1) Suggest experimental means by which the following reactions can be monitored for rate.
 $CaCO_3(s)$ $\longrightarrow$ $CaO(s) +$ CO_2 (g)

2) Iron (III) chloride is reduced by tin (II) chloride in the following reaction.
   $2FeCl_3(aq) + SnCl_2(aq)$ $\longrightarrow$ $2FeCl_2(aq)$ $+$ $SnCl_4(aq)$
   The concentration of Fe^{3+} ion at the beginning of an experiment was 0.03586M and after 4.00 min it was 0.02715M. What is the average rate of reaction of $FeCl_3$ in this time? What is the rate of formation of tin (IV) chloride? (ans: (*E*) 0.00218M/min; 0.00109M/min))

3) The rate of the following reaction in aqueous solution is monitored by measuring the rate of formation of I_3^-. Data obtained are listed in the table below.
   $S_2O_8^{2-} + 3I^-$ $\longrightarrow$ $2SO_4^{2-} + I_3^-$
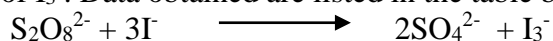
Exp	$[S_2O_8^{2-}]$, M	$[I^-]$, M	Initial rate M/s
1	0.038	0.060	1.4×10^{-5}
2	0.076	0.060	2.8×10^{-5}
3	0.076	0.120	5.6×10^{-5}

   a) Determine the order of the reaction with respect to $S_2O_8^{2-}$, and with respect to I^- and overall. (ans: 1,1, 2)
   b) What is the value of rate constant, k? (ans: 6.1×10^{-3} M^{-1} s^{-1})
   c) What would be the initial rate of reaction if $[S_2O_8^{2-}] = 0.083$ M and $[I^-] = 0.115$ M? (ans: 5.8 x 10^{-5} M/s)

4) A first order A ⟶ products, has a rate constant k, of 0.0462 min^{-1}.
   a) What is the [A] at the time when the reaction is proceeding at a rate of 0.0150 M min^{-1}? (ans: 0.325M)
   b) It takes 12 mins for the reaction to 12% completion and 48 min to 56% completion. Without doing detailed calculations, determine how long it should take the reaction to 78% completion? (*Hint*: what is the % remaining each time?) (ans: 84 min)

5) The initial concentration of H_2O_2 is 0.2546 M and the rate constant is 9.32 x 10^{-4} s^{-1}. What will be the [H_2O_2] at t = 35s? (ans: 0.246M)

6) The thermal decomposition of phosphine (PH_3) into phosphorous and molecular hydrogen is a first order reaction.

   $$4PH_3 \longrightarrow P_4 + 6H_2$$

   The half life of the reaction is 35.0 s at 680°C. Calculate
   a) The first order rate constant for the reaction. ((*B*)ans: 0.0198/s)
   b) The time required for 95% of the phosphine to decompose. ((*B*)ans: 151s)

7) Given the same concentrations, the reaction at 250°C, is 1.50 x 10³ times faster than the same reaction at 150°C. Calculate the activation energy for this reaction. ((B)ans: 135KJ/mol)

$$CO(g) + Cl_2(g) \longrightarrow COCl_2(g)$$