

CHEM 1412 Worksheet - Kinetics

1. The table presents data for the reaction: $2\text{H}_2(g) + 2\text{NO}(g) \rightarrow 2\text{H}_2\text{O}(g) + \text{N}_2(g)$
The temperature of the reaction is constant.

Exp.	Initial Concentration (<i>M</i>)		Initial Rate $-\Delta[\text{NO}]/\Delta t$ (<i>M/s</i>)
	[NO]	[H ₂]	
1	0.60	0.10	1.8×10^{-3}
2	0.60	0.20	3.6×10^{-3}
3	0.10	0.60	3.0×10^{-4}
4	0.20	0.60	1.2×10^{-3}

Determine the rate law and the value of *k* for the above reaction system.

Calculate the necessary [NO] to achieve a rate of 8.0×10^{-4} M/s when [H₂] = 0.35 M.

What is the rate of production of N₂(*g*) in trial #3?

2. Initial rate data for the reaction: $2\text{N}_2\text{O}_5(g) \rightarrow 4\text{NO}_2(g) + \text{O}_2(g)$

Exp.	[N ₂ O ₅] <i>M</i>	Rate (<i>M/s</i>)
1	0.15	0.0046
2	0.20	0.0061

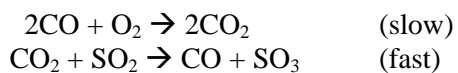
Write the rate law for the above reaction and determine *k*.

In experiment #2, what will [N₂O₅] be after 1.0 min?

3. Rate = $k[\text{NOCl}]^2$ for the reaction $2\text{NOCl} \rightarrow 2\text{NO} + \text{Cl}_2$
Initially, 0.100 M NOCl is present, then after 12 minutes, 0.085 M remains.
Determine *k* for this reaction.

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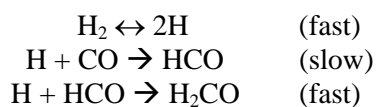
4. Consider this reaction mechanism



Write the balanced equation for the overall reaction.

Write the rate law for the overall reaction.

5. Consider this reaction mechanism:



Write the balanced equation for the overall reaction.

Write the rate law for the overall reaction.

6. For each combination of sign for enthalpy and entropy (+ +, - -, + -, - +) determine whether the reaction is

- spontaneous at all temperatures
- non-spontaneous at all temperatures (spontaneous in the reverse direction)
- spontaneous only at high temperatures
- spontaneous only at low temperatures

Hint: use $\Delta G = \Delta H - T\Delta S$

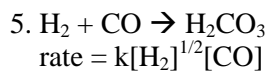
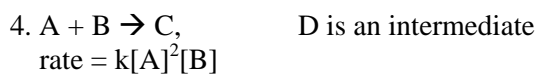
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Answers

1. $k = 0.05 \text{ M}^{-2}\text{s}^{-1}$
 $[\text{NO}] = 0.214 \text{ M}$
rate of $\text{N}_2 = 1.5 \times 10^{-4} \text{ M/s}$

2. rate = $k[\text{N}_2\text{O}_5]$
 $k = 0.031 \text{ s}^{-1}$
 $[\text{N}_2\text{O}_5] = 0.005 \text{ M}$

3. $k = 0.0735 \text{ M}^{-1}\text{min}^{-1}$, or $0.00122 \text{ M}^{-1}\text{s}^{-1}$



6. c, d, b, a