Eq Asmt

[44 marks]

42/44

Communication [3 marks] 3

1. The equilibrium constant for the reaction,

$$H_2(g) + I_2(g) \leftrightarrow 2HI(g)$$

varies with temperature in the following way: K_c=794 at 298 K and K_c=54 at 700 K. Is the formation of HI favoured more at the higher or lower temperature? Explain. [3 marks]

3 It is favoured at a lower temp. because Kc is larger Kc(794) at a lower temp (298 K.) And the ratio of products to reactants → $K_c = \frac{[P]}{[R]}$ is larger at a lower temp.

Making Connections [8 marks] 7

2. Will lithium carbonate form an acidic, basic or neutral solution? Show your work. [3 marks]

$Li_2(CO_3)_{(aq)} \rightarrow 2Li^+_{(aq)} + CO_3^{2-}{}_{(aq)}$ (strong)

① $Li^+_{(aq)} + H_2O_{(l)} \leftarrow LiOH_{(aq)} + H^+_{(aq)}$ ∴ No hydrolysis (weak)

② $CO_3^{2-}{}_{(aq)} + H_2O_{(l)} \rightleftharpoons HCO_3^-{}_{(aq)} + OH^-_{(aq)}$ ∴ hydrolysis occurs

2 3

∴ Li_2CO_3 will make a basic solution

3. For the reaction, $PBr_5(g) \leftrightarrow PBr_3(g) + Br_2(g)$, in what direction will the equilibrium shift when the following actions are taken on the system at equilibrium? [5 marks]

(a) $PBr_3(g)$ is added ←

(b) the temperature is decreased ←

(c) the volume of the reaction system is increased →

(d) a catalyst is added —

(e) $PBr_5(g)$ is removed ←

5

Inquiry [19 marks] 19

4. Calculate the pH of a buffer that is 0.25 M in lactic acid, $HC_3H_5O_3$ (K_a=1.4 × 10^{-4}) and 0.10 M in sodium lactate, $NaC_3H_5O_3$. [3 marks]

pH = ?

$K_a = 1.4 \times 10^{-4}$

$pH = pKa + \log\left[\frac{[NaC_3H_5O_3]}{[HC_3H_5O_3]}\right]$

$pH = 3.85 + \log\left(\frac{0.10\,M}{0.25\,M}\right)$

$pH = 3.46$

$pKa = -\log Ka$

$= -\log(1.4 \times 10^{-4})$

$= 3.85$

3

∴ pH would be 3.46

5. Calculate the pH of a 0.015 M solution of acetic acid. [8 marks]

pH = ?

Ac = 0.015 M

$HC_2H_3O_{2(aq)} \rightleftharpoons H^+_{(aq)} + C_2H_3O_{2(aq)}$

0.015 M	0	0
$-x$	$+x$	$+x$
$0.015+X$	X	X
	↳ 5.2×10^{-4} M	

$K_a = 1.8\times10^{-5}$

$$K_a = \frac{[H^+][C_2H_3O_2]}{[HC_2H_3O_2]}$$

$$1.8\times10^{-5} = \frac{x^2}{0.015+x}$$

$2.7\times10^{-7} = x^2$

$5.2\times10^{-4}\ M = x$

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

$pH = -\log(5.2\times10^{-4})$

$\boxed{pH = 3.28}$

∴ pH would be 3,28

6. A 0.125 M solution of an unknown acid has a pH of 5.34. What is the K_a of the acid? [8 marks]

$HX_{(aq)} \rightleftharpoons H^+_{(aq)} + X^-_{(aq)}$

0.125 M	0	0
$-x$	$+x$	$+x$
$0.125-x$	x	x
↳ 0.125 M	↳ 4.57×10^{-6} M	↳ 4.57×10^{-6} M

$K_a = ?$

$pH = 5.34$

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

$5.34 = -\log[H^+]$

$4.57\times10^{-6} = [H^+]$

∴ Ka would be 1.67×10^{-10}

$$K_a = \frac{[H^+][X^-]}{[HX]}$$

$$= \frac{(4.57\times10^{-6})^2}{(0.125)}$$

$$= 1.67\times10^{-10}$$

wledge & Understanding [14 marks] 13

Show the neutralization reaction between sulfurous acid and aluminum hydroxide. [4 marks]

4 $3H_2(SO_3)_{(aq)} + 2Al(OH)_{3\,(aq)} \longrightarrow 6H(OH)_{(l)} + 1Al_2(SO_3)_{3\,(aq)}$

8. Show the dissociation of barium chlorate in water. [2 marks]

2 $Ba(ClO_3)_{2\,(aq)} \longrightarrow Ba^{2+}_{(aq)} + 2ClO_3^-{}_{(aq)}$

9. Calculate the molar solubility of zinc cyanide, at 25°C, in the presence of 0.010 M potassium cyanide. The K_{sp} for zinc cyanide at 25°C is 8.0×10^{-12}. [8 marks]

$K_{sp} = 8.0 \times 10^{-12}$

$Zn(CN)_{2(s)} \longrightarrow Zn^{2+}_{(aq)} + 2CN^-_{(aq)}$

I	——	0	0.010
C	——	x	$2x$
E	——	x	$0.010 + 2x$

$K_{sp} = [CN^-]^2[Zn]$

$8.0 \times 10^{-12} = (0.010 + 2x)^2(x)$

$8.0 \times 10^{-12} = 0.0001x$

7 $8.0 \times 10^{-8}\ M = x$

∴ the molar solubility of zinc cyanide is $8.0 \times 10^{-8}\ M$