Chemistry 116 - Fall 2021

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Discussion Worksheet - Week 11

1. For the following changes predict the effect upon the equilibrium (shift to right, shift to left, or no change) and $P_{N_2O_4}$ (increase, decrease, or no change) for the endothermic reaction:

$N_2O_4(g)$ <=> $2\ NO_2(g)$	effect on equilibrium	effect on $P_{N_2O_4}$
addition of $N_2O_4(g)$ at constant T, V		
addition of $NO_2(g)$ at constant T, V		
removal of $N_2O_4(g)$ at constant T, V		
removal of $NO_2(g)$ at constant T, V		
addition of $He(g)$ at constant T, V		
increase vessel volume at constant T		
decrease vessel volume at constant T		
increase temperature at constant P		
decrease temperature at constant P		

2. From the Brønsted-Lowry point of view write a balanced equation for

a) addition of a solution of hydrochloric acid to water. Clearly identify each acid and its conjugate base and each base and its conjugate acid.

b) Do the same as in part a) for the addition of liquid ammonia to water.

c) How do you explain the behavior of water in parts a) and b)?

d) Identify the stronger acid and the stronger base in part a) and in part b).

3. For each of the following give the chemical formula for

a) the conjugate acid

OH^-	H_2O
CO_3^{2-}	O^{2-}
NH_3	HSO_4^-

b) the conjugate base

NH_3	H_2
H_2O	HI
HSO_4^-	NH_4^+

4. Fill in the following table using significant figures. Circle those values which are only valid at 25°C.

$[H_3O^+]$	pH	$[OH^-]$	pOH
1.40×10^{-3}			
6.1			
		3.55×10^{-2}	
		5.0	
			5.06
			13.00
	-1.225		
	15.3		

5. Fill in the following table including the formula of the missing respective conjugate acid or base.

acid	base	K_a	K_b
$HClO_2$		0.011	
	CH_3NH_2		4.39×10^{-4}
	NaOH		
HN_3		1.9×10^{-5}	
	H_2O		

at 25°C, $K_w = 1.01 \times 10^{-14}$

$pH = -\log_{10}[H_3O^+]$ $\quad$ $pOH = -\log_{10}[OH^-]$

$[H_3O^+] = 10^{-pH}$ $\quad$ $[OH^-] = 10^{-pOH}$

6. What is the sum of pH and pOH at body temperature (98.6°F = 37.0°C) if $K_w = 2.4 \times 10^{-14}$ at 37°C? [13.62]

7. The oxide ion, O^{2-}, is a very strong base in aqueous solution. Use Brønsted-Lowry theory to explain this including an equation and Lewis structures.

8. For the reaction $HF(aq) + CN^-(aq) <=> HCN(aq) + F^-(aq)$

   a) Identify each acid and its conjugate base and each base and its conjugate acid (Brønsted-Lowry).

   b) Which two acids are competing to give up their proton?

   c) Which two bases are competing for the proton?

   d) Write the equilibrium constant expression for the reaction.

   e) If $K_a(HF) = 6.6 \times 10^{-4}$ and $K_a(HCN) = 6.2 \times 10^{-10}$ what is K for the reaction? $[1.1 \times 10^6]$

   f) Identify the stronger acid and stronger base in part a).

9. If $K_a(CH_3COOH) = 1.8 \times 10^{-5}$ and $K_a(HClO) = 3.5 \times 10^{-8}$, which is the stronger base, CH_3COO^- or ClO^-?

10. Determine the pH and percent dissociation of a 0.20 M solution of iodic acid. $K_a(HIO_3) = 0.16$. [0.94]

11. If the pH of a solution of a weak acid ($K_a = 1.8 \times 10^{-5}$) is 3.30 what is its molarity? [0.014 M]

12. If a 0.450 M solution of a weak acid has a pH of 2.584 what is its K_a? $[1.52 \times 10^{-5}]$