2002학년도 2학기 화학과 기말고사 풀이. ①

530만점

1. (30)

(a)

(15) $K_{sp} = [Mn^{2+}][OH^-]^2$

$[Mn^{2+}] = \frac{K_{sp}}{[OH^-]^2} > 10^{-5}\ M$

$\therefore \frac{K_{sp}}{10^{-5}} > [OH^-]^2$

$\therefore \log \frac{K_{sp}}{10^{-5}} > 2\log[OH^-]$

$-\log \frac{K_{sp}}{10^{-5}} < 2pOH$

$\therefore pOH > -\frac{1}{2}\log\frac{K_{sp}}{10^{-5}} = -\frac{1}{2}\log\frac{2.0\times10^{-13}}{10^{-5}} = 3.8$ (3.849)

$pOH = 14 - pH$

$\therefore pH < 14 - 3.8 = 10.2$

$K_{sp} = [Mn^{2+}][OH^-]^2$

$[OH^-] < \left(\frac{K_{sp}}{[Mn^{2+}]}\right)^{1/2} = \left(\frac{2.0\times10^{-13}}{10^{-5}}\right)^{1/2} = 1.4\times10^{-4}(M)$

$\boxed{pH < 10.2}$

(b)

(15)

$Mn(OH)_2 \rightleftharpoons Mn^{2+} + 2OH^-$ ← 0.01M NaOH

처음 x M 0 M 0.01 M

평형 ∴ 0 M x M (0.01+2x) M ← $Mn(OH)_2$가 다 녹을 때

$\therefore K_{sp} = [Mn^{2+}][OH^-]^2$

$= x(0.01+2x)^2 \overset{\approx 0}{=} 2.0\times10^{-13}$ 5

$\therefore x = \frac{2.0\times10^{-13}}{(0.01)^2} = 2.0\times10^{-9}$

$\therefore Mn(OH)_2$는 최대 $\underline{2.0\times10^{-9}\ M}$ 녹는다. 8 5

$Mn(OH)_2$의 분자량 $= 54.9 + (16.0+1.0)\times2 = 88.9\ (g/mol)$

$\therefore 2.0\times10^{-9}\ mol/L \times 2L \times 88.9\ g/mol = 3.6\times10^{-7}\ g$

$\therefore Mn(OH)_2$는 최대 $\boxed{3.6\times10^{-7}\ g}$ 녹는다. 5

2. ⑤

$$[Ag(NH_3)_2]^+ \rightleftharpoons Ag^+ + 2NH_3$$

처음	0.10 M	0	0
평형	(0.10 − x) M	x M	2x M

$$K_d = \frac{[Ag^+][NH_3]^2}{[[Ag(NH_3)_2]^+]} = \frac{x \cdot (2x)^2}{0.10 - x \approx 0.10} = 6.3 \times 10^{-8}$$

$$\therefore 4x^3 = 6.3 \times 10^{-9}$$

$$\therefore x = 1.2 \times 10^{-3}$$

$$\therefore [[Ag(NH_3)_2]^+] = 0.10 - 1.2 \times 10^{-3} \ (M)$$

$$= 0.10\ M$$

$$[Ag^+] = 1.2 \times 10^{-3}\ M$$

$$[NH_3] = 2x\ M = 2.4 \times 10^{-3}\ M$$

3. ④

(a) ⑤ $Cu^{2+} + 2e^- \rightarrow Cu$

(b) ⑤ $Zn \rightarrow Zn^{2+} + 2e^-$

(c) ⑤ (a)+(b) ⇒ $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$

(d) ⑤ $E^\circ = 0.34\,V - (-0.76\,V) = 1.10\,V$

(e) ⑤ 2

(f) ⑤ b

(g) ⑩ $E = E^\circ - \frac{RT}{nF} \ln Q \left(= E^\circ - \frac{2.303RT}{nF} \log Q = E^\circ - \frac{0.0592}{n} \log Q\right)$

$$= E^\circ - \frac{0.0592}{2} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$= 1.10 - \frac{0.0592}{2} \log \frac{0.5}{0.3}\ (V) = 1.08\,V$$

4 (25)

(a) (5) α

(b) (5) 1.10 V

(c) (15)

