CHM152 Quiz 1a 25 Pts Spring 2012 Name: Key

******SHOW ALL WORK TO RECEIVE CREDIT*******

1.(4 Pts) Nitrogen monoxide reacts with chlorine at high temperature according to the equation,

same rate

$$2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$$

In a certain reaction mixture the rate of formation of NOCl(*g*) was found to be 4.50×10^{-4} mol L^{-1} s^{-1}. What is the rate of consumption of NO(*g*)?

$$\frac{\Delta[NOCl]}{2\Delta t} = \frac{-\Delta[NO]}{2\Delta t}$$

∴ They would have the same rate.

2.(4 Pts) The reaction, $2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g)$, was found to be first order in each of the two reactants and second order overall. What is the rate law?

$$rate = k[NO]^1[O_2]^1$$

3. For the reaction, $A + 2B \rightarrow C + 2\ D$, the following data were obtained

Experiment	[A]	[B]	Rate (mol L^{-1} s^{-1})
1	0.100	0.200	0.000360
2	0.200	0.200	0.000720
3	0.100	0.400	0.000720

a. (8 Pts) Determine the rate law:

1st general rate law: $rate = k[A]^x[B]^y$

for A: use Exp. $\frac{2}{1}$: $\frac{0.000720}{0.000360} = \frac{k[0.200]^x[0.200]^y}{k[0.100]^x[0.200]^y}$ $2 = 2^x$ $x = 1$

For B: use Exp $\frac{3}{1}$: $\frac{0.00720}{0.00360} = \left(\frac{0.400}{0.200}\right)^y$ $2 = 2^y$ $y = 1$

$$rate = k[A][B]$$

b. (5 Pts) Determine the value of the rate constant

Use data from any experiment: i.e. #1

$0.000360\ M\cdot s^{-1} = k[0.100][0.200]$

$0.018\ M^{-1}\cdot s^{-1} = k$

4. (4 Pts) Nitric oxide reacts with bromine at elevated temperatures according to the equation

$$2\ NO(g) + Br_2(g) \rightarrow 2\ NOBr(g)$$

The experimental rate law is rate = $k[NO][Br_2]$. In a certain reaction mixture the rate of formation of NOBr(*g*) was found to be 4.50×10^{-4} mol L^{-1} s^{-1}. What are the correct units for the rate constant in this case?

$\frac{M}{s} = k\ M\ M$

$k = s^{-1}\cdot M^{-1}$ or $L\cdot mol^{-1}\cdot s^{-1}$

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1.(4 Pts) Nitrogen monoxide reacts with bromine at elevated temperatures according to the equation

$$2\ NO(g) + Br_2(g) \rightarrow 2\ NOBr(g)$$

In a certain reaction mixture the rate of formation of NOBr(*g*) was found to be 4.50×10^{-4} mol L^{-1} s^{-1}. What is the rate of consumption of $Br_2(g)$?

$$-\frac{\Delta[Br_2]}{\Delta t} = \frac{\Delta[NOBr]}{2\Delta t} = \frac{4.50\times10^{-4}}{2} = 2.25\times10^{-4}\ mol\cdot L^{-1}\cdot s^{-1}$$

2.(4 Pts) The reaction, $2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g)$, was found to be first order in each of the two reactants and second order overall. What is the rate law?

$$rate = k[NO]^1[O_2]^1$$

3. For the reaction, $2\ XO + O_2 \rightarrow 2\ XO_2$, data obtained from measurement of the initial rate of reaction at varying concentrations are given below.

Experiment	[XO]	$[O_2]$	Rate (mmol L^{-1} s^{-1})
1	0.010	0.010	2.5
2	0.010	0.020	5.0
3	0.030	0.020	45.0

a. (8 Pts) Determine the rate law:

1st general rate law: $rate = k[XO]^x[O_2]^y$

for [XO] use exp. $\frac{3}{2}$ $\quad \frac{45.0}{5.0} = \frac{k[0.030]^x[0.020]^y}{k[0.010]^x[0.020]^y} \Rightarrow 9 = 3^x$ $\quad x = 2$

for $[O_2]$ use Exp $\frac{2}{1}$ $\quad \frac{5.0}{2.5} = \frac{k[0.010]^x[0.020]^y}{k[0.010]^x[0.010]^y}$ $\quad 2 = 2^y$ $\quad y = 1$

$$rate = k[XO]^2[O_2]^1$$

b. (5Pts) Determine the value of the rate constant and its units.

use data from any experiment: i.e. #1

$$2.5 = k[0.010]^2[0.010] = 2.5\times10^6\ mM^{-2}\cdot s^{-1}$$

4. (4 Pts) Nitric oxide reacts with bromine at elevated temperatures according to the equation

$$2\ NO(g) + Br_2(g) \rightarrow 2\ NOBr(g)$$

The experimental rate law is rate = $k[NO][Br_2]$. In a certain reaction mixture the rate of formation of NOBr(*g*) was found to be 4.50×10^{-4} mol L^{-1} s^{-1}. What are the correct units for the rate constant in this case?

$$rate = k[NO][Br_2]$$

$$\frac{M}{s} = k\ M\ M$$

$$k = s^{-1}\cdot M^{-1}\ \text{or}\ L\cdot mol^{-1}\cdot s^{-1}$$