CHM152 Quiz #1a 25 Pts Spring 13 Name: Key

Show work where possible

1. (6 Pts) What is the rate law that corresponds to the data shown for the reaction 2A + B → C? (Determine the order with respect to each reactant)

Exp.	Initial [A]	Initial [B]	Initial rate
1	0.015	0.022	0.125
2	0.030	0.044	0.500
3	0.060	0.044	0.500
4	0.060	0.066	1.125

*A —[2 & 3

*A: Since there is no rate change for 2 & 3, the order of A is 0.

B: picking any pair where B changes, i.e. 2 over 1.

$\frac{0.500}{0.125} = \left(\frac{0.044}{0.022}\right)^x$ $4 = 2^x$ $x = 2$

rate = $k[B]^2$

2. (11 Pts) Aspirin, $C_9H_8O_4$, slowly decomposes at room temperature by reacting with water in the atmosphere to produce acetic acid, $HC_2H_3O_2$, and 2-hydroxybenzoic acid, $C_7H_6O_3$ (this is why old bottles of aspirin often smell like vinegar):

$$C_9H_8O_4 + H_2O \rightarrow HC_2H_3O_2 + C_7H_6O_3$$ rate = $k[C_9H_8O_4]^x[H_2O]^y$

Concentration and rate data for this reaction are given below.

Exp	[$C_9H_8O_4$] (M)	[H_2O] (M)	Rate (M/s)
1	0.0100	0.0200	2.4×10^{-13}
2	0.0100	0.0800	9.6×10^{-13}
3	0.0200	0.0200	4.8×10^{-13}

Determine the rate law for this reaction and calculate k (be sure to include the correct units).

for $C_9H_8O_4$ use $\frac{Exp\,3}{Exp\,2}$: $\frac{4.8\times10^{-13}}{2.4\times10^{-13}} = \left(\frac{0.0200}{0.0100}\right)^x$ $x = 1$

For H_2O use $\frac{Exp\,2}{Exp\,1}$: $\frac{9.6\times10^{-13}}{2.4\times10^{-13}} = \left(\frac{0.0800}{0.0200}\right)^y$ $y = 1$

rate = $k[C_9H_8O_4][H_2O]$

$k = \frac{2.4\times10^{-13}}{[0.0100][0.0200]} = 1.2\times10^{-9}\ M^{-1}\cdot s^{-1}$

3 (4 Pts) Given the rate law for a reaction, rate = $k[A][B]^2$, where rate is measured in units of M s^{-1}, what are the units for the rate constant k?

$k = \frac{rate}{[A][B]^2} = \frac{M/s}{M\cdot M^2} = s^{-1}\cdot M^{-2}$

4. (4 Pts) Which one of the following is not a valid expression for the of the reaction below? **Explain your answer**.

$$4NH_3 + 7O_2 \rightarrow 4NO_2 + 6H_2O$$

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 = $k[NH_3]^x[O_2]^y$

NO_2 is a product, should be positive