Roll No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Total No. of Pages : 03

Total No. of Questions : 09

B.Tech (All Batches Chemistry) (2018 Batch) (Sem.–1)
CHEMISTRY-I
Subject Code : BTCH-101-18
Paper ID : [75343]

Time : 3 Hrs.   Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :
1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION - B & C. have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

SECTION-A

1. **Answer briefly :**

    a) What is fluorescence?

    b) What do you understand by effective nuclear charge?

    c) What is optical activity?

    d) What is the essential condition for a molecule to be IR active?

    e) Discuss entropy.

    f) What is the usefulness of Ellingham diagrams?

    g) What do you understand by polarizability?

    h) Write the electronic configurations for H_2 and H_2^+ in term of molecular orbital theory.

    i) How many signals would you expect to see in the ^1H NMR spectrum of the following :

    $CH_3CH_2CH_2CH_3$
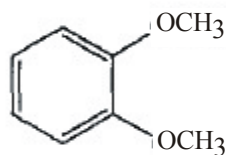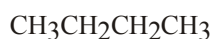
j) Indicate whether each of the following structures has the R or S configuration. Assign priorities to each group. What is the relationship between the two structures?

Br
HO —— CH$_3$
CH$_2$CH$_3$

OH
CH$_3$CH$_2$ —— Br
CH$_3$
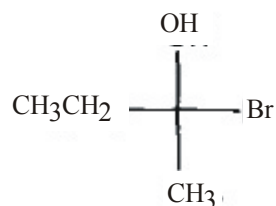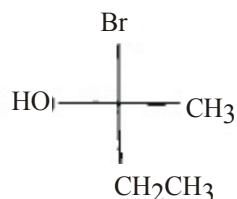
SECTION-B

Q2   a) Solve the Schrodinger wave equation for a particle in one-dimensional box.   (6)

b) What will happen if the walls of the one-dimensional box are suddenly removed?   (2)

Q3   a) With the help of a diagram, explain the splitting of d-orbital energy levels in tetrahedral ligand field? Account for the non-existence of tetrahedral complexes with low spin configurations.   (6)

b) Discuss the relationship that exists between crystal field splitting and pairing energy in determining whether a given complex will be high or low spin.   (2)

Q4   a) Discuss the principle of electronic spectroscopy. Explain with reference to $CH_2=CH_2$, 1, 3- butadiende and carbonyl compounds.   (6)

b) What is fluorescence? Discuss its applications in medicine.   (2)

Q5   a) What are van der Waals forces? Discuss them briefly.   (5)

b) What do you understand by potential energy surface? Explain with an example.   (3)

SECTION-C

Q6   a) Calculate the solubility product of AgBr in water at 25°C from the cell :

$$Ag, Ag^+Br_{\,(sat.soln.)} \,|\, AgBr_{(s)}, Ag$$

The standard potentials are $E^\circ_{AgBr,Ag} = 0.07\,V$; $E^\circ_{Ag+,Ag} = 0.80\,V$ (4)

b) What advantages does the use of "ion-exchange resin" provide over "zeolite process" for softening of hard water?   (4)

Q7 a) Explain the concept of hard soft acids and bases. (4)

b) Discuss the geometry of the following : BF_3, H_2O (4)

Q8 a) What is optical activity? What is the essential condition for a compound to be optically active? Explain. (4)

b) Draw structural isomers for C_3H_8O and $C_4H_{10}O$? (4)

Q9 a) Discuss the synthesis of a commonly used drug molecule by taking a suitable example. (3)

b) Discuss the S_N2 mechanism of alkyl halides in terms of kinetics, stereochemistry and reactivity of alkyl halides. (5)

Roll No. ☐☐☐☐☐☐☐☐☐☐☐☐☐ Total No. of Pages : 03

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B.Tech. (Agricultural Engg. / Automation & Robotics / Automobile Engg. / BT / CE / Computer Engg. / CSE / Electrical & Electronics Engg. / EE / ECE / Electronic & Electrical Engg. / FT / IT / ME) (2018 & Onwards) (Sem.–1,2)

CHEMISTRY-I

Subject Code : BTCH-101-18
M.Code : 75343

Time : 3 Hrs.   Max. Marks : 60

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2. **SECTION - B & C. have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

SECTION-A

Answer briefly :

1. What do you understand by effective nuclear charge?

2. Why d and f orbital show poor shielding effect?

3. What is the essential condition for a molecule to be IR active?

4. What is isomerism?

5. How do Vander Waals interactions occur?

6. Can oxidation state be negative? Discuss.

7. How many signals would you expect to see in the ^{1}H NMR spectrum of the   following:

    $CH_3CH_2CH_2CH_3$
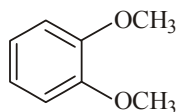
8. What are the shapes PCl_5 and H_2O?

