CH 117 Session 6: Test Review
Feb. 4, 2014

1. Consider the Reaction $2NOBr(g) \rightleftharpoons 2NO(s)+Br_2(g)$. Which way will the equilibrium shift if the volume is decreased by half?

right

b. If ΔH is 40. Which way will the reaction shift if temperature is increased?

right

k_1 T_1 T_2

2. A reaction is 5 times faster at 50 C than at 25 C. Find the Ea of the reaction? Note R is 8.314 J/mol K.

$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

solve for E_a → $\ln\left(\frac{1}{5}\right) = \frac{E_a}{8.314}\left(\frac{1}{273+50} - \frac{1}{25+273}\right)$

$\ln\left(\frac{1}{5}\right) = \frac{E_a}{8.314}(.00309 - .00335)$

$\ln\left(\frac{1}{5}\right) = \frac{E_a}{8.314}(-.000254)$

$\ln\left(\frac{1}{5}\right) = -.0000306\,E_a$

$E_a = 52675.4$

3. Write the overall reaction eq. for the following reaction. Identify the reactants

$Mo(CO)_6 \rightleftharpoons Mo(CO)_5 + CO$ (fast)

$Mo(CO)_5 + P(CH_3)_3 \longrightarrow Mo(CO)_5P(CH_3)_3$ (slow)

$Mo(CO)_6 + P(CH_3)_3 \rightleftharpoons Mo(CO)_5P(CH_3)_3 + CO$

Skip b

b. Write the Rate Law expression for the reaction.

$Rate = k_1[MoCO_6]$ $Rate = k_{-1}[CO][MoCO_5]$

$Rate = k_2[MoCO_5][P(CH_3)_3]$

$\frac{k_1[MoCO_6]}{k_{-1}[CO]} = \frac{k_{-1}[CO][MoCO_5]}{k_{-1}[CO]}$

$Rate = \left[k_2 \frac{k_1[MoCO_6]}{k_{-1}[CO]}\right][P(CH_3)_3]$

c. If ΔH is -60, how would increasing the temperature effect rate? Which direction would the reaction shift at equilibrium?

Increasing temp increases rate

Reaction will shift to the left

[A]

4. 5. The half-life for decomposition of cyclopentene at 825 K is 25s. How long would it take for a sample of cyclopentene to decompose to 4% of the original amount?

$t_{1/2} = \frac{.693}{k}$

$25 = \frac{.693}{k}$

$k = .0277$

this is first order since it has a half-life

$\ln(A) = -kt + \ln(A)_0$

$\ln(4) = -(.0277)(t) + \ln(100)$

$1.386 = -.0277t + 4.603$

$t = 116.2\ s$

5. 3. Use the Data from the table to determine the rate law expression.
$2A + B \rightarrow P$

Experiment	[A]	[B]	Initial Rate (M/s)
1	.4	.2	$2 * 10^{-2}$
2	.4	.4	$2 * 10^{-2}$
3	.6	1.0	$3 * 10^{-2}$
4	.8	.2	$8 * 10^{-2}$

$\left(\frac{.8}{.4}\right)^x = \frac{(8\times10^{-2})}{(2\times10^{-2})}$ $\quad 2^x = 4 \quad x = 2$

$[B] = \left(\frac{.4}{.2}\right)^x = \frac{2\times10^{-2}}{2\times10^{-2}} \quad x = 0$

$Rate = K[A]^2$

b. Using experiment 1, find k.

$2\times10^{-2} = K[.4]^2$

$K = .125\ s^{-1}$

d. Find concentration of A at t=6 if initial concentration of A is 9.

$\frac{1}{A} = kt + \frac{1}{A_0}$

$\frac{1}{A} = .125(6) + \frac{1}{9}$

$A = 1.16\ M$

Skip unless you have graphing calc.

6. Suppose you poured 1 M of SO_2 with 1M of O_2 in a 2L container. What would the equilibrium concentration of all reactant and product be?
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ K_c is $2.8E^{-2}$

1	1	0
$-2x$	$-x$	$+2x$
$1-2x$	$1-x$	$2x$

$\frac{(2x)^2}{(1-2x)^2(1-x)} = 2.8\times10^{-2}$

Solve for x

$x = .092$

$1-2(.092) \quad 1-.092$

$.816 \quad .908 \quad .184$