Name: _____

chm112final2014

THIS RATE CONSTANT IS UNUSUALLY SMALL, WHICH LEADS TO SOME STRANGE ANSWERS

Short Answer

1. For a first-order reaction that has a rate constant of $1.9 \times 10^{-7}\ s^{-1}$;

   a) if the initial concentration of the only reactant is 1.25 M, what is the concentration after 30.0 min min?

   b) How long will it take for the concentration to decrease to 0.75 M?

   c) How long will it take for the reaction to be 90% complete?

A) $\ln\left(\frac{[A]_t}{[A]_0}\right) = -kt$ $\quad -kt = 1.9\times10^{-7}\ s^{-1} \times 1800\ s = 3.4\times10^{-4}$

$e^{-0.00034} \approx 1$

SO 30 MIN IS TOO SHORT FOR ANY REACTION TO HAPPEN

B) $\ln\left(\frac{[A]_t}{[A]_0}\right) = -kt$ $\quad [A]_0 = 1.25\ M$

$\frac{[A]_0}{[A]_t} = \frac{0.75}{1.25} = 0.6$

$\ln 0.6 = -0.51 = -kt$

$t = \frac{-0.51}{-1.9\times10^{-7}} = 2.7\times10^{6}\ SEC$

C $\ln 0.1 = -2.3 = -kt$

$t = \frac{-2.3}{-1.9\times10^{-7}} = 1.2\times10^{7}\ SEC$

2. Two reactants, A and B, are mixed, and the reaction is timed until a color change occurs. The data from three experiments are as follows:

[A]	[B]	time (sec)
0.100	0.140	25
0.050	0.140	50
0.100	0.070	100

What is the order of the reaction with respect to A and B? What is the overall order of the reaction?

3. A coffee machine has become coated with 10.0 g $CaCO_3$. If the machine is washed with 1.00 L of pure water until equilibrium is reached, what fraction of the precipitate is removed? K_{sp} for $CaCO_3$ is 5.05×10^{-9}.

1 L OF SATURATED $CaCO_3$

$K_{sp} = [Ca^{2+}][CO_3^{=}]$

$5.05 \times 10^{-9} = x^2$

$x = 7.1 \times 10^{-5}$ MOLES $CaCO_3$ IN 1 L

1 mol $CaCO_3$ = 100 g $CaCO_3$

7.1×10^{-5} mol $CaCO_3 \times \frac{100\ g\ CaCO_3}{1\ mol\ CaCO_3} =$

7.1×10^{-3} g

"FRACTION"

$\frac{.0071\ g}{10.0\ g} \times 100$

0.07 %

4.

Inhalation of carbon monoxide, CO, is fatal if about 20 % of the lung's hemoglobin output is "tied up" as the complex heme-CO.
The reaction can be expressed as:

$$CO + \text{heme-}O_2 \rightleftharpoons O_2 + \text{heme-CO} \quad Kc = 420$$

If a person is breathing air that is .0085 M O_2 (normal air), what concentration of CO will be fatal? (All species may be considered to be in the same phase)

1) WRITE K
2) POPULATE K EXPRESSION
3) SOLVE FOR [CO]

$$K = \frac{[O_2][\text{HEME-CO}]}{[CO][\text{HEME-}O_2]}$$

$$420 = \frac{0.0085 \times 20}{[CO] \times 80}$$

5.

The rate constants for a reaction were determined at two temperatures.
At 100.0 degrees K the rate constant is $2.0 \times 10^3\ s^{-1}$, and at 500 degrees K the rate constant is $4.0 \times 10^7\ s^{-1}$. Calculate the activation energy for the reaction.

7. 252.0 mL of a 0.980 M solution of a base with K_b 1.48 x 10^{-5} was titrated with 1.55 M HCl. What is the pH after 159.3 mL of acid is added?

$K_a = \frac{[H^+][A^-]}{[HA]}$

VOL x MOL = 0.247 MOL ACID

0.247 MOL BASE

THIS IS EQUIVALENCE

SWITCH TO K_a

$HA \rightleftharpoons H^+ + A^-$

8. What is the pH of a solution of weak acid after 25% titration with strong base?
K_a = 1.81 x 10^{-6}

$pH = pK_a + \log \frac{25}{75}$

9. Calculate the standard free energy change □ G° for this reaction using standard reduction potentials E°.

$F_2(g) + Sn(s) \square 2\,F^-(aq) + Sn^{2+}(aq)$