

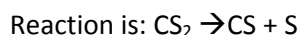
AP Chemistry - Kinetics Problems Part 2

1) Compound A decomposes to form B and C in a reaction that is first order with respect to A and first order overall. At 25°C, the specific rate constant for the reaction is 0.0450 s^{-1} . What is the half-life of A at 25°C? Reaction is $A + B \rightarrow C$

2) The first-order rate constant for the radioactive decay of radium-223 is 0.0606 day^{-1} . What is the half-life of radium-223 isotope?

3) The reaction $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 2\text{N}_2\text{O}_4(\text{g}) + \text{O}_2(\text{g})$ obeys the rate law: $\text{rate} = k[\text{N}_2\text{O}_5]$, in which the specific rate constant is 0.00840 s^{-1} at a certain temperature. (a) If 2.50 moles of N_2O_5 were placed in a 5.00-liter container at that temperature, how many moles of N_2O_5 would remain after 1.00 minute? (b) How long would it take for 90% of the original N_2O_5 to react?

4) The decomposition reaction of carbon disulfide, CS_2 , to carbon monosulfide, CS, and sulfur is first order with $k = 2.8 \times 10^{-7} \text{ s}^{-1}$ at 1000°C.



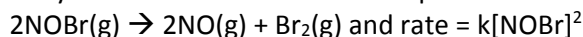
(a) What is the half-life of this reaction at 1000°C? (b) How many days would pass before a 2.00-gram sample of CS_2 had decomposed to the extent that 0.75 gram of CS_2 remained? (c) Refer to part (b). How many grams of CS would be present after this length of time? (d) How much of a 2.00-gram sample of CS_2 would remain after 45.0 days?

5) Cyclopropane rearranges to form propene in a reaction that follows first-order kinetics. At 800. K, the specific rate constant for this reaction is $2.74 \times 10^{-3} \text{ s}^{-1}$. Suppose we start with a cyclopropane concentration of 0.290 M. How long will it take for 99.0% of the cyclopropane to disappear according to this reaction?

6) Compounds A and B react to form C and D in a reaction that was found to be second order in A and second order overall. The rate constant at 30°C is 0.622 liter per mole per minute. What is the half-life of A when $4.10 \times 10^{-2} \text{ M}$ of A is mixed with excess B?



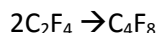
7) The gas-phase decomposition of NOBr is second order in [NOBr], with $k = 0.810 \text{ M}^{-1} \cdot \text{s}^{-1}$ at 10°C. We start with $4.00 \times 10^{-3} \text{ M}$ NOBr in a flask at 10°C. How many seconds does it take to use up $1.50 \times 10^{-3} \text{ M}$ of this NOBr?



8) Consider the reaction of problem above at 10°C. If we start with $2.40 \times 10^{-3} \text{ M}$ NOBr, what concentration of NOBr will remain after 5.00 minutes of reaction?

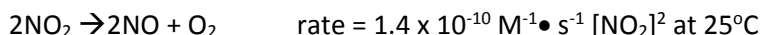
9) The rate constant for the decomposition of nitrogen dioxide $2\text{NO}_2 \rightarrow 2\text{NO} + \text{O}_2$ with a laser beam is $1.70 \text{ M}^{-1} \cdot \text{min}^{-1}$. Find the time, in seconds, needed to decrease 2.00 mol/L of NO_2 to 1.25 mol/L.

10) The second-order rate constant for the following gas phase reaction is $0.0442 \text{ M}^{-1} \cdot \text{s}^{-1}$. We start with 0.135 mol C_2F_4 in a 2.00-liter container, with no C_4F_8 initially present.



(a) What will be the concentration of C_2F_4 after 1.00 hour? (b) What will be the concentration of C_4F_8 after 1.00 hour? (c) What is the half-life of the reaction for the initial C_2F_4 concentration given in part (a)? (d) How long will it take for half of the C_2F_4 that remains after 1.00 hour to disappear?

11) Answer the questions for the reaction below.



(a) If 3.00 mol of NO_2 is initially present in a sealed 2.00-L vessel at 25°C, what is the half-life of the reaction? (b) Refer to part (a). What concentration and how many grams of NO_2 remain after 115 years? (c) Refer to part (b). What concentration of NO would have been produced during the same period of time?

12) We carry out the reaction $A + B \rightarrow C$ at a particular temperature. As the reaction proceeds, we measure the molarity of the reactant, $[A]$, at various times. The observed data are tabulated below.

<u>Time</u> <u>(min)</u>	<u>[A]</u> <u>(mol /L)</u>	<u>Time</u> <u>(min)</u>	<u>[A]</u> <u>(mol /L)</u>
0.00	2.000	6.00	0.338
2.00	1.107	8.00	0.187
4.00	0.612	10.00	0.103

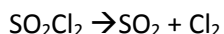
(a) Plot $[A]$ versus time. (b) Plot $\ln [A]$ versus time. (c) Plot $1/[A]$ versus time. (d) What is the order of the reaction? (e) Write the rate-law expression for the reaction. (f) What is the value of k at this temperature?

13) The following data were obtained from a study of the decomposition of a sample of HI on the surface of a gold wire.

<u>t (sec)</u>	<u>[HI] (mM)</u>
0.	5.46
250.	4.10
500.	2.73
750.	1.37

(a) Plot the data to find the order of the reaction, the rate constant, and the rate equation. (b) Calculate the HI concentration in mmol/L at 600. seconds.

14) The decomposition of SO_2Cl_2 in the gas phase, can be studied by measuring the concentration of Cl_2 as the reaction proceeds. We begin with $[\text{SO}_2\text{Cl}_2]^0 = 0.250 \text{ M}$. Holding the temperature constant at $320.^{\circ}\text{C}$, we monitor the Cl_2 concentration, with the following results:



<u>t (hours)</u>	<u>[Cl₂] (mol/L)</u>	<u>t (hours)</u>	<u>[Cl₂] (mol/L)</u>	<u>t (hours)</u>	<u>[Cl₂] (mol/L)</u>
0.00	0.000	8.00	0.117	16.00	0.180
2.00	0.037	10.00	0.137	18.00	0.190
4.00	0.068	12.00	0.153		
6.00	0.095	14.00	0.168		

(a) Plot $[\text{Cl}_2]$ versus t . (b) Plot $[\text{SO}_2\text{Cl}_2]$ versus t . (c) Determine the rate law for this reaction. (d) What is the value, with units, for the specific rate constant at $320.^{\circ}\text{C}$? (e) How long would it take for 95% of the original SO_2Cl_2 to react?