· 흘려준 전하량

$$10A \times 10min = 10\,C/s \times 600s = 6000C$$

· 흐른 전자의 양

$$\frac{6000\,C}{9648\,C/mol\,e^-} = 1.22 \times 10^{-2}\ mol\ e^-$$

· 2 mol의 전자가 흐를 때 1 mol의 Cu가 석출되고 1 mol의 Zn가 석출

∴ 석출된 Cu의 양 $= \frac{6.22 \times 10^{-2}\ mol}{2} \times 63.5\,g/mol$

$= 1.97\,g$

석출된 Zn의 양 $= \frac{6.22 \times 10^{-2}\ mol}{2} \times 65.4\,g/mol$

$= 2.03\,g$

∴ Cu 전극의 질량 $= 25g - 1.97g = \boxed{23.03g}$

Zn 전극의 질량 $= 25g + 2.03g = \boxed{27.03g}$

5. (10) $Cu^{2+} + Zn \longrightarrow Cu + Zn^{2+}$

$E = E^\circ - \frac{RT}{nF} \ln Q$

평형상수 ← 평형일 때 $E = 0$, $Q = K$

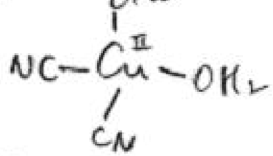
$\therefore E^\circ = \frac{RT}{nF} \ln K \left(= \frac{2.303RT}{nF} \log K = \frac{0.0592}{n} \log K \right)$

$\therefore K = e^{nFE^\circ/RT} \left(= 10^{nFE^\circ/2.303RT} = 10^{nE^\circ/0.0592} \right)$

$= \boxed{1.45 \times 10^{37}}$

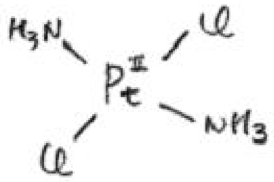
6. ㉕ (a) ⑤ tetracarbonylnickel (II)

(b) ⑤

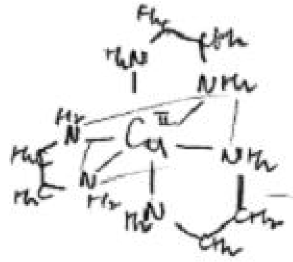


$[Cu(II)(CN)_2(H_2O)_2]$

(c) ⑤



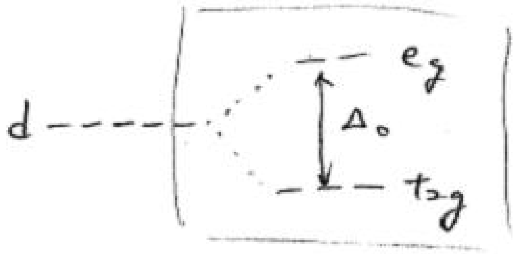
(d) ⑤



(e) ⑤ 광학이성질체 존재 (d)가 맞아야 점수 인정

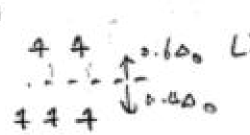
7. 34 (a) ⑤ $[Ar]\ 3d^5$ (또는 $[Ar]4s^0 3d^5$ 또는 5)

(b) 8



(c) ⑤ $[Fe(CN)_6]^{3-}$

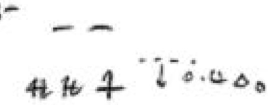
(d) 8 $[Fe(H_2O)_6]^{3+}$



$LFSE = 0.4\times3 - 0.6\times2\ (\Delta_o)$

$= \boxed{0}$

(e) 8 $[Fe(CN)_6]^{3-}$



$LFSE = 0.4\times5(\Delta_o)$

$= \boxed{2.0\ \Delta_o}$

(또는 $-2.0\Delta_o$ 또는 -2, 2)

8. (20)

(a) (5) V^{2+} (d^3) weak field t_{2g}^3

(b) (5) Mn^{4+} (d^3) strong field t_{2g}^5

(c) (5) Mn^{2+} (d^5) weak field $t_{2g}^3 e_g^2$

(d) (5) Ni^{2+} (d^8) weak field $t_{2g}^6 e_g^2$

9. (25)

(a) (5) propane

(b) (5) $CH_3CH_2CH_2CH(CH_3)CH_3$

(c) (5) meta-Xylene

(d) (5) $CH_3CH(OH)CH_3$

(e) (5) propyne

10. (15)

(a) (5) aldehyde

(b) (5) amide

(c) (5) ester