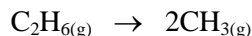


1. The decomposition of ethane,  $C_2H_6$ , to methyl radicals is a first-order reaction with a rate constant of  $5.36 \times 10^{-4} s^{-1}$  at  $700^\circ C$ . (6 pts)



a) Write the possible rate expressions for this reaction.

$$rate = -\frac{\Delta[C_2H_6]}{\Delta t} = \frac{1}{2} \frac{\Delta[CH_3]}{\Delta t}$$

b) Write the rate law for this reaction.

$$rate = k[C_2H_6]$$

c) Calculate the half-life for this reaction in minutes.

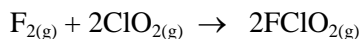
$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{5.36 \times 10^{-4} s^{-1}} = 1.29 \times 10^3 s \times \frac{1 \text{ min}}{60 s} = 21.5 \text{ min}$$

d) How many minutes would it take for 12.5% of ethane to decompose from its initial concentration? Use the integrated rate law for a 1<sup>st</sup> order reaction.

$$[A]_t = 0.875[A]_0$$

$$\ln \frac{0.875[A]_0}{[A]_0} = -kt \quad \text{Solve for } t \text{ yields } t = 249 \text{ s or } 4.2 \text{ min}$$

2. Consider the reaction:



From the following data, determine the order of the reaction and calculate the rate constant (include proper units). (4 pts)  $rate = k[F_2]^x[ClO_2]^y$  must find x and y

$[F_2]$ (M)	$[ClO_2]$ (M)	Initial Rate (M/s)
0.10	0.010	$1.2 \times 10^{-3}$
0.10	0.040	$4.8 \times 10^{-3}$
0.20	0.010	$2.4 \times 10^{-3}$

$$\frac{rate_3}{rate_1} = \frac{2.4 \times 10^{-3}}{1.2 \times 10^{-3}} = 2 = \frac{k(0.2)^x(0.01)^y}{k(0.1)^x(0.01)^y} = 2^x \quad x = 1$$

$$\frac{rate_2}{rate_1} = \frac{4.8 \times 10^{-3}}{1.2 \times 10^{-3}} = 4 = \frac{k(0.1)^x(0.04)^y}{k(0.1)^x(0.01)^y} = 4^y \quad y = 1$$

$$rate = k[F_2][ClO_2]$$

$$k = \frac{1.2 \times 10^{-3} \text{ M/s}}{(0.1 \text{ M})(0.01 \text{ M})} = 1.2 \text{ M}^{-1} \text{ s}^{-1}$$

2<sup>nd</sup> – order reaction overall