

**SHRI MATA VAISHNO DEVI UNIVERSITY,
KATRA**
School of Biotechnology
NEP MAJORS-Examination
(Odd Semester) 2024-25

Entry No: **2 4 B E C O S S**

Total Number of Pages: [02]

Date: 23/12/2024

Total Number of Questions: [5]

**Course Title: Applied Chemistry
Course Code: BTLBS101**

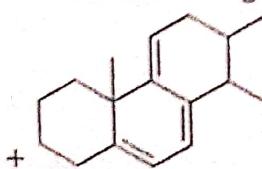
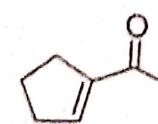
Time Allowed: 3 hours

Max Marks: [40]

Instructions / NOTE

Answer All Questions.

- Support your answer with neat freehand sketches/diagrams, wherever appropriate.
- Assume appropriate data/information, wherever necessary / missing.

PART-A		
Q-1	<p>a) Using Slater rules, calculate the effective nuclear charge of 3p-electron in phosphorus</p> <p>b) Discuss briefly the principle of Nuclear Magnetic Resonance.</p> <p>c) Calculate the CFSE in case of d⁶ tetrahedral system.</p> <p>d) Discuss: Successive electron affinities have negative values</p> <p>e) Define corrosion. What are the factors affecting corrosion?</p>	2 [CO2] 2 [CO1] 2 [CO3] 2 [CO2] 2 [CO1]
Q-2	<p>a) Define Effective Nuclear Charge and screening effect? How does it govern the ionization energy of an atom.</p> <p>b) Explain on the basis of HSAB principle, as to why [CoF₆]³⁻ is more stable than [CoI₆]³⁻.</p> <p>c) Define entropy. How does entropy relate to the direction of natural processes? Give an example.</p> <p>d) On the basis of Woodward-Fieser rules, calculate λ_{\max} for the following compounds:</p>	3 [CO1, CO2] 3 [CO3] 3 [CO1, CO2] 3 [CO3]
	 + 	

e) Explain the following:

(i) Non-existence of He_2 molecule

(ii) Bond strength of N_2 molecule is more as compared to O_2 molecule.

3 [CO3]

PART-C

Q-3

On the basis of Molecular Orbital Theory, how will you account for the fact that the bond strength of N_2 is more than the N_2^+ , whereas the bond strength of O_2 is less than O_2^+ ion.

OR

Derive the relationship between Gibb's free energy (ΔG) in terms of entropy change (ΔS) and enthalpy change (ΔH). How can this expression be used to estimate whether a chemical reaction will be spontaneous or not.

5 [CO2, CO3]

5 [CO3]

Q-4

What are the salient features of crystal field theory. How does crystal field theory explains the magnetic behaviour of $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$.

OR

Explain what do you mean by chromophores and auxochromes. How do auxochrome affect the position of absorption of chromophore? Give suitable example to justify your answer.

5 [CO1, CO3]

5 [CO1, CO2]

Q-5

Discuss briefly the principle of IR spectroscopy. What are the fundamental vibrations. Name their types with examples.

OR

Explain the concept of valence band, conduction band and energy band gap. Use diagrams to differentiate between conductors, insulators and semiconductors in terms of their band structure.

5 [CO1]

5 [CO1, CO2]

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Biotechnology
NEP MID SEM-Examination
(Odd Semester) 2024-25

Entry No: **2 4 B E C 0 5 5**

Total Number of Pages: [02]

Date: 8/10/2024

Total Number of Questions: [4]

Course Title: Applied Chemistry
Course Code:BTL BS111

Time Allowed: 1½ hours

Max Marks: [20]

Instructions / NOTE

Answer All Questions.

- Support your answer with neat freehand sketches/diagrams, wherever appropriate.
- Assume appropriate data/information, wherever necessary / missing.

PART-A		
Q-1	(a) Draw the shapes of $3_{dx^2-y^2}$ and 3_{dz^2} . (b) On the basic of MO theory, calculate the bond order in - (a) O_2^{2-} - (b) N_2^+ (c) How does MO theory account for: (i) B_2 molecule is paramagnetic (ii) Bond energy of NO^+ is larger than that of NO (d) Which has lower IE ₂ : Na or Mg. Why? (e) How Δ_f and Δ_o are related?	[1] [1] [2] [2]
Q-2	(a) Give reason for each of the following: (i) The size of an ^{Anion} atom is larger than its parent atom. (ii) Electron affinities of halogens are by far the highest. (iii) The second ionization energy of an atom is always greater than the first ionization energy of an atom. (b) Give reasons: (i) Why the magnitude of crystal field splitting in tetrahedral complexes is smaller than in the octahedral fields. (ii) Define electron affinity. Which has large electron affinity and why? Cl or F.	[3] [3]
PART-B (Long Answer Type)		

