

Name: \_\_\_\_\_

date: \_\_\_\_\_ period: \_\_\_\_\_

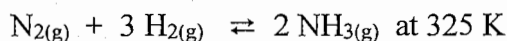
Che. 15 &amp; 16 equilibrium test

65 → 60 pt (5 ec)  
75 points ap chemistry

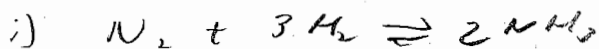
**Academic Honesty:** The answers on this test are my own and I am using only the allowed set of notes as described in the syllabus. I have not discussed the test questions with anyone before or during the test nor have I seen the test questions prior to the exam. If you violate any of the preceding 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  $K_c$  of the reaction:

if the initial partial pressure of  $\text{N}_2$ ,  $\text{H}_2$ , and  $\text{NH}_3$  were 3.0, 4.0, and 1.0 atm, respectively and the equilibrium partial pressure of  $\text{N}_2$  is 2.0 atm? [25 points] 15



I	3 atm	4 atm	1 atm
C	-1	-3	+2
E	2 atm	1	3

$$\text{ii) } K_p = \frac{P_{\text{NH}_3}^2}{P_{\text{N}_2} P_{\text{H}_2}^3} = \frac{3^2}{2 \cdot 1^3} = 4.5$$

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

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

$$= K_c (0.0014)$$

$$K_c = 3.2 \cdot 10^3$$

2. Would increasing the temperature of an aqueous solution of  $\text{KClO}_3$  increase or decrease its solubility? basis / rationale? [10 points]

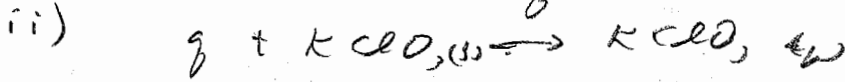
2 pt  
2  
1  
5 pt



$$\Delta H = \Delta H_f \text{KClO}_3(aq) - \Delta H_f \text{KClO}_3(s)$$

$$= (-349.5 - -391.2) \text{ kJ} > 0$$

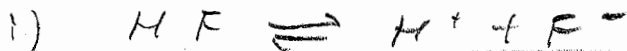
consume  $\delta$



$\uparrow T \rightarrow$  "want"  $\downarrow T \rightarrow$  consume  $\delta \rightarrow \uparrow r_f \rightarrow \uparrow \text{KClO}_3(aq)$   
 $\downarrow$   
 $\uparrow$  solubility

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

5 pt  
2  
2  
1  
2  
2  
1



I	2mM	0	0
C	-x	+x	+x
E	2.0 - x	x	x

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

$$6.8 \cdot 10^{-4} = \frac{x^2}{0.002 - x} \approx \frac{x^2}{0.002} \quad \text{b/c } K_a \ll 1$$

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

$$= 0.00117 \text{ M}$$

iii)  $\text{pH} = -\log [\text{H}^+]$   
 $= -\log (0.00117)$   
 $= -\log (1.17 \cdot 10^{-3})$   
 $= 2.93$

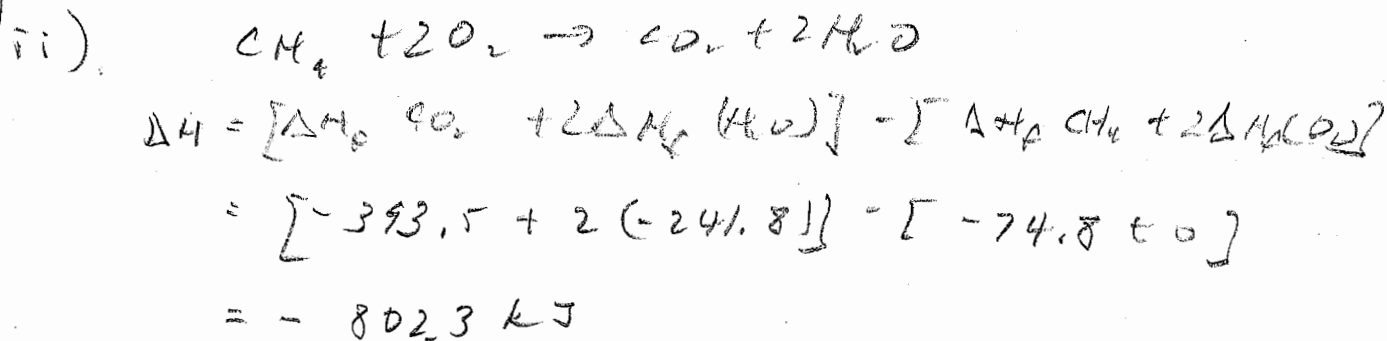
4. What is the pH of mixing 175 mL aqueous solution of 1.0 mM hydrogen chloride and 125 mL aqueous solution of 5.0 mM hydrogen bromide? [10 points]

$$\begin{aligned}
 \text{i) } [H^+] &= \frac{n_{H^+}}{V_{\text{total}}} = \frac{n_{H^+ \text{ from HCl}} + n_{H^+ \text{ from HBr}}}{V_{\text{total}}} = \frac{n_{\text{HCl}} + n_{\text{HBr}}}{V_{\text{total}}} \\
 &= \frac{[HCl] V_{\text{HCl}} + [HBr] V_{\text{HBr}}}{V_{\text{HCl}} + V_{\text{HBr}}} = \frac{1 \text{ mM} (175 \text{ mL}) + 5 \text{ mM} (125 \text{ mL})}{(175 + 125) \text{ mL}} \\
 &= \frac{175 \text{ mM} + 625 \text{ mM}}{300} = 2.67 \text{ mM}
 \end{aligned}$$

$$\begin{aligned}
 \text{ii) } \text{pH} &= -\log [H^+] \\
 &= -\log (2.67 \cdot 10^{-3}) = \boxed{2.57}
 \end{aligned}$$

5. Old topic: In regards to the reaction:  $\underline{\hspace{1cm}}$  g  $\text{CH}_4(\text{g}) + \text{excess O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$ , how many grams of methane would be needed to heat 125 mL of water at 21.0 °C to increase its temperature to 37.0 °C? [15 points]

$$\begin{aligned}
 \text{i) } q &= m c \Delta T = m c (T_f - T_i) \\
 &= 125 \text{ g} \left( \frac{4.18 \text{ J}}{\text{g} \cdot ^\circ\text{C}} \right) (37 - 21) ^\circ\text{C} \\
 &= 8360 \text{ J needed to heat 125 mL H}_2\text{O.} \dots
 \end{aligned}$$



$$\begin{aligned}
 \text{iii) } \Delta H - m_{\text{CH}_4} &= -q_{\text{needed}} \\
 -802.3 \text{ kJ} \frac{10^3 \text{ J}}{\text{kJ}} m_{\text{CH}_4} \frac{\text{mol}}{16 \text{ g}} &= -8360 \text{ J}
 \end{aligned}$$

$$5.0144 m_{\text{CH}_4} = 8360$$

$$m_{\text{CH}_4} = \boxed{0.17 \text{ g}}$$