



BRAINWARE UNIVERSITY

Term End Examination 2025-2026

Programme – B.Tech.(BT)-2024/B.Tech.(BT)-2025

Course Name – Applied Chemistry

Course Code - BBS00003

(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) Compare the first ionization potential of C, N, O and F and identify the correct order.

a) $O > F > N > C$

b) $O > N > F > C$

c) $C > N > O > F$

d) $F > N > O > C$

(ii) Identify the nucleus that does not give an NMR signal.

a) ^1H

b) ^{16}O

c) ^{19}F

d) ^{31}P

(iii) Show the molecule that will not undergo $\pi \rightarrow \pi^*$ transition among the following.

a) $\text{CH}_3\text{-CH=CH-CH}_3$

b) $\text{CH}_3\text{-CH}_2\text{-CH=CH}_2$

c) CH_3COCH_3

d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

(iv) Which of the following equations relates the corrosion rate of metal with its weight?

a) Nernst equation

b) Faraday's equation

c) Gibb's Helmholtz equation

d) Schrodinger Wave equation

(v) Which of the following elements can be used for cathodic protection of iron?

a) Al

b) Cd

c) Cu

d) Ni

(vi) Which of the following materials will undergo corrosion?

a) Metals & alloys

b) Metals and Non-metals

c) Metals, Non-metals, Ceramics and Plastics

d) Metals, Non-metals, Ceramics, Plastics and Rubbers

(vii) Which of the following is the most corrosion-resistant metal at room temperature?

a) Iron

b) Copper

c) Platinum

d) Aluminum

(viii) Waterline corrosion in steel tank is an example of:

- a) Stress corrosion
c) Pitting corrosion
- b) Differential aeration corrosion
d) Differential metal corrosion
- (ix) Classify the thermosetting polymer from the following.
- a) Terylene
c) Bakelite
- b) Polystyrene
d) Neoprene
- (x) A polymer made of identical monomer units is classified as ____.
- a) Linear polymer
c) Copolymer
- b) Homopolymer
d) Branched polymer
- (xi) Condensation polymerization of _____ produces bakelite.
- a) Propylene and ethanol
c) Phenol and acetaldehyde
- b) Phenol and formaldehyde
d) Urea and formaldehyde
- (xii) For a chemical reaction, $\text{rate} = k[A][B]^2$; the concentration unit is given in mol/L. The Unit of rate constant for that reaction is:
- a) $\text{L mol}^{-1} \text{s}^{-1}$
c) $\text{L}^2 \text{mol}^{-2} \text{s}^{-2}$
- b) $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$
d) s^{-1}
- (xiii) Choose the correct relation between stepwise stability constants (K_i) and overall stability constant (β_n).
- a) $\beta_n = K_1 + K_2 + \dots + K_n$
c) $\beta_n = \log K_1 + \log K_2 + \dots + \log K_n$
- b) $\beta_n = K_1 \times K_2 \times \dots \times K_n$
d) $\beta_n = 1/(K_1 + K_2 + \dots + K_n)$
- (xiv) Select the equivalents of phosphoric acid present in 300 mL of 4.00 M phosphoric acid. (Assume the acid is to be completely neutralized by a base.)
- a) 1.20 eqv
c) 3.60 eqv
- b) 2.40 eqv
d) 4.80 eqv
- (xv) Identify the acid among the following that ionizes to give the strongest conjugate base.
- a) CH_3COOH
c) HClO_4
- b) H_2SO_4
d) HI

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Group-B

(Short Answer Type Questions)

3 x 5 = 15

- Identify the number of ^1H -NMR signals shown by the following molecules: methanol, 2-butanone, nitrobenzene, 1,4-difluorobenzene, n-butane, cis-2-butene. (3)
- Explain the following: (3)
 - Chromium (Cr) has an anomalous electronic configuration compared to other transition metals.
 - Atomic size increases down the group.
- Write down the chemical formula of rust. Why is the rusting of iron quicker in saline water than in ordinary water? (3)
- Plan a stepwise mechanism for the synthesis of polyvinylchloride (PVC). Give an important application of PVC. (3)
- Derive a relation between half-life and the rate constant of a first order reaction, and also analyze why the half-life is independent of the initial concentration of the reactant. (3)

OR

The rate constant of a first order reaction is $1.0 \times 10^{-4} \text{ s}^{-1}$ at 350 K. Inspect the rate (3)
constant at 450 K. Given $E_a = 60 \text{ kJ mol}^{-1}$.

Group-C

(Long Answer Type Questions)

5 x 6=30

7. Illustrate addition (chain-growth) polymerization and condensation (step-growth) (5)
polymerization. Interpret the mechanisms by taking one example in each type.
8. (i) Explain the reason for using TMS as a reference in NMR spectroscopy. (5)
- (ii) Classify the following molecules as IR-active or IR-inactive: H_2 , NH_3 , HCl , HCN .
- (iii) Show one application of fluorescence spectroscopy in medicine.
9. (i) Illustrate Pilling Bedworth Rule. (5)
- (ii) The specific volume ratio (R) of W, Cr, and Ni are 3.6, 2.0, and 1.6 respectively.
Identify the metals with the highest and lowest rates of corrosion.
- (iii) Identify the reason why iron corrodes faster than aluminum, even though iron is
placed below aluminum in the electrochemical series.
10. Consider the reaction: $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \rightleftharpoons 2\text{NH}_3 (\text{g}) + \text{Heat}$ (5)
- Analyze the changes in equilibrium according to Le Chatelier's Principle for the
following changes:
- (i) Pressure is decreased at constant temperature and volume.
- (ii) An inert gas is added at constant volume.
- (iii) A catalyst is added.
- (iv) Temperature is increased.
- (v) NH_3 is added.
11. Develop a detailed stepwise mechanism for the formation of polyethylene from (5)
ethylene using Ziegler-Natta catalyst.

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12. (i) Prove that in a first-order reaction, the time required for completion of 99% is (5) twice the time required for completion of 90% of the reaction.
- (ii) A first-order reaction has a rate constant of $1.05 \times 10^{-3} \text{ s}^{-1}$. Evaluate the time taken for 5 g of this reactant to get reduced to 3 g.

OR

- (i) The decomposition of 'A' into the product has a value of rate constant (k) as $4.65 \times (5) 10^3 \text{ s}^{-1}$ at 10°C and energy of activation 60 kJ mol^{-1} . Determine the temperature when k is $1.55 \times 10^4 \text{ s}^{-1}$.
- (ii) The first order rate constant for the decomposition of ethyl chloride at 600 K is $1.62 \times 10^{-5} \text{ s}^{-1}$. Its energy of activation is 208 kJ/mol . Estimate the rate constant of the reaction at 700 K.

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