Name: _____ date: _____ period: _____

65 → 60 pt (5 ec)

Che. 15 & 16 equilibrium test 75 points ap chemistry

Academic Honesty: The answers on this test are my own and I am using only the allowed set of notes as described in the syllabus. I have not discussed the test questions with anyone before or during the test nor have I seen the test questions prior to the exam. If you violate any of the preceding items or do not sign, your semester grade is a F.

Signature: _____

In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) proper number of significant figures in your answer.

1. What is the numeric value of Kc of the reaction:

$N_{2(g)} + 3\ H_{2(g)} \rightleftarrows 2\ NH_{3(g)}$ at 325 K

if the initial partial pressure of N_2, H_2, and NH_3 were 3.0, 4.0, and 1.0 atm, respectively and the equilibrium partial pressure of N_2 is 2.0 atm ? [25 points] 15

i) $N_2 + 3H_2 \rightleftarrows 2NH_3$

	N_2	H_2	NH_3
I	3 atm	4 atm	1 atm
C	-1	-3	+2
E	2 atm	1	3

5pt

5 i) $K_p = \dfrac{P_{NH_3}^2}{P_{N_2} P_{H_2}^3} = \dfrac{3^2}{2 \cdot 1^3} = 4.5$

5 ii) $K_p = K_c (RT)^{\Delta n}$

$4.5 = K_c [0.0821 (325)]^{-2}$

$= K_c (0.0014)$

$K_c = 3.2 \times 10^3$

2. Would increasing the temperature of an aqueous solution of $KClO_3$ increase or decrease its solubility ? basis / rationale ? [10 points]

2 + 2 + 1 + 5 pts

i) $KClO_3(s) \rightarrow KClO_3(aq)$

$\Delta H = \Delta H_f\, KClO_3(aq) - \Delta H_f\, KClO_3(s)$

$= (-349.5 - -391.2)\ kJ > 0$

ii) $q + KClO_3(s) \rightleftharpoons KClO_3(aq)$

consume q

$\uparrow T \rightarrow$ "want" $\downarrow T \rightarrow$ consume $q \rightarrow \uparrow r_f \rightarrow \uparrow [KClO_3(aq)] \rightarrow \uparrow$ solubility

3. What is the pH of 175 mL aqueous solution of 2.0 mM hydrofluoric acid ? [15 points]

5 pts + 2 + 2 + 1 + 2 + 2 + 1

i) $HF \rightleftharpoons H^+ + F^-$

	HF	H^+	F^-
I	2 mM	0	0
C	$-x$	$+x$	$+x$
E	$2\text{ mM} - x$	x	x

ii) $K_a = \dfrac{[H^+][F^-]}{[HF]}$

$6.8 \cdot 10^{-4} = \dfrac{x^2}{0.002 - x} \approx \dfrac{x^2}{0.002}$ b/c $K_a << 1$

$x = \sqrt{0.002\ (6.8 \cdot 10^{-4})}$

$= 0.001167\ M$

iii) $pH = -\log [H^+]$

$= -\log (0.001167)$

$= -\log (1.17 \cdot 10^{-3})$

$= 2.93$

4. What is the pH of mixing 175 mL aqueous solution of 1.0 mM hydrogen chloride and 125 mL aqueous solution of 5.0 mM hydrogen bromide ? [10 points]

3 pt

i) $[H^+] = \frac{n_{H^+}}{V_{total}} = \frac{n_{H^+ from\ HCl} + n_{H^+ from\ HBr}}{V_{total}} = \frac{n_{HCl} + n_{HBr}}{V_{total}}$

2 $= \frac{[HCl]\,V_{HCl} + [HBr]\,V_{HBr}}{V_{HCl} + V_{HBr}} = \frac{1\,mM\,(175\,mL) + 5\,mM\,(125\,mL)}{(175 + 125)\,mL}$

2 $= \frac{175\,mM + 625\,mM}{300} = 2.67\,mM$

2 ii) $pH = -\log[H^+]$

1 $= -\log(2.67 \cdot 10^{-3}) = \boxed{2.57}$

5. Old topic: In regards to the reaction: ____ g $CH_{4(g)}$ + excess $O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$, how many grams of methane would be needed to heat 125 mL of water at 21.0 °C to increase it's temperature to 37.0 °C ? [15 points]

2 pt

2 i) $q = mc\Delta T = mc(T_f - T_i)$

2 $= 125\,g\left(\frac{4.18\,J}{g \cdot °C}\right)(37 - 21)\,°C$

1 $= 8360\,J$ needed to heat 125 mL H_2O

ii) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

2 $\Delta H = [\Delta H_f^\circ\ CO_2 + 2\Delta H_f^\circ\ (H_2O)] - [\Delta H_f\ CH_4 + 2\Delta H_f(O_2)]$

2 $= [-393.5 + 2(-241.8)] - [-74.8 + 0]$

1 $= -802.3\,kJ$

2 iii) $\Delta H \cdot m_{CH_4} = -q$

2 $-802.3\,kJ\ \frac{10^3\,J}{1\,kJ}\ m_{CH_4}\ \frac{mol}{16\,g} = -8360\,J$

$50.144\,m_{CH_4} = 8360$

1 $m_{CH_4} = \boxed{0.17\,g}$