9. Define entropy and gibbs free energy.

10. Write down the Nernst equation and define electric potential.

SECTION-B

11. a) Obtain the time-dependent Schrödinger wave equation for a particle. (6)

   b) Give the physical meaning of wave function. (2)

12. Write short notes on :

   a) Shielding and deshielding of protons (4)

   b) Factors affecting vibrational frequency (4)

13. a) What is crystal field theory? How does this theory account for the fact that $[CoF_6]^{3-}$ is paramagnetic but $[Co(NH_3)_6]^{3+}$ is diamagnetic though both are octahedral. (6)

   b) Discuss the role of doping on the band structure of solids. (2)

14. a) Derive the van der Waals equation for describing P-V-T relationship in real gases. (5)

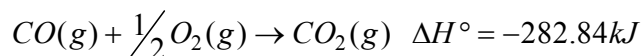   b) Explain the different type of molecular forces. (3)

SECTION-C

15. a) Calculate the solubility product of AgBr in water at 25°C from the cell : (4)

$$a.\ Ag, Ag^+ Br_{(sat, sol)} \mid AgBr_{(s),} Ag$$
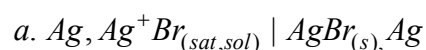
   The standard potentials are $E^°_{AgBr,Ag} = 0.07V; E^°_{Ag^+,Ag} = 0.80V$

   b) Calculate the standard free energy change (ΔG°) of the reaction : (4)

$$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)\ \ \Delta H° = -282.84 kJ$$

   The standard entropy of $CO_2(g)$, $CO(g)$ and $O_2(g)$ are 213.80,197.90 and 205.01 J K mol^{-1}, respectively. Is this reaction feasible at standard state?

16. a) Discuss the molecular geometries of the following : (4)

   i) BCl$_3$

   ii) PCl$_5$

(Atomic number: B = 5, P = 15) (4)

    b) What is effective nuclear charge? Which element has the highest effective nuclear charge? (2)

    c) What is ionization energy? Which elements have the highest ionization energy? (2)

17. Explain the following terms : (4 × 2)

    a) Chirality

    b) Enatiomers

    c) Diastereomers

    d) Optical activity

18. a) Discuss the synthesis of a commonly used drug molecule by taking suitable example. (4)

    b) Discuss the S_N2 mechanism of alkvl halides in terms of kinetics, stereochemistry and reactivity of alkyl halides. (4)

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B.Tech. (Chemistry Groups) (2018 Batch) (Sem.–1,2)
CHEMISTRY-I
Subject Code : BTCH-101-18
M.Code : 75343

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SECTION-A

1. **Answer briefly :**

   a) What are the important features of crystal field theory?

   b) Can oxidation state be negative? Discuss.

   c) What is the difference between conduction band and valence band?

   d) Why is fluorescence so sensitive?

   e) Give one main point of difference between wet and dry corrosion.

   f) Write the transition state for the following S_N2 reaction :

   $$(CH_3)_3N + (CH_3)_3S^+ \rightarrow (CH_3)_4N^+ + (CH_3)_2S$$

   g) Why d and f orbitals show poor shielding effect?

   h) How do vander Waals interactions occur?

   i) The following compounds show only one signal in ^{1}H NMR. Write their structural formula.

   C_5H_{12} C_2H_6O

j) Indicate R or S configuration at stereogenic center(s). Assign priorities to each group.
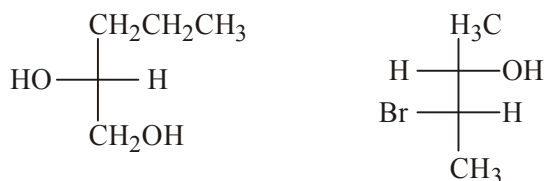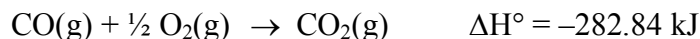

SECTION-B

2. a) Obtain the time-dependent Schrodinger wave equation for a particle. (6)

   b) Give the physical meaning of wave function. (2)

3. a) What is crystal field theory? How does this theory account for the fact that $[CoF_6]^{3-}$ is paramagnetic but $[Co(NH_3)_6]^{3+}$ is diamagnetic though both are octahedral. (6)

   b) Discuss the role of doping on the band structure of solids. (2)

4. a) Why is UV-Visible spectroscopy called electronic spectroscopy? Explain various types of transitions for organic molecules that take place in UV-Visible range. (5)

   b) How is fluorescence used in medicine? What is the unit of fluorescence intensity?

   (3)

5. a) Derive the van der Waals equation for describing P-V-T relationship in real gases.

   (5)

   b) The van der Waals constants of a gas are: a = 0.751 dm^6 atm mol^{-2} and b = 0.0226 dm^3 mol^{-1}. Calculate critical constants. (3)

SECTION-C

6. a) Calculate the standard free energy change ($\Delta G°$) of the reaction :

   $$CO(g) + \tfrac{1}{2} O_2(g) \rightarrow CO_2(g) \qquad \Delta H° = -282.84 \text{ kJ}$$

   The standard entropy of $CO_2(g)$, $CO(g)$ and $O_2(g)$ are 213.80, 197.90 and 205.01 J K^{-1} mol^{-1}, respectively. Is this reaction feasible at standard state? (4)

   b) What advantages does the use of "ion-exchange resin" provide over "zeolite process" for softening of hard water? (4)

7. a) Discuss the molecular geometries of the following :

   i) BCl_3

   ii) PCl_5

   (Atomic number: B = 5, P = 15) (4)

   b) What is effective nuclear charge? Which element has the highest effective nuclear charge? (2)

   c) What is ionization energy? Which elements have the highest ionization energy?

   (2)

8. a) Discuss isomerism in transitional metal complexes. (5)

   b) The following compound has only one stereogenic center. Why then does it have four stereoisomers? Explain. (3)

   $$CH_3CH_2\underset{\underset{Br}{|}}{C}HCH_2CH{=}CHCH_3$$

9. a) Explain S_N2 mechanism by taking an example of alkyl halide as a substrate. (4)

   b) Write short notes on the following organic reactions :

   i) Oxidation reactions

   ii) Ring opening reactions (4)

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.