

Show work where possible

1. (5 Pts) The rate law for the reaction  $A + B \rightarrow C + D$  is first order in  $[A]$  and second order in  $[B]$ . If  $[A]$  is doubled and  $[B]$  is tripled, what will be the effect on the rate of the reaction?

$$\text{rate} = k[A][B]^2$$

$$[2][3]^2 = 18 \text{ fold increase}$$

- 2a. (5 Pts) The table presents data for the reaction:  $2H_2(g) + 2NO(g) \xrightarrow{k_1} 2H_2O(g) + N_2(g)$

Exp.	Initial Concentration (mol·L <sup>-1</sup> )		Initial Rate M/s
	[NO]	[H <sub>2</sub> ]	
I	6.0 × 10 <sup>-3</sup>	1.0 × 10 <sup>-3</sup>	18
II	6.0 × 10 <sup>-3</sup>	2.0 × 10 <sup>-3</sup>	36
III	1.0 × 10 <sup>-3</sup>	6.0 × 10 <sup>-3</sup>	3
IV	2.0 × 10 <sup>-3</sup>	6.0 × 10 <sup>-3</sup>	12

General rate law:  
rate = k [NO]<sup>x</sup> [H<sub>2</sub>]<sup>y</sup>

The temperature of the reaction is constant. Determine the rate law for the reaction. Show all work.

Use  $\frac{\text{Exp II}}{\text{Exp I}}$  for H<sub>2</sub>:  $\frac{36}{18} = \left(\frac{2.0 \times 10^{-3}}{1.0 \times 10^{-3}}\right)^y$   $2 = (2)^y \therefore y = 1$

Use  $\frac{\text{Exp IV}}{\text{Exp III}}$  for [NO]:  $\frac{12}{3} = \left(\frac{2.0 \times 10^{-3}}{1.0 \times 10^{-3}}\right)^x$   $4 = (2)^x \therefore x = 2$

rate = k [NO]<sup>2</sup> [H<sub>2</sub>]

- 2b. (3 Pts) Determine the numerical value of the rate constant for 2a. and its units.

$$\frac{M}{s} = k [NO]^2 [H_2] \quad 18 = k [6.0 \times 10^{-3}]^2 [1.0 \times 10^{-3}] = 5.0 \times 10^8 M^{-2} \cdot s^{-1}$$

3. (5 Pts) If rate is measured in (M)/min. What are the correct units for the rate constant in the rate law having: rate = k[D]<sup>2</sup> [X]<sup>2</sup>?

$$\frac{M}{min} = k M^4 \quad k_{units} = M^{-3} \cdot min^{-1}$$

4. (3 Pts) Which one of the following is not a valid expression for the of the reaction below?



- a.  $-\frac{\Delta[O_2]}{7\Delta t}$    b.  $-\frac{\Delta[NO_2]}{4\Delta t}$    c.  $\frac{\Delta[H_2O]}{6\Delta t}$    d.  $-\frac{\Delta[NH_3]}{4\Delta t}$    e. rate = k[NH<sub>3</sub>]<sup>x</sup>[O<sub>2</sub>]<sup>y</sup>

- 4b. (2 Pts) Explain you answer:

NO is not a reactant

5. (2 Pts) The rate expression for a second order reaction is

- (A) rate = k [A]   (C) rate = k [A] [B]   (B) rate = k [A]<sup>2</sup> [B]   (D) rate = k [A]<sup>2</sup> [B]<sup>2</sup>

1. (5 Pts) The rate law for the reaction  $A + B \rightarrow C + D$  is first order in  $[A]$  and second order in  $[B]$ . If  $[A]$  is tripled and  $[B]$  is doubled, what will be the effect on the rate of the reaction?

rate =  $k[A][B]^2$        $[3]^1 \times [2]^2 = 12$  fold increase

- 2a. (5 Pts) The table presents data for the reaction:  $2H_2(g) + 2NO(g) \xrightarrow{k_1} 2H_2O(g) + N_2(g)$

Exp.	Initial Concentration (mol·L <sup>-1</sup> ) [NO]	Initial Concentration (mol·L <sup>-1</sup> ) [H <sub>2</sub> ]	Initial Rate M/s
I	6.0 x 10 <sup>-3</sup>	1.0 x 10 <sup>-3</sup>	18
II	6.0 x 10 <sup>-3</sup>	2.0 x 10 <sup>-3</sup>	36
III	1.0 x 10 <sup>-3</sup>	6.0 x 10 <sup>-3</sup>	3
IV	2.0 x 10 <sup>-3</sup>	6.0 x 10 <sup>-3</sup>	12

same as Quiz 1a

The temperature of the reaction is constant. Determine the rate law for the reaction. Show all work.

- 2b. (3 Pts) Determine the numerical value of the rate constant for 2a. and its units.

3. (5 Pts) If rate is measured in (M)/min. What are the correct units for the rate constant in the rate law having:  
 rate =  $k[D][X]^2$ ?

$\frac{M}{min} = k M^3$        $k_{units} = M^{-2} min^{-1}$

4. (3 Pts) Which one of the following is not a valid expression for the of the reaction below?



- a.  $-\frac{\Delta[O_2]}{7\Delta t}$     b.  $-\frac{\Delta[NO_2]}{4\Delta t}$     c.  $\frac{\Delta[H_2O]}{6\Delta t}$     d.  $-\frac{\Delta[NH_3]}{4\Delta t}$     e. rate =  $k[NH_3]^x[O_2]^y$

- 4b. (2 Pts) Explain your answer:

No is not a reactant

5. (2 Pts) The rate expression for a second order reaction is

(A) rate =  $k[A]$

**(C) rate =  $k[A][B]$**

(B) rate =  $k[A]^2[B]$

(D) rate =  $k[A]^2[B]^2$