

① حد استحياء السحابة الأولى في مضامنا

التوازنات المتعددة في المحاليل ماسرسة

⑥ حد الترتيب الأول : في أحد محاليل متساوية تركيز $p_{\text{act}} + p_{\text{act}} = 0$

$$V_T = \sum n_i \bar{V}_i$$

$$\sum n_i d\bar{V}_i = 0$$

$$\Rightarrow \Delta G = RT [x_1 \ln x_1 + x_2 \ln x_2]$$

$$0 < x_1 < 1$$

$$0 < x_2 < 1$$

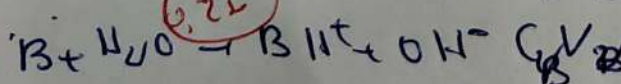
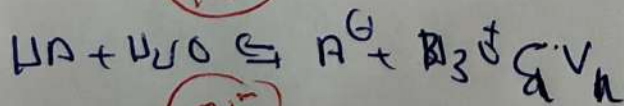
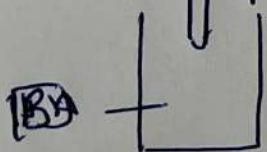
$$\ln x_1 < 0, \ln x_2 < 0$$

$$RT > 0, x_1 > 0, x_2 > 0$$

$$\Delta G < 0 \Rightarrow \text{الترتيب تلقائي}$$

③ حد الترتيب الثاني

تقامر اساسا صفة B بواسطة صفا قوي HA



بصفة عامة كبرية المعايير

$$K_a [C_a] = \frac{C_a V_a}{V_a + V_B} \quad (0.25)$$

$$K_b [C_B] = \frac{C_B V_B}{V_a + V_B} \quad (0.25)$$

$$V(p, T, n_i) \quad \bar{V} \text{ حالة } V$$

$$dV_T = \left(\frac{\partial V}{\partial p} \right)_{T, n_i} dp + \left(\frac{\partial V}{\partial T} \right)_{p, n_i} dT + \left(\frac{\partial V}{\partial n_i} \right)_{p, T, n_j} dn_i$$

$$p, T, t = \text{const}$$

$$dV_T = \left(\frac{\partial V_i}{\partial n_i} \right)_{p, T, n_j} dn_i = 0$$

$$\frac{\partial V_i}{\partial n_i} = \bar{V}_i$$

$$dV_T = \sum \bar{V}_i dn_i = 0 \quad (1)$$

$$V_T = \sum n_i \bar{V}_i \Rightarrow$$

$$dV_T = \sum n_i d\bar{V}_i + \sum \bar{V}_i dn_i \quad (2)$$

مع المعادلتين (1) و (2)

$$\Rightarrow \sum n_i d\bar{V}_i = 0$$

$$n_1 d\bar{V}_1 + n_2 d\bar{V}_2 + \dots + n_i d\bar{V}_i = 0$$

$$\Delta G = RT [n_1 \ln x_1 + n_2 \ln x_2] \quad (3)$$

$$n_1 + n_2 = 1$$

$$\Rightarrow \Delta G = RT \left[\frac{n_1}{n_1 + n_2} \right] \ln x_1 + \left[\frac{n_2}{n_1 + n_2} \right] \ln x_2$$

$$pH = pK_a + \lg \frac{C_b V_b - C_a V_a}{C_a V_a}$$

$$C_a V_{eq} = C_b V_b \Rightarrow$$

$$C_a = C_b = 10^{-2} \Rightarrow [V_{eq} = V_b]$$

$$pH = pK_a + \lg \frac{C_a [V_{eq} - V_a]}{C_a V_a}$$

$$pH = pK_a + \lg \frac{V_{eq} - V_a}{V_a} \quad (1)$$

$$V_a = V_{eq} / 4 \Rightarrow$$

$$pH = pK_a + \lg \left(\frac{V_{eq} - V_{eq}/4}{V_{eq}/4} \right)$$

$$pH = pK_a + \lg 3 = 9 + \lg 3$$

$$pH = 9.48 \quad (0.8)$$

$$V = V_a / 2 \Rightarrow$$

$$pH = pK_a + \lg \frac{V_{eq} - V_{eq}/2}{V_{eq}/2} = pK_a + \lg 1 = pK_a = 9$$

$$pH = 9 \quad (0.8)$$

$$\text{قبل نقطة } V_a = V_{eq} \quad (8)$$

$$pH = \frac{1}{2} [pK_a - \lg \frac{C_b V_b}{V_a + V_b}]$$

$$= \frac{1}{2} [pK_a - \lg \frac{C_b V_b}{2 V_{eq}}] \quad (1)$$

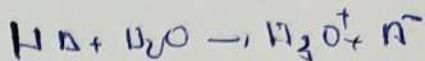
$$pH = \frac{1}{2} [9 - \lg \frac{10^{-2}}{2}]$$

$$pH = \frac{1}{2} [9 + 2 + 0.30] = \frac{11.3}{2}$$

$$pH = 5.65 \quad (0.8)$$

(2)

