# BRAINWARE UNIVERSITY

## Term End Examination 2024-2025

## Programme – B.Tech.(CSE)-AIML-2024/B.Tech.(CSE)-DS-2024/B.Tech.(CSE)-CYS-2024/B.Tech.(ME)-2024

## Course Name – Engineering Chemistry

## Course Code - BBS00010

## ( Semester II )

**Full Marks : 60** **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

### Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) The sum of internal energy and pressure-volume product is reported as

a) entropy b) enthalpy
c) heat supplied d) work done

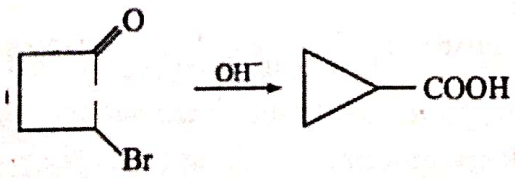
(ii) 1-butene on ozonolysis can be transformed to

a) Formaldehyde only b) Propanal only
c) Both Formaldehyde and propanal d) Acetone only

(iii) Which compound is better suited for use in Friedel Craft reaction?

a) Acetyl chloride b) Nitrobenzene
c) Methyl chloride d) Aniline

(iv) Predict the name of the reaction given below.




a) Intramolecular Aldol condensation b) Intramolecular Cannizaro reaction
c) Favorskii rearragement d) Pinacol Pinacolene rearragement

(v) Predict the correct order of λmax for n –> σ* transition.

a) R-OH > R-$NH_2$ > R-SH b) R-OH < R-$NH_2$ < R-SH
c) R-OH > R-SH > R-$NH_2$ d) R-OH < R-SH < R-$NH_2$

(vi) The force of attraction that occurs between two non-polar molecules can be defined as:

a) Dipole-dipole interaction
b) Dipole-induced dipole interaction
c) Instantaneous dipole-induced dipole interaction
d) Hydrogen bonding

(vii) Choose the correct statement from the following.

a) An exothermic process is always spontaneous.
b) An endothermic process is always spontaneous.
c) A process with a negative free energy change will be always spontaneous.
d) A process with a positive free energy change will be always spontaneous.

(viii) Identify the most non-metallic element among the following.

a) Be
b) B
c) Mg
d) Al

(ix) Predict the number of unpaired electron present in the highest occupied molecular orbital of oxygen.

a) 0
b) 1
c) 2
d) 3

(x) What is the short-range force acting between one HCl and one methane molecule?

a) Dipole-induced dipole interaction
b) Dipole-dipole interaction
c) H-bonding
d) Instantaneous dipole-induced dipole interaction

(xi) Choose the correct expression for a cyclic process.

a) $Q = \Delta U$
b) $Q = -\Delta U$
c) $Q = W$
d) $Q = -W$

(xii) The energy of the $4^{th}$ energy level of a particle in 1-D box can be expressed as

a) $h^2/8mL^2$
b) $2h^2/8mL^2$
c) $8h^2/8mL^2$
d) $16h^2/8mL^2$

(xiii) The value of energy can be expressed as:

a) $E = hc\lambda$
b) $E = h\lambda$
c) $E = hc$
d) $E = hc\bar{\nu}$

(xiv) Select the molecule from the following for which all the vibrational modes are IR active.

a) $H_2$
b) $XeF_2$
c) $H_2O$
d) $CO_2$

(xv) The nucleus that doesn't give an NMR signal is

a) $^{15}N$
b) $^{32}S$
c) $^{19}F$
d) $^{31}P$

## Group-B

(Short Answer Type Questions) 3 x 5=15

2. State the selection rule for an allowed transition in IR spectroscopy. (3)

Examine which one between 2-butanone and but-3-ene-2-one has a higher carbonyl (>C=O) stretching frequency.

3. Explain the advantages of the ion-exchange process over the other water-softening methods. (3)

4. Normal boiling point of ethanol is 78°C and standard enthalpy of vaporization ($\Delta H°$) is 42.4 kJ/mol. Calculate the entropy of vaporization ($\Delta S°$) of ethanol. (3)

5. Predict the number of unpaired electrons present in each case from the d-orbital splitting diagram with electronic configuration. (3)

   i) $[CuCl_4]^{2-}$

   ii) $[Co(H_2O)_6]^{3+}$

6. Correlate the following molecules with R or S configuration. (3)

**OR**

Compare the electron affinity of oxygen and sulfur. (3)

## Group-C
(Long Answer Type Questions) 5 x 6=30

7. a. Examine the reasons behind the following facts: (5)

   i) $H_2S$ has lower boiling point than $H_2Se$. ii) HCl has a more significant dipole-dipole interaction than HBr.

   b. Describe dipole-induced dipole interaction with an example. Why is it considered as one of the short-range forces?

8. Explain why $[Fe(H_2O)_6]^{2+}$ is a paramagnetic complex but $[FeCN_6]^{4-}$ is diamagnetic from the view point of CFT. (5)

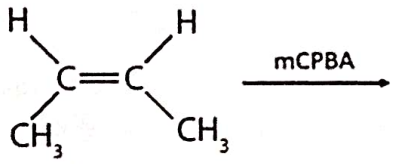
9. Predict the cell potential of an electrochemical cell in which the cell reaction is $Pb^{2+} + Cd \rightarrow Cd^{2+} + Pb$. Given that $E°_{cell} = 0.277$ V; Temperature = 25°C, $[Cd^{2+}] = 1$ M, $[Pb^{2+}] = 0.1$ M. (5)

10. (5)

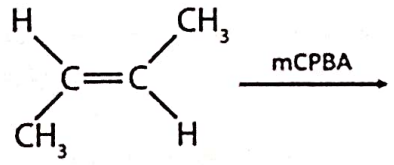
    a. Prove that for an ideal gas under isothermal condition $\Delta G = \Delta A$. Where, 'G' is Gibbs Free energy and 'A' is Helmholtz Free energy.

b. Determine the change in entropy when 2 moles of an ideal gas is compressed from 10 L to 1 L under isothermal condition.

11. Identify the products of the following reactions with a suitable mechanism: (mCPBA = meta-chloroperbenzoic acid) (5)




*cis*-2-butene




*trans*-2-butene



12. Using the Carnot Cycle, examine the fact that efficiency of a heat engine is always less than one. (5)

**OR**

a. Arrange the following in increasing order: (5)

i) Ionic or atomic radii : $O^{2-}$, $Na^{+}$, Ne, $Mg^{2+}$, $F^{-}$

ii) Metallic character : Cs, Na, Al, K.

b. Using Slater's rule deduce the effective nuclear charge experienced by one of the 3d valence electrons of a Chromium atom.

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