Q-3	<p>What is crystal field theory? What do you understand by crystal field stabilization energy? How do you represent CFSE in case of octahedral and tetrahedral complexes?</p> <p>OR</p> <p>Using crystal field theory, predict the number of unpaired electrons in $[FeCl_4]^-$ and $[Mn(CN)_6]^{3-}$ and find out the CFSE in both the cases.</p>	[4]
Q-4	<p>Define doping and types of doping. How does doping effect the electrical properties of a semiconductor and examples of commonly used dopants.</p> <p>OR</p> <p>Explain on the basis of MO theory, N_2 molecule is diamagnetic while O_2 is paramagnetic.</p>	[4]

Course Title: Applied Chemistry
Course Code: BTL1710

Time Allowed: 1h

Max Marks: [20]

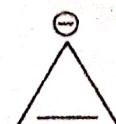
Instructions / NOTE

Answer All Questions.

- Support your answer with neat freehand sketches/diagrams, wherever appropriate.
- Assume appropriate data/information, wherever necessary / missing.

PART-A

Q-1	A. Considering the x-axis as the internuclear axis, which of the following will form a pi (π) bond?	[1]	CO2
	(a) s and p _x (b) p _x and p _x (c) s and s (d) p _y and p _y	[1]	CO2
	B. In reverse phase chromatography, the stationary phase is (a) Non-polar (b) Polar (c) Either non-polar or polar (d) None of these.	[1]	CO2
Q-2	C. Which is the most commonly used detector in high-performance liquid chromatography?	[1]	CO1
	A. By using the Molecular Orbital diagram, compare the: a) Bond orders of O ₂ ⁺ , O ₂ , & O ₂ ⁻ . $O_2^+ > O_2 > O_2^-$ b) Bond length of C ₂ ⁺ , C ₂ , & C ₂ ⁻ . $C_2^+ > C_2 > C_2^-$	[2]	CO3
	B. If element A has electronic configuration 1s ² 2s ² 3p ³ and it forms a homonuclear diatomic A ₂ (<u>without the s-p mixing</u>), what will be the bond order of A ₂ molecule? $A_2 = B.O = 3$	[2]	CO2
	C. What is meant by distribution ratio (K _D)? What happens if the numerical value of D is very small or too large?	[2]	CO2
	D. Why do we change from less polar to more polar eluting solvents and not in the reverse order in column chromatography?	[2]	CO3
	E. Explain the bond order and stability of cyclopropenyl anion and cyclopropenyl cation.	[2]	CO2



PART-B (Long Answer Type)

Q-3	Draw a well-labeled molecular orbital diagram of the OH ⁻ molecule and describe its bonding & magnetic behavior.	[3]	CO1
Q-4	State and explain the principle of paper chromatography. How is it better than column chromatography?	[4]	CO1

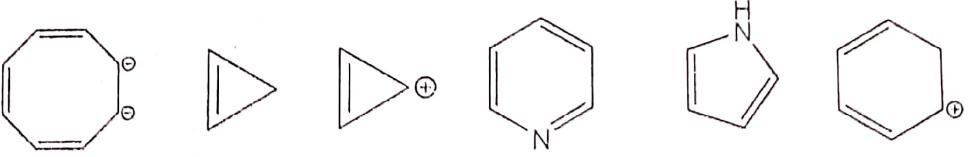
Time Allowed: 1h

Max Marks: [20]

Instructions / NOTE

Answer All Questions.

- i. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
 ii. Assume appropriate data/information, wherever necessary / missing.

