PSC 1222 — Basic Chemistry for Laboratory Practice 2009/10
Home Assignment

Pleas write the answers in a separate sheets of paper.

1. At 400°C, a student starts with pure HI at a concentration of 0.22 M. Some of the HI decomposes and at equilibrium the concentration of HI is found to be 0.020 M.
   (i) What is $[I_2]$?
   (ii) What is [HI]?
   (iii) What is the value of the equilibrium constant at 400°C?
   (iv) What will happen if some I_2 is withdrawn from the system?
   (v) What will happen if some I_2 is added to the system?

2. (i) Write expressions for K_c for the following system.

   $SO_3(g)$ $SO_2(g) + 1/2O_2(g)$

   (ii) Write the corresponding balanced chemical equation for the expression for K_c.

$$K_c = \frac{[NH_3]^4 \times [O_2]^5}{[NO]^4 \times [H_2O]^6}$$

3. The concentration a NaOH solution is 0.020 M.
   (i) What is the concentration of H^+ ions?
   (ii) What is the pH of the solution?
   (iii) A 25.0 mL of this solution was titrated with H_2SO_4 and the end point reading was 20.00 mL. What is the concentration of H_2SO_4?

4. Arrange the following compounds each having a concentration of 0.2 M in the order of decreasing pH. Explain your answer.
   H_2SO_4, HNO_3, KOH, CH_3COOH, $Ca(OH)_2$

5. (i) Give the oxidation number of chlorine in,
   (a) Cl_2 (b) HCl (c) ClO_3^- (d) ClO_4^-
   (ii) Balance the following redox equations for reactions in the acidic medium.
   (a) $Cu\,(s) + NO_3^-\,(aq) \rightarrow Cu^{2+}\,(aq) + NO_2\,(g)$
   (b) $Cr_2O_7^{2-}\,(aq) + C_2H_4(g) \rightarrow Cr^{3+}\,(aq) + CO_2(g)$
   (iii) Identify the species that is oxidised and reduced of each equation.
   (iv) Identify the oxidizing and the reducing agent in each equation.

THE OPEN UNIVERSITY OF SRI LANKA

Certificate course for Laboratory Technology 2009/2010

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Answer guide for Home assignment

1.

	$2\,HI \rightleftharpoons$	H_2 +	I_2
Stoicheometry	2	1	1
Initial concentration	0.22 M	-	-
Equilibrium concentration		0.020 M	

(i) $[H_2] = [I_2] = 0.020$ M

(ii) No of moles of HI required to give 1 mol of H_2 = 2 moles

" " " " " 0.02 mol of H_2 = 2 X 0.02 mol

= 0.04 mol

" " " HI remained in equilibrium = 0.22-0.04 mol

= 0.18 mol

Concentration of HI = 0.18 M

(iii) $K_c = \dfrac{[H_2]\,[I_2]}{[HI]}$

$= (0.02\ M \times 0.02\ M) / 0.18\ M$

$= 0.01\ M$

(iv) More and more HI will be decomposed. As a result [HI] will reduced and $[H_2]$ will be increased.

(v) More and more HI will be formed with the reaction of I_2. As a result [HI] will be increased and $[H_2]$ will be reduced.

2. (i) $2SO_3 \rightarrow 2SO_2 + O_2$

$Kc = \dfrac{[SO_2]^2[O_2]}{[SO_3]^2}$

(ii) $4\,NO + 6H_2O \quad 4NH_3 + 5O_2$

3. (i) $NaOH \rightarrow Na^+ + OH^-$

0.02 0.02 0.02

$K_w = [H^+]\,[OH^-]$

$10^{-14} = [H^+]\ 0.02$

$[H^+] = 0.5 \times 10^{-12}$ M

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

$pH = -\log (0.5 \times 10^{-12})$

$pH = 12.3010$

(iii) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

2 1

No of moles of NaOH in 25 ml = (0.02/1000) x 25 mol

,, ,, ,, H_2SO_4 required = (1/2) x (0.02/1000) x 25 mol

= 0.25 /1000

Concentration of H_2SO_4 = (0.25/1000) x (1000/20)

= 0.0125 M

4. H_2SO_4 and HNO_3 are strong acids. One mole of H_2SO_4 gives 2 moles of H^+ while HNO_3 gives only one mole of H^+. Therefore, H_2SO_4 is more acidic than HNO_3.

Acetic acid (CH_3COOH) is a weak acid so less acidic.

pH = -log $[H^+]$. Therefore, pH decreases when $[H^+]$ increases.

KOH and $Ca(OH)_2$ are strongly basic. One mole of $Ca(OH)_2$ gives 2 moles of OH^- while KOH gives only one mole of OH^-. Therefore, $Ca(OH)_2$ is basic than KOH.

pOH = - log $[OH^-]$. Therefore, higher the amount of OH^-, lower the pOH value.

pH = 14 – pOH. Therefore, pH increases with decreasing pOH.

The order of decreasing pH is,

$Ca(OH)_2$, KOH, CH_3COOH, HNO_3, H_2SO_4

5. i) a) 0 b) -1 c) +5 d) +7

ii) $2NO_3^- + 4H^+ + Cu \longrightarrow Cu^{2+} + 2NO_2 + 2H_2O$

$16\,H^+ + 2Cr_2O_7^{2-} + C_2H_4 \longrightarrow 4Cr^{3+} + 2CO_2 + 10H_2O$

iii) oxidized species a) Cu b) C_2H_4

Reduced species a) NO_3^- b) $Cr_2O_7^{2-}$

iv) Oxidizing agent a) NO_3^- b) $Cr_2O_7^{2-}$

reducing agent a) Cu b) C_2H_4