages : 2)

Name.....

Reg. No.....

SECOND SEMESTER B.A./B.Sc. DEGREE EXAMINATION, APRIL 2020

(CBCSS—UG)

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

Section A (Short Answers)

Answer questions up to 20 marks.

Each question carries 2 marks.

1. Explain Einstein's interpretation of Photoelectric effect.
2. Calculate the wavelength of spectral line in Balmer series if $n_2 = 3$.
3. Sketch spectral series of hydrogen atom and label them. Which of these series is observed in visible region ?
4. What is an operator ? Give an example.
5. Write down expression for Hamiltonian operator.
6. Draw radial distribution curve of 1 s orbitals of H_2 .
7. What is antibonding molecular orbital ?
8. Explain LCAO principle.
9. What is the shape and angle of molecule in which the central atom undergoes :
 - (i) sp^2 hybridisation.
 - (ii) dsp^2 hybridisation.
10. Which p orbital is involved in (a) sp ; (b) sp^2 hybridisation.
11. What are the conditions to be satisfied for hybridization of atomic orbitals ?
12. What is orthogonality of hybrid orbitals ?

Turn over

Section B (Paragraph)

Answer questions up to 30 marks.

Each question carries 5 marks.

13. Calculate the radius of first orbit of hydrogen atom and calculate velocity and energy of an electron revolving in it. $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ m}^{-1} \text{ J}^{-1}$.
14. Explain the defects of Bohr atom model.
15. When are molecular orbital said to be (a) normalized ; (b) Hermitian.
16. What are the conditions for effective linear combination of atomic orbitals ? Explain.
17. Give angular distribution plots of d orbitals.
18. Explain Born-Oppenheimer approximation.
19. What is the type of hybridization in the formation of CH_4 ? Discuss.

Section C (Essay)

Answer any one question.

The question carries 10 marks.

20. (a) Explain terms radial distribution function and radial distribution curves.
(b) Draw the radial distribution curves for 1s, 2s and 2p orbitals of hydrogen atom.
21. (a) Calculate bond order of O_2 , O_2^- , O_2^+ .
(b) Compare their stability and arrange them in increasing order of bond strength and bond length.
(c) Draw molecular orbital diagram of O_2^{2+} .

C 24740

(Pages : 3)

Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2017

(CUCBCSS—UG)

Core Course—Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

Time : Three Hours

Maximum : 80 Marks

Section A

Answer in one word or sentence.

Answer all questions.

1. If $A^{\wedge} f(x) = c f(x)$, 'c' is called _____.
2. Wave functions ψ is said to be a normalised function when _____ = 1.
3. A 2s orbital has _____ radial nodes
4. The electronic configuration of Cr (Z = 24) is [Ar] _____.
5. Be shows diagonal relationship with _____.
6. What is the state of hybridization of I in IF_7 .
7. NH_4^+ has _____ geometry.
8. What is the dipole moment of BCl_3 molecule.
9. What is the bond order of O_2^+ molecule .
10. Name a compound that shows intramolecular hydrogen bonding.

(10 × 1 = 10 marks)

Section B

Answer any ten questions.

Each question carries 2 marks.

11. Explain the term Hermitian operator.
12. What is meant by a well behaved wave function ?
13. State and explain Hund's rule of maximum multiplicity.
14. Write the designation given to sublevels having (a) $n = 2 ; l = 1$ (b) $n = 4 ; l = 3$.

Turn over

15. Write the equation for energy and wavefunction for a particle confined to move in a 1D box of length ' a '.
16. Calculate the effective nuclear charge felt by a 2p electron of nitrogen atom.
17. Mention two differences between a sigma bond and a pi bond.
18. What are the conditions which favour the formation of an ionic compound ?
19. PCl_5 is a reactive molecule. Explain.
20. Write the molecular orbital configuration of F_2 molecule and calculate its bond order.
21. Write the resonance structures of carbonate ion.
22. What is electron affinity ? Arrange the following elements in the increasing order of electron affinity.
F, Cl, Br, I.

(10 × 2 = 20 marks)

Section C

Answer any five questions.

Each question carries 6 marks.

23. What are Laplacian and Hamiltonian operators ? Explain.
24. Calculate the energy difference, between states $n = 2$ and $n = 1$ of an electron confined in a 1D box of side 10Å . (mass of electron = $9.1 \times 10^{-31}\text{kg}$; $h = 6.626 \times 10^{-34}\text{Js}$. Also calculate the wavelength corresponds to spectral transition between the $n = 1$ and $n = 2$ levels.
25. Explain the terms eigen value and eigen function.
26. Define electronegativity of an atom . What are the factors influencing it ?
27. Explain the shape of XeF_4 molecule on the basis of VSEPR theory.
28. Draw the MO energy diagram for CO molecule. Calculate the bond order and explain its magnetic behaviour.
29. How does Valence Bond Theory explain the electrical and thermal conductivity of metals ?
30. Write any two applications of dipolemoment measurement for determining molecular structure. Explain with examples.

(5 × 6 = 30 marks)

Section D

Answer any two questions.

Each question carries 10 marks.

31. State and explain the postulates of quantum mechanics.
32. (a) Define ionization enthalpy and explain the variation of ionization enthalpy along a period and down a group of the periodic table .
- (b) Account for the shape of CCl_4 molecule on the basis of VSEPR theory'.
33. (a) Write the Born — Lande equation and explain the terms.
- (b) State and explain Fajan's rule.
34. (a) Discuss hydrogen bonding in water and explain the unique properties of water.
- (b) How does free electron theory explain the properties of metals ?

(2 × 10 = 20 marks)