ELIDASA LEARN – ADVANCED CHEMISTRY

FORM SIX TOPICAL TEST

CHEMISTRY (ELECTROCHEMISTRY & CHEMICAL KINETICS)

TIME: 3 Hours
Date: November, 2025

Instructions:

1. This paper consists of **ten (10)** questions.
2. Answer **all questions**.
3. Show all your working clearly where necessary.
4. Write your **examination number** on every page.
5. You may use the following constants:

Faraday Constant, F = 96500 C mol^{-1}
Gas Constant, R = 8.31 J mol^{-1} K^{-1}
1 Faraday = 96500 Coulombs

ELECTROCHEMISTRY SECTION

1.

(a) Define the following terms:
(i) Oxidation
(ii) Reduction
(iii) Standard electrode potential [3 marks]

(b) Write the conventional cell representation and overall cell reaction for a galvanic cell formed by **Cu^{2+}/Cu** and **Zn^{2+}/Zn** half-cells. [4 marks]

(c) Calculate the EMF of the cell using the data below:

$$E^{\circ}_{Cu^{2+}/Cu} = +0.34V, E^{\circ}_{Zn^{2+}/Zn} = -0.76V$$

[3 marks]

2.

(a) Explain the difference between **electrolytic** and **galvanic** cells in terms of energy change and electrode polarity. [3 marks]

(b) During electrolysis of aqueous copper(II) sulfate using copper electrodes:
(i) Identify the products formed at both electrodes.
(ii) Write the half equations.
(iii) Explain why the blue color of the solution remains unchanged. [5 marks]

(c) Sketch a well-labeled diagram of the apparatus used in this electrolysis. [2 marks]

3.

(a) State **Faraday's First and Second Laws of Electrolysis.** [2 marks]

(b) 0.54 g of silver was deposited during the electrolysis of silver nitrate solution using a current of 2 A. Calculate the time required.
(Relative atomic mass of Ag = 108) [4 marks]

(c) State two experimental sources of error that can affect the accuracy of such an electrolysis experiment. [4 marks]

4.

(a) Write the **Nernst equation** and explain the meaning of each term. [3 marks]

(b) The potential of a copper electrode in a Cu^{2+} solution is +0.25 V at 25°C. Calculate the concentration of Cu^{2+} ions if the standard electrode potential is +0.34 V. [5 marks]

(c) Explain why electrode potential depends on **temperature** and **concentration**. [2 marks]

5.

(a) Explain how **electrochemical series** is useful in:
(i) Predicting feasibility of redox reactions
(ii) Metal extraction
(iii) Electroplating [6 marks]

(b) Suggest the **anode and cathode reactions** when an iron spoon is electroplated with silver. [4 marks]

CHEMICAL KINETICS SECTION

6.

(a) Define the following terms:
(i) Rate of reaction
(ii) Activation energy
(iii) Catalyst [3 marks]

(b) State three factors that affect the rate of a chemical reaction and explain how each influences the rate. [6 marks]

(c) Draw a labeled energy profile diagram for a catalyzed and uncatalyzed reaction. [1 mark]

7.

(a) Write the general rate law expression for a reaction:

$$aA + bB \rightarrow cC + dD$$

and explain the meaning of each term. [3 marks]

(b) The rate of a reaction between A and B was found to obey the rate equation:

$$\text{Rate} = k[A]^2[B]$$

If the concentration of A is doubled while B remains constant, by what factor does the rate change? [3 marks]

(c) The rate constant, k, of a reaction double when temperature increases from 300 K to 310 K. Calculate the activation energy of the reaction (R = 8.31 $Jmol^{-1}K^{-1}$). [4 marks]

8.

(a) Define **order of reaction** and **molecularity of a reaction**. [2 marks]

(b) Explain two differences between the two. [2 marks]

(c) The decomposition of N_2O_5 follows the first-order kinetics.
Given that 50% decomposes in 30 minutes, calculate the rate constant and the time required for 75% decomposition. [6 marks]

9.

(a) Explain how temperature affects the rate of a reaction using the **collision theory**. [4 marks]

(b) Describe how a catalyst affects:
(i) Activation energy
(ii) Rate of reaction [2 marks]

(c) The following data were obtained for a reaction:

[A] (mol dm^{-3})	**[B] (mol dm^{-3})**	**Rate (mol $dm^{-3}s^{-1}$)**
0.1	0.1	2.0×10^{-5}
0.2	0.1	8.0×10^{-5}
0.1	0.2	4.0×10^{-5}

Determine the **order of reaction** with respect to A and B. [4 marks]

10.

(a) Differentiate between **instantaneous** and **average rate of reaction**. [2 marks]

(b) Explain how you would determine the order of reaction experimentally using the **initial rates method.** [4 marks]

(c) Sketch and label a graph showing how **concentration of reactant** changes with time for a **first-order reaction.** [4 marks]

THE END

Nothing is permanent