Name: _____ date: _____ period: _____

Ch. 18 & 19 equilibrium & acid / base / pH **test** 65 points (2 ec) honors chemistry

For problems, involving calculations, show your work in an organized manner, show formula / equation used, include the appropriate units and conversion factor(s) in your work / answer.

1. Write the algebraic expression of the equilibrium constant, Kc and Kp, for the following chemical reactions; if it does not exist, then clearly state it. [10 points]

a. $3N_{2(g)} + 3H_{2(g)} \rightleftarrows 2\,NH_{3(g)}$

$K_c = \dfrac{[NH_3]^2}{[N_2]^1[H_2]^3}$; $K_p = \dfrac{P_{NH_3}^2}{P_{N_2}^1 P_{H_2}^3}$

2 + 2 pts

b. $3\,Ca(NO_3)_{2(aq)} + 2Na_3PO_{4(aq)} \rightleftarrows Ca_3(PO_4)_{2(s)} + 6NaNO_{3(aq)}$

$K_c = \dfrac{[NaNO_3]^6}{[Ca(NO_3)_2]^3[Na_3PO_4]^2}$; no k_p

2 pts

c. $2\,C_2H_{6(g)} + 7O_{2(g)} \rightleftarrows 4CO_{2(g)} + 6H_2O_{(l)}$

$K_c = \dfrac{[CO_2]^4}{[C_2H_6]^2[O_2]^7}$; $K_p = \dfrac{P_{CO_2}^4}{P_{C_2H_6}^2 P_{O_2}^7}$

2 + 2 pts

2. Based on the below table, what is the numeric value of the equilibrium constant, Kc, for the reaction: $3N_{2(g)} + 3H_{2(g)} \rightleftarrows 2\,NH_{3(g)}$ [10 points]

	N_2 (M)	H_2 (M)	NH_3 (M)
[initial]	5.0	3.0	2.0
[change]	−0.5	−1.5	+1
[equilibrium]	4.5	1.5	3

5 pts

$K_c = \dfrac{[NH_3]^2}{[N_2]^1[H_2]^3} = \dfrac{3^2}{(4.5)^1(1.5)^3} = 0.59$

$K_c = \dfrac{5^2}{0.5^1(1.5)^3} = 133$ 1.8

2 2 1 pt

3. In the reaction: $Br_{2(g)} + H_{2(g)} \rightleftarrows 2\,HBr_{(g)}$; Kc = 10; what is the equilibrium concentration of HBr by mixing 3.0 M Br_2 and 4.0 M H_2. [15 points]

5 pts

i) $Br_2 + H_2 \rightleftharpoons 2HBr$

	Br_2	H_2	HBr
I	3	4	0
Δ	$-x$	$-x$	$+2x$
E	$3-x$	$4-x$	$2x$

5

ii) $K_c = \dfrac{[HBr]^2}{[Br_2][H_2]}$

$10 = \dfrac{(2x)^2}{(3-x)(4-x)}$

$x = 9.58;\ 2.09$

5

iii) $[HBr] = 2x = 2(2.09) = 4.18\ M$

not 9.58 b/c [reactants] < 0

4. Fill-in the below table; need not show your work. [12 points]

2 pts ea

pH	$[H^+]$ (M)	$[OH^-]$ (M)
6.5	$10^{-6.5} = 3.16 \cdot 10^{-7}$	$3.16 \cdot 10^{-8}$
4.70	$2.0 * 10^{-5}$	$5.0 \cdot 10^{-10}$
10.70	$2.0 \cdot 10^{-11}$	$5.0 * 10^{-4}$

5. What is the pH of a 2.0 mM aqueous solution of methylamine. [20 points]

i) $CH_3NH_2 + H_2O \rightleftharpoons OH^- + CH_3NH_3^+$

I	2mM		0	0
C	$-x$		$+x$	$+x$
E	$0.002-x$		x	x

ii) $K_b = \dfrac{[OH^-][CH_3NH_3^+]}{[CH_3NH_2]}$

$$4.4\cdot10^{-4} = \frac{x^2}{0.002-x}$$

$$x = -0.0012 \; ; \; 0.00074$$

5 pts @

iii) $[OH^-][H^+] = 10^{-14}$

$$(0.00074)[H^+] = 10^{-14}$$

$$[H^+] = 1.34\cdot10^{-11}$$

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

$$= -\log(1.34\cdot10^{-11})$$

$$= 10.87$$