

# Bihar Engineering University, Patna

B.Tech 2<sup>nd</sup> Semester Examination, 2025

Course: B.Tech  
Code: 100215

Subject: Engineering Chemistry

Time: 03 Hours  
Full Marks: 70

## Instructions:-

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

Q.1 Choose the correct option / answer the following (Any seven question only):

- (a) Planck's constant has the same dimensions as that of  
(i) angular momentum (ii) radiant energy  
(ii) work (iv) power
- (b) Which of the following is not a property of electromagnetic radiation?  
(i) It can travel through vacuum (ii) It shows wave-particle duality  
(ii) It travels at the speed of light (iv) It requires a medium for propagation
- (c) Identification of functional groups in a compound can be established by using  
(i) IR spectroscopy (ii) NMR spectroscopy  
(ii) UV-Vis spectroscopy (iv) chromatography
- (d) Which of the following is an application of NMR spectroscopy?  
(i) Determination of molecular vibrations (ii) Determination of molecular mass  
(ii) Structural elucidation of organic compounds (iv) Determination of color intensity
- (e) A fuel cell converts  
(i) electrical energy into chemical energy (ii) chemical energy directly into electrical energy  
(ii) mechanical energy into electrical energy (iv) thermal energy into electrical energy
- (f) Temporary hardness of water is caused due to presence of  
(i) sulphates of Ca and Mg (ii) chlorides of Ca and Mg  
(ii) bicarbonates of Ca and Mg (iv) nitrates of Ca and Mg
- (g) In the Zeolite process, the exhausted zeolite is regenerated by using  
(i) NaCl solution (ii) Ca(OH)<sub>2</sub> solution  
(ii) Na<sub>2</sub>CO<sub>3</sub> (iv) HCl
- (h) Neoprene is a polymer of  
(i) isoprene (ii) chloroprene  
(ii) butadiene (iv) acryl nitrate
- (i) Phenol-formaldehyde resin is obtained by polymerization of  
(i) condensation polymerization (ii) Copolymerization  
(ii) addition polymerization (iv) None of these
- (j) Aspirin is mainly used as  
(i) antimalarial (ii) antiseptic  
(ii) antibiotic (iv) analgesic and antipyretic



- Q.2** (a) (i) Discuss Einstein's photoelectric equation and explain how it supports the particle nature of light. [7]  
 (ii) Calculate the uncertainty in the velocity of a cricket ball of mass 150 g if the uncertainty in its position is of order of 1 Å. [ $h = 6.6 \times 10^{-34} \text{ kg m}^2 \text{ s}^{-1}$ ] [7]  
 (b) (i) Explain VSEPR theory. Predict the structures of  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ , and  $\text{SF}_6$ . [7]  
 (ii) Discuss Bent's rule and its significance in predicting molecular shapes.
- Q.3** (a) (i) What are metal carbonyls? Explain in brief the synthesis, structure and geometry of  $\text{Ni}(\text{CO})_4$ . [7]  
 (ii) Define isomerism in coordination compounds. Enumerate the different types of isomerism in coordination compounds with suitable examples.  
 (b) Define corrosion by giving an example. Describe the different types of corrosion with suitable examples. [7]
- Q.4** (a) (i) Explain the working of a Leclanche cell with chemical reactions. [7]  
 (ii) Calculate the potential of the following electrochemical cell at 25 °C:  
 $\text{Cu(s)} | \text{Cu}^{2+}(\text{aq}) (0.50 \text{ M}) || \text{H}^+ (0.01) | \text{H}_2 (0.95 \text{ atm}); \text{Pt}$   
 Given :  $E^\circ_{\text{cathode}} = 0.00 \text{ V}$  and  $E^\circ_{\text{anode}} = 0.34 \text{ V}$   
 (b) (i) Calculate the gross and net calorific value of coal sample having the following composition: C = 80%, H = 7%, O = 3%, S = 3.5%, N = 2.1, and ash = 4.4% [7]  
 (ii) What are biofuels? Discuss their types and advantages over conventional fuels.
- Q.5** (a) (i) Distinguish between rotational and vibrational spectroscopy. [7]  
 (ii) Explain the selection rules for vibrational transitions in diatomic molecules and their applications.  
 (b) (i) State Beer's and Lambert's law and derive mathematical expression for Lambert-Beer's law. [7]  
 (ii) Explain the basic principle and applications of Nuclear Magnetic Resonance (NMR) spectroscopy.
- Q.6** (a) Name the various methods which are used for softening of water. Explain with equations which is the best method and why? [7]  
 (b) (i) How would you determine the alkalinity of water sample containing hydroxide and carbonate ion? [7]  
 (ii) 50 ml of standard hard water containing 1 mg of pure  $\text{CaCO}_3$  per ml consumed 20 ml of EDTA. 50 ml of a water sample consumed 25 ml of the same EDTA solution. Using eriochrome T as indicator, calculate the total hardness of water in ppm.
- Q.7** (a) Explain scale formation, caustic embrittlement, priming and foaming in boilers. What are the methods employed to remove these defects. [7]  
 (b) What are the different types of polymerization mechanisms? Explain free radical polymerization mechanism in detail. [7]
- Q.8** (a) Write short notes on: [7]  
 (i) Silicones  
 (ii) Buna-S rubber  
 (iii) Epoxy resin  
 (b) (i) Differentiate between thermoplastics and thermosetting plastics. [7]  
 (ii) Write the structure unit and two important applications of the Poly ethylene, Polyvinyl chloride, Polystyrene.
- Q.9** (a) (i) Define and illustrate the terms carbonium ion (carbocation), carbanion, and free radical. [7]  
 (ii) Explain the various types of organic reaction with examples.  
 (b) (i) Give the mechanism and industrial applications of Diels-Alder cyclization reaction. [7]  
 (ii) What are drug molecules? Explain in brief synthesis of aspirin including the reaction, conditions, and uses.