

Five Year Integrated M. Sc. Examination 2023

Semester-III

Course: CH-2-3-1 (2016)

(Chemistry)

Time: Three Hours

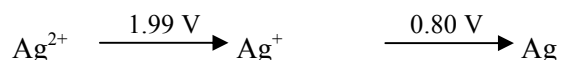
Full Marks: 60

Questions are of value as indicated in the margin

Group-A

(Answer *any four* questions)

1. (a) What do you understand by a disproportionation reaction?



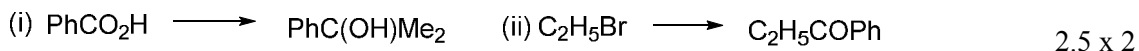
Explain with proper justification whether Ag^+ will disproportionate or not.

- (b) Predict the boiling points of the various isomers of hydroxybenzoic acids with proper justification. 3+2
2. (a) E^0 value of $\text{Cu}^{2+}/\text{Cu}^+$ system is 0.15 V and that of $\frac{1}{2}\text{I}_2/\text{I}^-$ system is 0.54 V. Still the iodometric estimation of copper salts is based on the oxidation of I^- by Cu^{2+} . Give appropriate explanation to the procedure.
- (b) Write the IUPAC name of the following:
- (i) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$
- (ii) $[(\text{NH}_3)_5\text{Cr}-\text{OH}-\text{Cr}(\text{NH}_3)_5]\text{Cl}_5$ 3+2
3. (a) Comment on the tendency of transition metals to form alloy and interstitial compounds.
- (b) Establish the Nernst equation for $\text{MnO}_4^-/\text{Mn}^{2+}$ couple in acidic medium. Find out the formal potential of the system at pH = 6. Given: E° for $\text{MnO}_4^-/\text{Mn}^{2+} = +1.51 \text{ V}$ 2+3
4. (a) Establish the potential range of an indicator across which it exhibits sharp color contrast between the oxidized and reduced forms.
- (b) Name and draw the possible geometries for coordination number 4 and 5. Give one example for each.
- (c) What kinds of forces are responsible for dissolution of ionic/polar compounds in non-polar solvents? 2+2+1
5. (a) Account for the higher melting and boiling points of H_2O compared to H_2S .
- (b) Comment on the chemical and physical properties of Zr and Hf. Justify the phenomenon with appropriate reason. 2+3

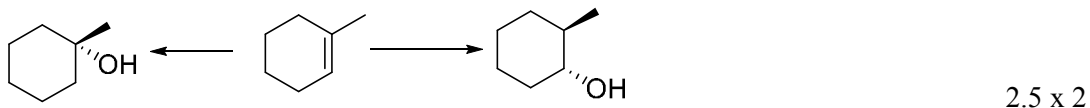
Group-B

(Answer *any four* questions)

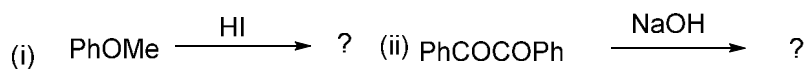
6. Carry out the following transformations using Grignard reagents.



7. Carryout the following transformations with plausible reaction mechanism.



8. Predict the product(s) with plausible reaction mechanism.



2.5 x 2

9. Write short note on the followings reactions (mechanism, examples, and application)

(i) Reimer-Tiemann reaction (ii) Kolbe-Schmitt reaction

2.5 x 2

10. Do the following transformation with plausible reaction mechanism.



2.5 x 2

Group-C

(Answer *any four* questions)

11. (a) What is the angle of contact (θ) between a pair of liquid and solid?
 (b) Explain why kerosene does spread over, when falls on a flat and smooth solid surface?
 (c) Shows that the pressure on the concave side of an interface is always greater than convex side by $2\gamma/r$. Symbols have their usual meaning.

1+1+3

12. (a) Define the thermodynamic temperature scale enabled in Kelvin. In order to increase the efficiency of a Carnot engine, would you increase the temperature of the source or decrease the temperature of the sink? Explain.
 (b) A Carnot engine has the same efficiency (i) between 200 K and 600 K and (ii) between T K and 900 K. Calculate the temperature T of the sink.
 (c) $\left(\frac{\partial(\frac{G}{T})}{\partial T}\right)_P$ is a state function. Justify or criticize.

(1+1)+2+1

13. (a) With the help of Clausius inequality, derive the expression, $A = U - TS$, where symbols have their usual meaning.
 (b) Derive the expression of ΔG_{mix} of two ideal gases at constant pressure and temperature and hence calculate the molar ratio of the two gases for which ΔG_{mix} will be minimum.

2+(2+1)

14. (a) Starting from the definition of the Helmholtz's free energy expression 'A', obtain the corresponding Maxwell's relation.
 (b) Derive the slope, $\frac{dP}{dT}$, of a liquid-vapour phase boundary and hence establish the Trouton's rule.

2+(2+1)

15. (a) Define heterogeneous equilibrium. Derive the partition co-efficient (K_D) of iodine between water and carbon disulphide mediums. Does K_D depend on temperature?
 (b) Derive the slope of the equilibrium constant, specifically $\ln K$, as a function of temperature.

(1+2+1)+1