Assignment 7

Indian Institute of Science Education and Research

CHM202: Energetics and dynamics of chemical reactions

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Ques. 1 Initial rate of a first order gaseous reaction becomes three times when the temperature increases from 400K to 420K. If the half-life time of the reaction at 400K is 10 minutes, find out the time (in seconds) needed for 25% conversion of the reactant into product at 420K. [R=1.987cal K^{-1} mol^{-1}]

Ques.2 Derive an integrated expression for a second-order rate law $v = k[A][B]$ for a reaction of stoichiometry 2 A + 3 B →P.

Ques.3 The second-order rate constant for the reaction

$$CH_3COOC_2H_5\,(aq) + OH^-\,(aq) \rightarrow CH_3CO_2^-\,(aq) + CH_3CH_2OH\,(aq)$$

is 0.21 dm^3 mol^{-1} s^{-1}. What is the concentration of ester after (a) 10 s, (b) 10 min when ethyl acetate is added to sodium hydroxide so that the initial concentrations are [NaOH] = 0.030 mol dm^{-3} and $[CH_3COOC_2H_5]$ = 0.200 mol dm^{-3} ?

Ques.4 Find an expression for the time it takes for the concentration of a substance to fall to one-third its initial value in an *n*th-order reaction.

Ques.5 The rate constant of a first order reaction is 2.50×10^{-4} sec^{-1} at 290°C. If the activation energy is 154 kJ/mol, what is the temperature at which the rate constant is 3.20×10^{4} sec^{-1}.

Ques.6 One of the hazards of nuclear explosions is the generation of ^{90}Sr and its subsequent incorporation in place of calcium in bones. This nuclide emits β rays of energy 0.37 MeV, and has a half-life of 22.1 year. Suppose 2.00 μg was absorbed by a newly born child. How much will remain after (a) 15 year, (b) 60 year if none is lost metabolically?