$$pH = 7 \quad \text{في نقطة } (1)$$

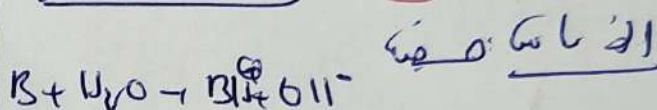


$$[H_2O] = C_a \quad [H^+] = [OH^-] = [H_3O^+] = C_a$$

$$pH = -\lg [H_3O^+] = -\lg C_a$$

$$\Rightarrow C_a = 10^{-pH} = 10^{-7} M$$

$$C_a = 10^{-7} M \quad (0.8)$$



$$K_a = \frac{[H_3O^+][B]}{[BH^+]} = \frac{C_b [H_3O^+]}{K_e / [H_3O^+]}$$

$$[H_3O^+] = \sqrt{\frac{K_e K_a}{C_b}} \quad (1)$$

$$pH = 7 + \frac{1}{2} [pK_a + \lg C_b]$$

$$C_b = 10^{-2} \quad pH = 10.5$$

$$2 [pH - 7] = pK_a + \lg C_b \Rightarrow$$

$$pH K_a = 2 [pH - 7] - \lg C_b = 2 [10.5 - 7] - \lg 10^{-2}$$

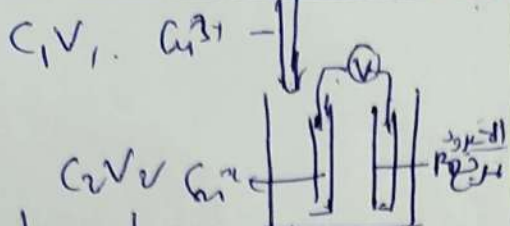
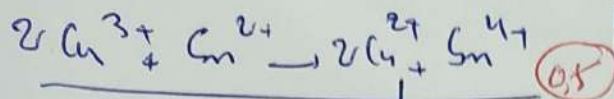
$$pK_a = 9$$

$$\text{في نقطة } V_a = \frac{V_{eq}}{4} \quad (1)$$

$$\text{قبل نقطة التوازن} \quad \frac{C_a V_a}{C_a V_a + C_b V_b} =$$

$$pH = pK_a + \lg \frac{[B]}{[BH^+]}$$

$$[BH^+] = \frac{C_a V_a}{V_a + V_b} \quad [B] = \frac{C_b V_b - C_a V_a}{V_a + V_b}$$



	2Cu^{3+}	Cu^{2+}	Cu^{2+}	Cu^{4+}
$t=0$	$C_1 V_1$	$C_2 V_2$	0	0
t	$\frac{C_1 V_1}{2}$	$C_1 V_1$	$\frac{1}{2} C_1 V_1$	
t_{eq}	$\frac{C_1 V_1}{2}$	$C_1 V_{eq}$	$\frac{1}{2} C_1 V_{eq}$	
المعادلة	$C_1 V_1$	$\frac{C_1 V_1}{2}$	$C_1 V_{eq}$	$\frac{1}{2} C_1 V_{eq}$

① قبل التفاعل

$$E_1 = E_2 = E^0 + \frac{0.06}{2} \lg \frac{[\text{Cu}^{4+}]}{[\text{Cu}^{2+}]}$$

$$C_1 V_1 = 2 C_2 V_2 \quad \text{نسبة التفاعل}$$

$$= \left(V_{eq} = \frac{2 C_2 V_2}{C_1} \right)$$

$$E = E_1 = E^0 + \frac{0.06}{2} \lg \frac{C_2 V_2 - \frac{1}{2} C_1 V_1}{\frac{1}{2} C_1 V_1}$$

$$E = E_2 = E^0 + \frac{0.06}{2} \lg \frac{\frac{1}{2} C_1 V_1}{C_2 V_2 - \frac{1}{2} C_1 V_1}$$

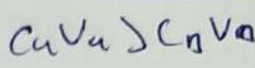
$$= E^0 + \frac{0.06}{2} \lg \frac{\frac{1}{2} C_1 V_1}{\frac{1}{2} C_1 V_{eq} - \frac{1}{2} C_1 V_1} \quad (1)$$

$$E = E^0 + 0.03 \lg \frac{V_1}{V_{eq} - V_1} = [E_2] = E$$

$$V_1 = \frac{V_{eq}}{4} \Rightarrow E = E_1 = E^0 + 0.03 \lg \frac{V_{eq}}{V_{eq} - \frac{V_{eq}}{4}}$$

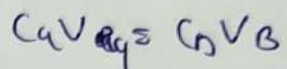
$$(0.5) = 0.15 + 0.03 \lg \frac{1}{3}$$

③ بعد التفاعل



(المعادلة) (المعادلة) (المعادلة)

$$\text{pH} = -\lg \left[\frac{C_1 V_1 - C_2 V_2}{V_1 + V_2} \right]$$



$$C_1 = C_2 \Rightarrow V_{eq} = V_2$$

$$\text{pH} = -\lg \left[\frac{C_1 V_1 - C_2 V_{eq}}{V_1 + V_{eq}} \right]$$

$$V_1 = V_{eq} =$$

$$\text{pH} = -\lg \left[\frac{2 C_1 V_{eq} - C_2 V_{eq}}{2 V_{eq} + V_{eq}} \right]$$