		PART-A	
Q-1	a) How many unpaired electrons are in the weak field Cr(II) octahedral complex? i) 1 ii) 0 iii) 4 iv) 3 b) The splitting configuration and magnetism of $[\text{Fe}(\text{CN})_6]^{3-}$ complex respectively is: i) $t_{2g}^3 e_g^2$, paramagnetic ii) $t_{2g}^3 e_g^2$, diamagnetic iii) $t_{2g}^5 e_g^0$, paramagnetic iv) $t_{2g}^5 e_g^0$, diamagnetic c) Among 1,3-hexadiene and 1,4-hexadiene, which molecule will absorb at a longer wavelength? <i>Vs Ans</i> d) What is the wavelength range of the UV spectrum? (a) 100 nm to 500 nm (b) 200 nm to 800 nm (c) 300 nm to 1000 nm (d) 400 nm to 1600 nm	[1]	
Q-2	a) Define doping and differentiate between n-type and p-type doping. b) What are the main components of a UV visible spectrophotometer? (Name only)	[2]	[2]
Q-3	a) Are the following given compounds aromatic, anti-aromatic, homoaromatic or non-aromatic in nature?  b) Draw a well-labeled crystal field splitting diagram for Ni(II) complex both in an octahedral field and a tetrahedral field. Calculate the spin-only magnetic moment in both cases.	[3]	[3]
Q-4	Answer any two of the following: a) How can we differentiate between primary, secondary and tertiary amines on the basis of IR spectroscopy? b) With suitable examples describe any one factor responsible for the red and blue shift in UV-VIS spectroscopy. c) Explain the following: (i) Fingerprint region (ii) Why HCl is IR active but H_2 is not? (iii) What is the necessary condition for molecule to be IR active?	[3]	[3]

**School of Biotechnology
NEP Major Examination
(Odd Semester) 2023-24**

Entry No: _____

Total Number of Pages: [02]

Date: 27/12/2023

Total Number of Questions: [6]

**Course Title: Applied Chemistry
Course Code:BTL BS111**

Time Allowed: 3h

Max Marks: [50]

Instructions / NOTE

Answer All Questions.

- Support your answer with **neat freehand sketches/diagrams**, wherever appropriate.
- Assume appropriate data/information, wherever necessary / missing.

PART-A		
Q-1	a) Define intensive and extensive properties with examples. b) Calculate the crystal field stabilization energy for a weak field Cr(II) octahedral complex. c) Out of o-nitrophenol and p-nitrophenol which has higher boiling point and why? d) What do you mean by eluent and isocratic elution technique in chromatography.	[2] [2] [2] [2]
Q-2	a) Compare the bond orders of O_2 , O_2^{2+} and O_2^{2-} . b) Explain Head-to-head and side-wise atomic orbital mixing with examples. c) What are isoelectronic ions? Account for the decrease in size of the following isoelectronic ions: $O_2^{2-} > F^- > Na^+ > Mg^{2+}$ d) How many bands due to fundamental vibrations do you expect to observe in the IR spectrum of water, HCl and N_2 ?	[3] [3] [3] [3]

Long Answer question (Attempt any three of the following)

Q-3	a) What will be the formula to calculate the change in internal energy (ΔU) when <ol style="list-style-type: none"> Work is done on the system and energy is added to the system. In an isochoric process. b) 2 moles of an ideal gas expand isothermally and reversibly at 27°C from volume 10 lts to 50 lts. Calculate the work done by the gas. Also calculate the change in entropy of this gas. c) Would you expect the following reactions to be spontaneous at low temperature, high temperature, all temperatures or not at all? <ol style="list-style-type: none"> $2N_2O(g) \longrightarrow 2N_2(g) + O_2(g) \quad \Delta H = +167.2 \text{ KJ}$ $H_2O(l) + \frac{1}{2} O_2(g) \longrightarrow H_2O_2(g) \quad \Delta H = -180 \text{ KJ}$ d) Calculate the magnetic moment of a strong field Fe(II) octahedral complex.	[2] [5] [2] [1]
Q-4	a) Derive expressions to calculate EMF (Reduction) of the following half-cell <ol style="list-style-type: none"> $Cu^{2+} Cu(s)$ ————— $H^+ H_2(Pt)$ (1 atm) ————— b) Calculate the E°_{cell} and ΔG°_{cell} for the cell $Zn Zn^{2+} Ni^{2+} Ni$, given that $E^\circ (Zn Zn^{2+}) = 0.76 \text{ V}$ and $E^\circ (Ni^{2+} Ni) = 0.25 \text{ V}$.	[2] [3]

	c) If the solid CaCO_3 has $K_{\text{sp}} 9.3 \times 10^{-8}$ calculate the concentrations of Ca^{2+} and CO_3^{2-}	[3]
	d) How do you prevent corrosion by electroplating?	[2]
Q-5	a) What is ionisation energy? On what factors it depend? How does the ionisation energy of the elements vary as we move down a group and along a period? b) Which has higher electron affinity and why? (F or Cl) c) What is meant by periodicity of elements?	[7]
Q-6	(a) What are intermolecular forces? Explain briefly ion-dipole interaction with suitable examples. (b) What are hard & soft acids and bases (HSAB)? Explain the following on the basis of Pearson's HSAB principle. (i) Why AgF is more stable than AgF_2 ? (ii) Why Mg^{2+} & Ca^{2+} occur mostly as their oxides and carbonates?	[5]

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Show and Show Work
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