

28-3-2018



**DOON UNIVERSITY, DEHRADUN**  
**Mid Semester Examination, 2<sup>nd</sup> Semester, 2018**  
**Academic Year 2017-18 (Even Semester)**

**School of Physical Sciences (SoPS) Department name: Chemistry**  
**Programme Name: Generic Elective, Integrated M.Sc. 5 Years**  
**Course Title: Chemical Energetics, Equilibria & Functional Organic Chemistry-I**  
**Course Code: CYG-151**

*Time Allowed 2.00 Hours*

*Maximum Marks: 30*

*Note: Attempt All Questions from Sections A, B and C. (All terms have their usual meaning)*

**Part A: Organic Chemistry**

[15 Marks]

**SECTION: A**

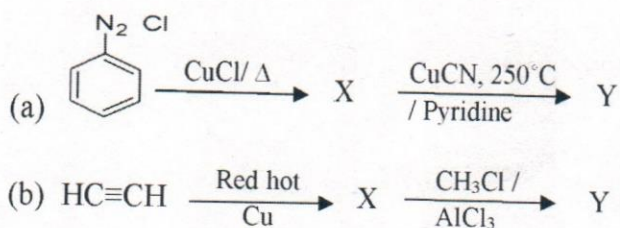
*(Marks: 3)*

1. When considering electrophilic aromatic substitution reactions electron, withdrawing substituents (e.g. nitro) are described as. [1]
  - (a) *Ortho/para* directing
  - (b) *Ortho/meta* directing
  - (c) *Meta/para* directing
  - (d) None of above
2. Complete the following reaction:  $\text{CH}_3\text{CH}=\text{CH}_2 + \text{HBr} \rightarrow \underline{\hspace{2cm}}$  [1]
  - a)  $\text{BrCH}_2\text{CH}=\text{CH}_2$
  - b)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
  - c)  $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$
  - d)  $\text{Br}_2\text{CHCH}=\text{CH}_2$
3. When            reacts with heated zinc dust, the product is benzene [1]
  - a) Benzoic acid
  - b) Phenol
  - c) Benzaldehyde
  - d) Aniline

**SECTION: B**

*(Marks: 6)*

4. a) Differentiate between  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$  reactions. [1]  
b) Explain why chlorobenzene is more stable than methyl chloride. [1]
5. Identify X and Y in the following reactions: [2 x 2]



**SECTION: C**

(Marks: 6)

6. Elaborate:

[1 x 3]

- Benzyne mechanism
- Williamson's ether synthesis
- Gattermann reaction

7. Why does benzene undergo electrophilic substitution reactions? Explain electrophilic substitution mechanism w.r.t sulphonation, nitration and Friedal craft acylation of benzene. [3]

**Part B: Physical Chemistry**

[15 Marks]

**SECTION: A**

(Marks: 3)

8. Which of the following is true regarding the concentration of products, for a chemical reaction that is already at equilibrium, assuming no disruptions to the equilibrium? [1]

- The concentrations of products will not change because there are no more reactants.
- The concentrations of products will not change because the limiting reagent is gone.
- The concentrations of products will not change because the forward and reverse rates are equal.
- The concentrations of products will change continually because of reversibility.

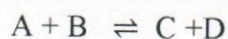
9.  $\Delta H_f^\circ$  is non zero for

[1]

- $\text{Br}_2(\text{l})$
- $\text{O}_2(\text{g})$
- $\text{C}(\text{graphite})$
- $\text{CO}_2(\text{g})$

10. Consider the following reversible exothermic reaction

[1]



The temperature of the vessel in which reaction is taking place is increased from 300 K to 350 K. This leads the rate of the reverse reaction to \_\_\_\_\_

- The change cannot be determined
- Increase
- Decrease
- Stay the same

**SECTION: B****(Marks: 6)**

11. (a) How much heat is needed to raise the 100 g of copper from 10 °C to 100 °C ?  
Given specific heat of copper = 0.092 cal/g°C [1]  
(b) Derive Kirchoff's equation depicting the variation of reaction with temperature. [1]
12. a) State the law of chemical equilibrium. [1]  
b) The heat evolved on dissolving CuSO<sub>4</sub>(s) in water is 86.6 kJ/mol. If  $\Delta H_f^\circ(\text{Cu}^{2+})$  is 64.4 kJ/mol, what is  $\Delta H_f^\circ(\text{SO}_4^{2-})$ ?  $\Delta H_f^\circ(\text{CuSO}_4(\text{s})) = -770.0 \text{ kJ/mol}$  [1]
13. a) State second and third law of thermodynamics. [1]  
b) Calculate the equilibrium constant for the reaction [1]
- $$\text{A} + \text{B} \rightleftharpoons 2\text{C}$$
- If 1.0 mole of A, 1.4 mole of B and 0.5 mole of C are placed in a 1.0 dm<sup>3</sup> vessel and allowed to come to equilibrium. The final concentration of C is 0.75 mol/dm<sup>3</sup>.

**SECTION: C****(Marks: 6)**

14. (a) Calculate  $K_p/K_c$  for the following reactions at 27 °C. [1]
- $$\text{NH}_4\text{Cl}(\text{s}) \rightleftharpoons \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$$
- (b) Explain the effect of change of concentration and temperature on the state of equilibrium with the help of Le Chatelier's principle. [2]
15. (a) How do you determine resonance energy with the help of bond energy? [1]  
(b) What is the heat of reaction ( $\Delta H$ ) for the following reaction? [2]
- $$\text{N}_2 + 3\text{H}_2 \longrightarrow 2\text{NH}_3$$
- Given: Bond energy of N≡N = 945 kJ/mol, H-H = 436 kJ/mol, N-H = 390 kJ/mol.