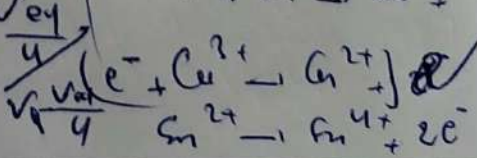
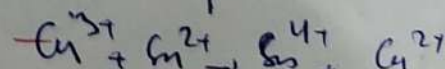
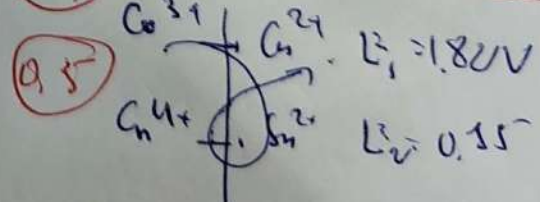
$$\text{pH} = -\lg \left[\frac{C_1 V_{eq}}{3 V_{eq}} \right] = -\lg \frac{C_1}{3}$$

$$= -\lg \frac{10^{-3}}{3} = 2 + 0.48 = 2.48$$

$$\boxed{\text{pH} = 2.48} \quad (0.5)$$

pH	9.48	9	5.56	2.48
V_1	$\frac{V_{eq}}{4}$	$\frac{V_{eq}}{2}$	V_{eq}	$2 V_{eq}$

⑦ جدول التغيرات



(4)

$$V_1 = 2V_{eq}$$

$$E = E_1 = E_1^0 + 0.06 \lg \frac{2V_{eq} - V_{eq}}{V_{eq}}$$

$$E = E_1^0 = 1.8 \text{ V}$$

(0.5)

$$E = E_1 = 0.18 - 0.48 \times 0.03$$

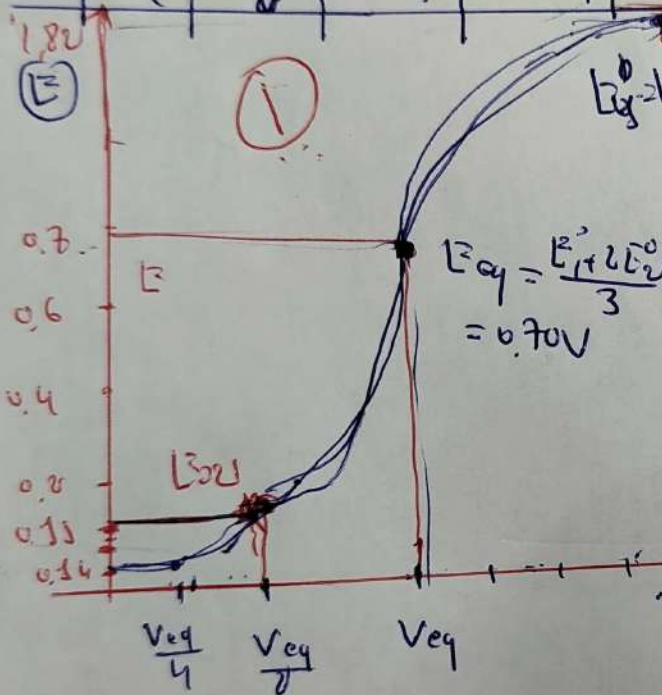
$$E = E_2 = 0.136 \text{ V}$$

$$V_1 = \frac{V_{eq}}{2}$$

$$E = E_2 = E_2^0 + 0.06 \lg \frac{V_{eq}/2 - V_{eq}}{V_{eq} - V_{eq}/2}$$

$$E = E_2^0 = 0.15 \text{ V}$$

E (V)	0.136	0.15	0.70	1.82
V_1	$\frac{V_{eq}}{4}$	$\frac{V_{eq}}{2}$	V_{eq}	$2V_{eq}$



$$E_{eq} = \frac{E_1^0 + 2E_2^0}{3} = 0.70 \text{ V}$$

(1) = عند التوازن

$$E_{eq} = E_1 = E_2 = E_1^0 + 0.06 \lg \frac{[G^4]}{[S^2]}$$

$$= E_2^0 + 0.06 \lg \frac{[G^3]}{[G^+]}$$

$$2E_{eq} = 2E_2^0 + 0.06 \lg \frac{[G^4]}{[S^2]}$$

$$2E_{eq} + E_{eq} = 2E_2^0 + E_1^0 + 0.06 \lg \frac{[G^4]}{[G^+][S^2]}$$

(5)

$$3E_{eq} = E_1^0 + 2E_2^0 =$$

$$E_{eq} = \frac{E_1^0 + 2E_2^0}{3} = \frac{1.82 + 2 \times 0.15}{3}$$

$$E_{eq} = 0.70 \text{ V}$$

في حالة

$$E_{eq} = E_1^0 + 0.06 \lg \frac{[G^3]}{[G^+]}$$

$$= E_1^0 + 0.06 \lg \frac{C_1 V_{eq} C_1 V_{eq}}{C_1 V_{eq}}$$

$$= E_1^0 + 0.06 \lg \left(\frac{V_1 - V_{eq}}{V_{eq}} \right)$$

(1)