

End Semester Examination, 17th Feb 2021

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End Semester Examination, February 2021  
BSC102 - Chemistry

End Sem  
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**University of Engineering & Management, Kolkata**  
**End Semester Examination, February 2021**  
**Course: B.Tech Semester: 1<sup>st</sup>**  
**Paper Name: Chemistry**  
**Paper Code: BSC102**

**Full Marks: 100 Time: 3 hours**

**Answer all the questions. Each question is of 10 marks.**

- A.** Calculate the equilibrium constant for the given reaction at 25°C. Also find out the equilibrium constant when the same reaction starting with double concentration of both the reactants. Provided,  $E^\circ_{\text{Ce}^{4+}/\text{Ce}^{3+}} = 1.44 \text{ V}$  and  $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.68 \text{ V}$ . **5+5**

**OR**

**B.** Is a solution of  $\text{NiSO}_4$  can be kept in a copper pot? Give support of your answer. Given  $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25$  and  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ .
- A.** Calculate the EMF of the cell showing half cell reactions of the given reaction  
 $\text{Ni(s)} + \text{Fe}^{3+} (0.04\text{M}) \rightarrow \text{Ni}^{2+} (0.0125\text{M}) + \text{Fe}^{2+} (0.0075\text{M})$   
Provided,  $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ V}$  and  $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$  at 25°C.  
**OR**

**B.**  $\text{Ag}^+(\text{aq}) + \text{Fe}^{2+}(\text{aq}) \rightarrow \text{Ag} + \text{Fe}^{3+}(\text{aq})$   
 $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ V}$  and  $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80 \text{ V}$ , Comment on the feasibility of the reaction with the help of Gibbs free energy at 25°C. Also construct the correct cell representation.
- A.** 1 mole of an ideal monoatomic gas at 27°C is allowed to expand isothermally and reversibly from 150 liters to 200 dm<sup>3</sup>. Calculate  $q$ ,  $W$ , temperature change and enthalpy change.  
**OR**

**B.** Derive the equation of entropy change for an ideal gas.

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from 150 liters to 200 dm<sup>3</sup>. Calculate q, W, temperature change and enthalpy change.  
**OR**  
**B.** Derive the equation of entropy change for an ideal gas.

4. **A.** Two mole of H<sub>2</sub> gas at 120°C is compressed adiabatically and reversibly from 1 atm to 12 atm and the final temperature is 941.6 K. Calculate ΔU, ΔH. Given C<sub>p</sub> = 6.9 Cal K<sup>-1</sup> mole<sup>-1</sup>.  
**OR**  
**B.** Ten moles of ideal gas expands reversibly and adiabatically. If T<sub>1</sub> = 300 K and T<sub>2</sub> = 200 K, calculate W, q, ΔH and ΔU. (C<sub>p</sub> = 5/2 R).

5. **A.** State the difference in mechanism when methyl bromide (CH<sub>3</sub>Br) and 1 bromo 1,1 dimethyl ethane ((CH<sub>3</sub>)<sub>2</sub>CBr) reacts with sodium hydroxide (NaOH) separately. Describe the different factors that may affect both the reaction. **5+5**  
**OR**  
**B.** CH<sub>3</sub>CH=C(CH<sub>3</sub>)<sub>2</sub>: When reacts with HBr What are the Products that may form, Which one

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is the major product and Why? If the whole reaction is conducted in presence of hydrogen peroxide then what will be the major product? Give detail mechanism. **5+5**

6. **A.** i) What kind of reaction is involved in the reaction :  
 $\text{CH}_3\text{CH}_2\text{BrCH}_3 + \text{KOH (alc.)} \longrightarrow \text{CH}_3\text{CH}=\text{CH}_2 + \text{KBr} + \text{H}_2\text{O}$ ?  
 Give Detail mechanism.  
 ii) Arrange C<sub>6</sub>H<sub>5</sub>CHO, C<sub>6</sub>H<sub>5</sub>COCH<sub>3</sub> and C<sub>6</sub>H<sub>5</sub>COC<sub>6</sub>H<sub>5</sub> in decreasing order of reactivity towards nucleophilic addition reaction and explain. **5+5**  
**OR**  
**B.** What is codon and write a short name on Genome. What are components of bioinformatics?

7. **A.** 80 ml of 0.025 M acetic acid is mixed with 20 ml of 0.05 M sodium acetate solution. What will be the pH of the mixture and concentration of H<sup>+</sup>? The dissociation constant of acetic acid is 1.7 × 10<sup>-5</sup>.  
**OR**

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**OR**  
 B. Which pairs are correct & why? Explain using crystal field theory.  
 i)  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ , paramagnetic and **5+5**  
 ii)  $[\text{Co}(\text{NH}_3)_6]^{3+}$ , paramagnetic.

8. A. What is the solubility of  $\text{AgCl}$  if the  $K_{sp}$  is  $8.5 \times 10^{-10}$ ? Calculate the  $K_{sp}$  value of  $\text{BaSO}_4$  which has a solubility of  $6.5 \times 10^{-9}$  moles/L. at 298 K. **5+5**  
**OR**  
 B. What are the factors affecting magnitude of crystal field splitting energy in transition metal complexes? Describe energy level diagrams and show the occupancy of the orbitals in the following complexes;  $d^1$  system, octahedral and high spin with suitable example. **5+5**

9. A. Calculate the force constant of the  $\text{CO}$  molecule, if the wave number of the fundamental vibration is  $1840 \text{ cm}^{-1}$  (At. mass of  $\text{C} = 1.99 \times 10^{-26} \text{ kg}$  and  $\text{O} = 2.66 \times 10^{-26} \text{ kg}$ ). **5+5**  
**OR**  
 B. Arrange  $\text{CH}_2=\text{CH}_2$ ,  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$  and  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}-\text{CH}_2$  in increasing order of their UV absorption maxima. Justify your answer.

10. A. What is the frequency of the rotational line shown by a diatomic molecule for the transition between  $J = 4$  to  $J = 3$ , having the moment of inertia value  $17 \times 10^{-40} \text{ gm.cm}^2$ . **5+5**  
**OR**  
 B. Write down the important applications of nanocomposites materials. How the band gap energy changes with the decrease of size of the particle from bulk size to nanometre size? **5+5**