CHM152 Quiz 1a 25 Pts Spring 2017 Name: Key

Turn off all cell phones. Show all work.

1. (2 Pts) The rate law for the chemical reaction
$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$
has been determined experimentally to be Rate = $k[Br^-][BrO_3^-][H^+]^2$. What is the overall order of the reaction?

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2 The reaction between selenous acid and the iodide ion in acid solution is
. $H_2SeO_3(aq) + 6I^-(aq) + 4H^+(aq) \rightarrow Se(s) + 2I_3^-(aq) + 3H_2O(l)$ rate = $k[H_2SeO_3]^x[H^+]^y[I^-]^z$
The data in the following table were measured at 0°C.

Experiment	$[H_2SeO_3]_0$ (*M*)	$[H^+]_0$ (*M*)	$[I^-]_0$ (*M*)	Initial Rate [mol/(L · s)]
1	1.00×10^{-4}	2.00×10^{-2}	3.00×10^{-2}	5.30×10^{-7}
2	2.00×10^{-4}	2.00×10^{-2}	3.00×10^{-2}	1.06×10^{-6}
3	3.00×10^{-4}	4.00×10^{-2}	3.00×10^{-2}	6.36×10^{-6}
4	3.00×10^{-4}	8.00×10^{-2}	3.00×10^{-2}	2.54×10^{-5}
5	3.00×10^{-4}	8.00×10^{-2}	6.00×10^{-2}	2.04×10^{-4}
6	2.00×10^{-4}	2.00×10^{-2}	6.00×10^{-2}	8.48×10^{-6}

a. (6 Pts) Determine the order for each reactant.

for $[H_2SeO_3]$ use (Exp 2/1): $\frac{rate_2}{rate_1} = \frac{[\ ]_2^x}{[\ ]_1^x}$ or $\frac{1.06\times10^{-6}}{5.30\times10^{-7}} = \left(\frac{2\times10^{-4}}{1\times10^{-4}}\right)^x$

$2 = 2^x$ $x = 1$

for $[H^+]$ use (Exp 4/3): $\frac{rate_4}{rate_3} = \frac{[\ ]^y}{[\ ]}$ or $\frac{2.54\times10^{-5}}{6.36\times10^{-6}} = \left(\frac{8\times10^{-2}}{4\times10^{-2}}\right)^y$

$4 = 2^y$ $y = 2$

for: $[I^-]$ use (Exp 5/4): $\frac{rate_5}{rate_4} = \frac{[\ ]^z}{[\ ]}$ or $\frac{2.04\times10^{-4}}{2.54\times10^{-5}} = \left(\frac{6\times10^{-2}}{3\times10^{-2}}\right)^z$

$8 = 2^z$ $z = 3$

b. (4 Pts) Determine the value of the rate constant and its units.

rate = $k[H_2SeO_3]^1[H^+]^2[I^-]^3$

use ANY data set (i.e. #1) $5.30\times10^{-7} = k[1\times10^{-4}][2\times10^{-2}]^2[3\times10^{-2}]^3$

$k = 4.9\times10^5\ M^{-5}\cdot s^{-1}$

3. (4 Pts) A second-order reaction starts with an initial concentration of 0.100 mol/L of the reactant. If the rate constant is 2.8×10^{-2} L/(mol · s), what is the time required to decrease the initial concentration to 0.050 mol/L?

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$$

$$\frac{1}{0.050} = 2.8\times10^{-2}(t) + \frac{1}{0.100}$$

$$t = 357 \text{ seconds}$$

4. (2 Pts) Which of the following statements is true concerning the reaction given below?

$2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(g)$

A) The reaction is second-order in $H_2S(g)$ and first-order in $O_2(g)$.
B) The reaction is first-order in $H_2S(g)$ and second-order in $O_2(g)$.
C) The rate law is Rate = $k[H_2S]^2[O_2]$.
D) The rate law is Rate = $k[H_2S][O_2]$.
E) The rate law may be determined only by experiment.

5. (4 Pts) The nuclide ^{96}Nb decays by a first-order process with a rate constant of 2.96×10^{-2} h^{-1}. How long will it take for 78.0% of the initial amount of ^{96}Nb to be consumed?

$$\ln [A]_t = -kt + \ln [A]_0$$

$$\ln \frac{[A]_t}{[A]_0} = -kt$$

$$\ln 0.22 = (-2.96\times10^{-2})\, t$$

$$t = 51 \text{ hrs}$$

6. (3 Pts) Nitric oxide reacts with hydrogen at a measurable rate at 1000 K according to the following equation:

$2NO + 2H_2 \rightarrow N_2 + 2H_2O$

The experimental rate law is Rate = $k[NO]^2[H_2]$. If time is measured in minutes and concentration is measured in moles per liter, what are the units for the rate constant?

$$\frac{M}{min} = k\, M^2 M^1$$

$$\frac{M}{min} = k\, M^3$$

$$k_{\text{units}} = M^{-2} \cdot min^{-1} = L^2 \cdot mol^{-2} \cdot min^{-1}$$

CHM152 Quiz 16 25 pts Spring 2011 Name: Key

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1. (4 Pts) A second-order reaction starts with an initial concentration of 0.100 mol/L of the reactant. If the rate constant is 2.6×10^{-2} L/(mol · s), what is the time required to decrease the initial concentration to 0.050 mol/L?

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$$

$$\frac{1}{0.050} = 2.6 \times 10^{-2}\, t + \frac{1}{0.100}$$

$$t = 384 \text{ seconds}$$

2. (4 Pts) The nuclide ^{96}Nb decays by a first-order process with a rate constant of $2.96 \times 10^{-2}\ h^{-1}$. How long will it take for 95.0% of the initial amount of ^{96}Nb to be consumed?

$$\ln [A]_t = -kt + \ln [A]_0$$

$$\ln \frac{[A]_t}{[A]_0} = -kt$$

$$\ln 0.050 = -2.96 \times 10^{-2}\,(t)$$

$t = 101$ hrs

3. The reaction between selenous acid and the iodide ion in acid solution is

$H_2SeO_3(aq) + 6I^-(aq) + 4H^+(aq) \rightarrow Se(s) + 2I_3^-(aq) + 3H_2O(l)$

The data in the following table were measured at 0°C.

Experiment	$[H_2SeO_3]_0$ (M)	$[H^+]_0$ (M)	$[I^-]_0$ (M)	Initial Rate [mol/(L · s)]
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a. (6 Pts) Determine the order for each reactant.

b. (4 Pts) Determine the value of the rate constant and its units.

4. (3 Pts) Nitric oxide reacts with hydrogen at a measurable rate at 1000 K according to the following equation:

$2NO + 2H_2 \rightarrow N_2 + 2H_2O$

The experimental rate law is Rate = $k[NO]^2[H_2]$. If time is measured in minutes and concentration is measured in moles per liter, what are the units for the rate constant?

$k_{units} = M^{-2} \cdot min^{-1} = L^2 \cdot mol^{-2} \cdot min^{-1}$

5. (2 Pts) Which of the following statements is true concerning the reaction given below?

$2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(g)$

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B) The reaction is first-order in $H_2S(g)$ and second-order in $O_2(g)$.
C) The rate law is Rate = $k[H_2S]^2[O_2]$.
D) **The rate law is Rate = $k[H_2S][O_2]$.**
E) **The rate law may be determined only by experiment.**

6. (2 Pts) The rate law for the chemical reaction

$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$

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