

Using Line Equations to Find Information

1. For the first order reaction: $2 \text{N}_2\text{O}_5 \rightarrow 2 \text{N}_2\text{O}_4 + \text{O}_2$
at 45°C , $k = 6.22 \times 10^{-4} \text{ s}^{-1}$. If $[\text{N}_2\text{O}_5] = 0.100\text{M}$:

a.) How long does it take for the concentration to drop to 0.010M ?
A: $3.70 \times 10^3 \text{s}$

b.) What is the concentration after one hour? A: 0.0107M

2. The decomposition of sulfuryl chloride (SO_2Cl_2) is first order in SO_2Cl_2 . The rate constant for the decomposition at 660K is $4.5 \times 10^{-2} \text{ s}^{-1}$.

a.) If we begin with an initial SO_2Cl_2 pressure of 450 torr, what is the pressure of this substance after 60.s? **A: 30. torr**

b.) At what time will the pressure of SO_2Cl_2 decline to 1/10 its initial value? **A: 51s**

Half-life Examples

1. For a 1st order reaction, determine the time it will take for only 1/8 of a material to be left if $t_{1/2} = 3.47 \times 10^2 \text{s}$

A: $1.04 \times 10^3 \text{s}$

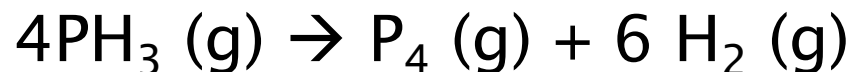
2. The reaction below is first order in $[\text{H}_2\text{O}_2]$:



A solution originally at 0.600M is found to be 0.075M after 54min. Determine the half-life.

A: 18 min

3. The thermal decomposition of phosphine (PH₃) into phosphorus and molecular hydrogen is a first order reaction:



The half-life of the reaction is 35.0s at 680°C. Calculate (a) the first order rate constant for the reaction and (b) the time required for 95% of the phosphine to decompose.

A: (a) 0.0198s⁻¹ (b) 151s

4. The rate constant for the second-order reaction



is $0.54 \text{ M}^{-1}\text{s}^{-1}$ at 300°C .

(a) How long, in seconds, would it take for the concentration of NO_2 to decrease from 0.62M to 0.28M ?

A: 3.6s

(b) Calculate the half-lives at these two concentrations.

A: 3.0s, 6.6s

More uses of the Arrhenius Equation

1. The activation energy of a certain reaction is 31.5 kJ/mol. At 30°C, the rate constant is 0.0190 s⁻¹. At what temperature in degrees Celsius would this reaction go twice as fast?

A: 48°C

2. The gas-phase reaction $\text{Cl(g)} + \text{HBr(g)} \rightarrow \text{HCl(g)} + \text{Br(g)}$ has an overall enthalpy change of -66kJ . The activation energy for the reaction is 7 kJ .

(a) Sketch the energy profile for the reaction, and label E_a and ΔE .

(b) What is the activation energy for the reverse reaction?

A: 73 kJ

3. On the basis of the frequency factors and activation energy values of the following two reactions, determine which one will have the larger rate constant at room temperature (298K).

A: second reaction

