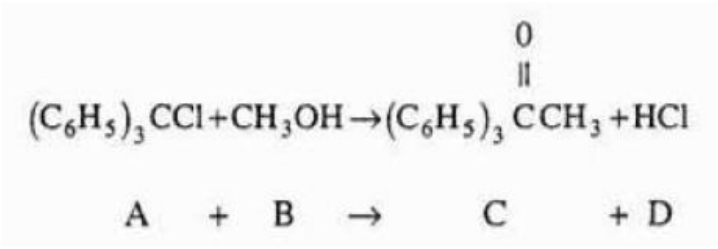
DETERMINING RATE LAW

1) The reaction of triphenyl metyl chloride (trityl) (A) ve methanol (B) was carried out in a solution of benzene and pyridine at 25°C. Pyridine reacts with HCl that then precipitates as pyridine hydrochloride thereby making the reaction irreversible.

The concentration-time data in the following table was obtained in a batch reactor. Initial concentration of methanol was 0.5 mol/dm^3.



$$(C_6H_5)_3CCl + CH_3OH \rightarrow (C_6H_5)_3C\overset{\overset{O}{\|}}{C}CH_3 + HCl$$

A + B → C + D

Time (min)	0	50	100	150	200	250	300
Concentration of A (mol/dm^3) × 10^3	50	38	30.6	25.6	22.2	19.5	17.4

(At $t = 0$, $C_A = 0.05\ M$)

Part 1. Determine the reaction order with respect to triphenyl methyl chloride.

Part 2. In a separate set of experiments, the reaction order with respect to methanol was found to be first order. Determine the specific reaction rate constant.

2) The decomposition reaction of hydrogen peroxide occurs according to the following mechanism. In this study, the data in the table was obtained. Propose a rate law for this reaction based on table data.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

t (s)	0	400	800	1200	1600	2000	2400	2800
[H_2O_2] (mol/L)	2.32	1.72	1.3	0.98	0.73	0.54	0.39	0.28

3) The initial rates found for the reaction $2\ HgCl_2 + C_2O_4^{2-} \rightarrow 2\ Cl^- + 2\ CO_2 + Hg_2Cl_2$ are given in the table. Propose a rate law based on the data.

Exp.	**$[HgCl_2]_o$, mol/L**	**$[C_2O_4^{2-}]_o$, mol/L**	**$(-r_{HgCl2})_0$, mol/L.min**
1	0.105	0.15	1.8×10^{-5}
2	0.105	0.30	7.1×10^{-5}
3	0.052	0.30	3.5×10^{-5}

4) **(A) NH_4^+ + (B) NO_2^- $\longrightarrow$ N_2 + 2 H_2O** reaction is carried out at 25°C and experimental data is given below. Postulate a rate expression for this reaction based on the data obtained.

$[NH_4]_o$	**$[NO_2]_o$**	**$(-r_{NH4})_0 \times 10^7$**
0.01	0.2	5.4
0.02	0.2	10.8
0.04	0.2	21.5
0.06	0.2	32.3
0.2	0.0202	10.8
0.2	0.0404	21.6
0.2	0.0606	32.4
0.2	0.0808	43.3

5) The hydrolysis of ethyl nitrobenzoate with hydroxyl ions is carried out in a constant volume batch reactor at 15°C. The conversion rates in the table were obtained in the reaction performed by taking the concentration of both reactants as 0.05 mol/L. Find the order of reaction and the value of the rate constant using the integral method.

$$NO_2C_6H_4COOC_2H_5\ (A) + OH^-\ (B) \longrightarrow NO_2C_6H_4COO^-\ (C) + C_2H_5OH\ (D)$$

t (s)	0	120	180	240	330	530	600
% conversion	0	32.95	41.75	48.8	58.05	69.0	70.4
C_A, C_B	0.05	0.034	0.029	0.026	0.021	0.016	0.015

6) The etching of semiconductors in the manufacture of computer chips is another important solid-liquid dissolution reaction. The dissolution of the semiconductor MnO_2 was studied using a number of different acids and salts. The rate of dissolution was found to be a function of the reacting liquid solution redox potential relative to the energy level conduction band of the semiconductor. It was found that the reaction rate could be increased by a factor of 10^5 simply by changing the anion of the acid. From the data below, determine the reaction order and the specific rate for the dissolution of MnO_2 in HBr.

C_{A0} (mol HBr/dm^3)	0.1	0.5	1.0	2.0	4.0
$-r''_{A0}$ (mol HBr/m^2.h) x 10^2	0.073	0.70	1.84	4.86	12.84