

Lesson #54

**Before Lesson**

Read assigned pages in your text: \_\_\_\_\_  
Work Exercise 6 in the Lectureguide

**During Lesson**

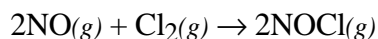
Work Exercises 6 - 9 in the Lectureguide

**After Lesson**

Complete Lectureguide material  
Work Problems 21.2 and 21.3 in Problem Set #21

6. Define the terms; *rate equation* and *rate law* for a chemical reaction.

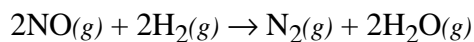
7. Write the general rate law for the following reaction;



Identify the rate constant in the rate law. What are the exponents in the rate law called?

8. What experimental data is needed to determine the order of a chemical reaction?

a. Consider the reaction



and the following initial rate data.

Experiment Number	$P_{\text{NO}}(\text{mmHg})$	$P_{\text{H}_2}(\text{mmHg})$	Initial Rate ( $\frac{\text{mmHg}}{\text{s}}$ )
1	400	150	0.66
2	400	300	1.34
3	150	400	0.25
4	300	400	1.03

i) Determine the reaction order for NO and H<sub>2</sub>.

**Ans: H<sub>2</sub> is 1st order and NO is 2nd order**

ii) Determine the overall order of the reaction.

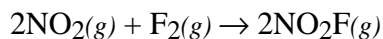
iii) Write the specific rate law for the reaction.

**Ans: rate =  $k(P_{\text{NO}})^2(P_{\text{H}_2})^1$**

iv) Determine the rate constant for the reaction (include units).

**Ans:  $k = 2.7 \times 10^{-8} \text{ mmHg}^{-2}\cdot\text{sec}^{-1}$**

b. The following initial rate data were collected for the reaction



at 100 °C. (Problems: BL 15.15 – 15.16)

Exp.	[NO <sub>2</sub> ]	[F <sub>2</sub> ]	initial rate (M/sec)
1	0.0482 M	0.0318 M	1.90 x 10 <sup>-3</sup>
2	0.0120 M	0.0315 M	4.69 x 10 <sup>-4</sup>
3	0.0480 M	0.127 M	7.57 x 10 <sup>-3</sup>

i) Determine the reaction order for NO<sub>2</sub> and F<sub>2</sub>.

**Ans: F<sub>2</sub> is 1st order and NO<sub>2</sub> is 1st order**

ii) Determine the overall order of the reaction.

iii) Write the specific rate law for the reaction.

**Ans: rate = k[NO<sub>2</sub>]<sup>1</sup>[F<sub>2</sub>]<sup>1</sup>**

iv) Determine the rate constant for the reaction (include units).

**Ans: k = 1.24 M<sup>-1</sup>·sec<sup>-1</sup>**

c. For the reaction



and the following initial rate data.

Exp. #	[A]	[B]	[C]	Rate of formation of product $\left(\frac{M}{s}\right)$
1	$1.05 \times 10^{-2}$	$2.50 \times 10^{-2}$	$4.00 \times 10^{-3}$	$1.74 \times 10^{-4}$
2	$8.71 \times 10^{-2}$	$2.50 \times 10^{-2}$	$4.00 \times 10^{-3}$	$1.19 \times 10^{-2}$
3	$2.10 \times 10^{-2}$	$2.10 \times 10^{-2}$	$2.10 \times 10^{-2}$	$1.34 \times 10^{-3}$
4	$4.20 \times 10^{-2}$	$2.10 \times 10^{-2}$	$4.20 \times 10^{-2}$	$7.58 \times 10^{-3}$

i) Determine the reaction order for A, B and C.

ii) Determine the overall order of the reaction.

iii) Write the specific rate law for the reaction.

iv) Determine the rate constant for the reaction (include units).  
**Ans: rate =  $k[A]^2[Y]^1[C]^{1/2}$**

**Ans:  $k = 998 \text{ M}^{-2.5}\cdot\text{sec}^{-1}$**