

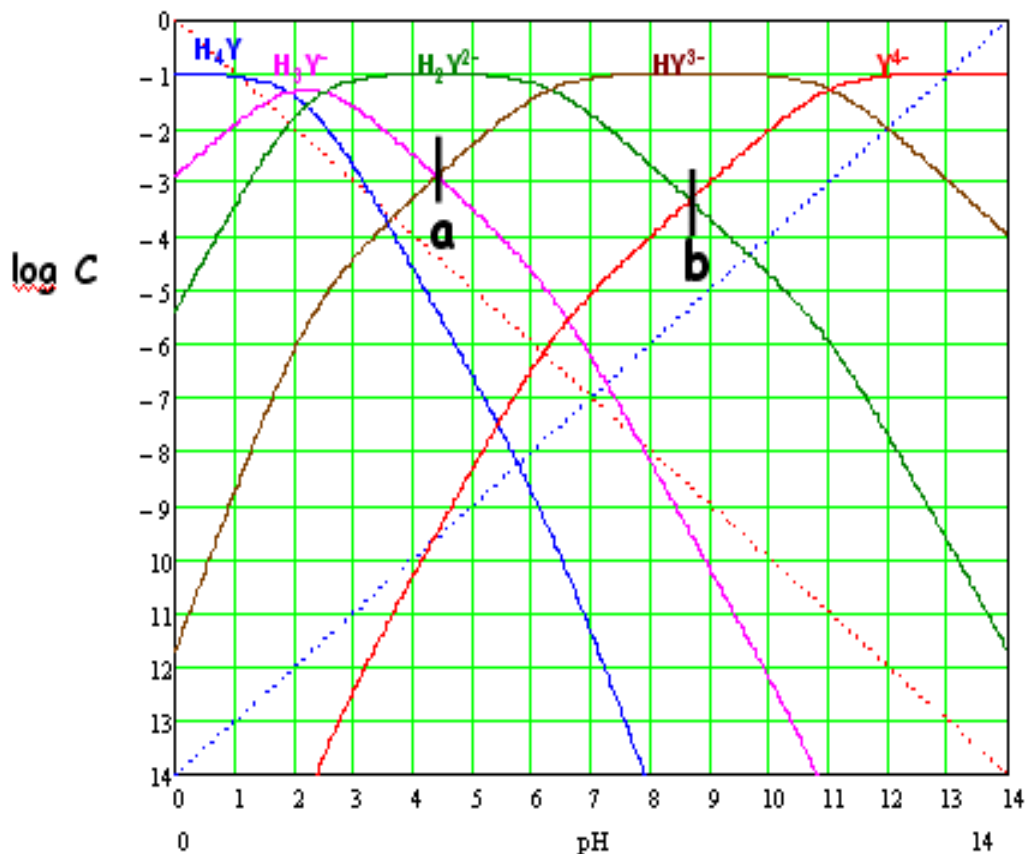


Problemas resueltos



18. $\text{Na}_2\text{H}_2\text{Y}$ 0.1 y Na_3HY 0.1 M

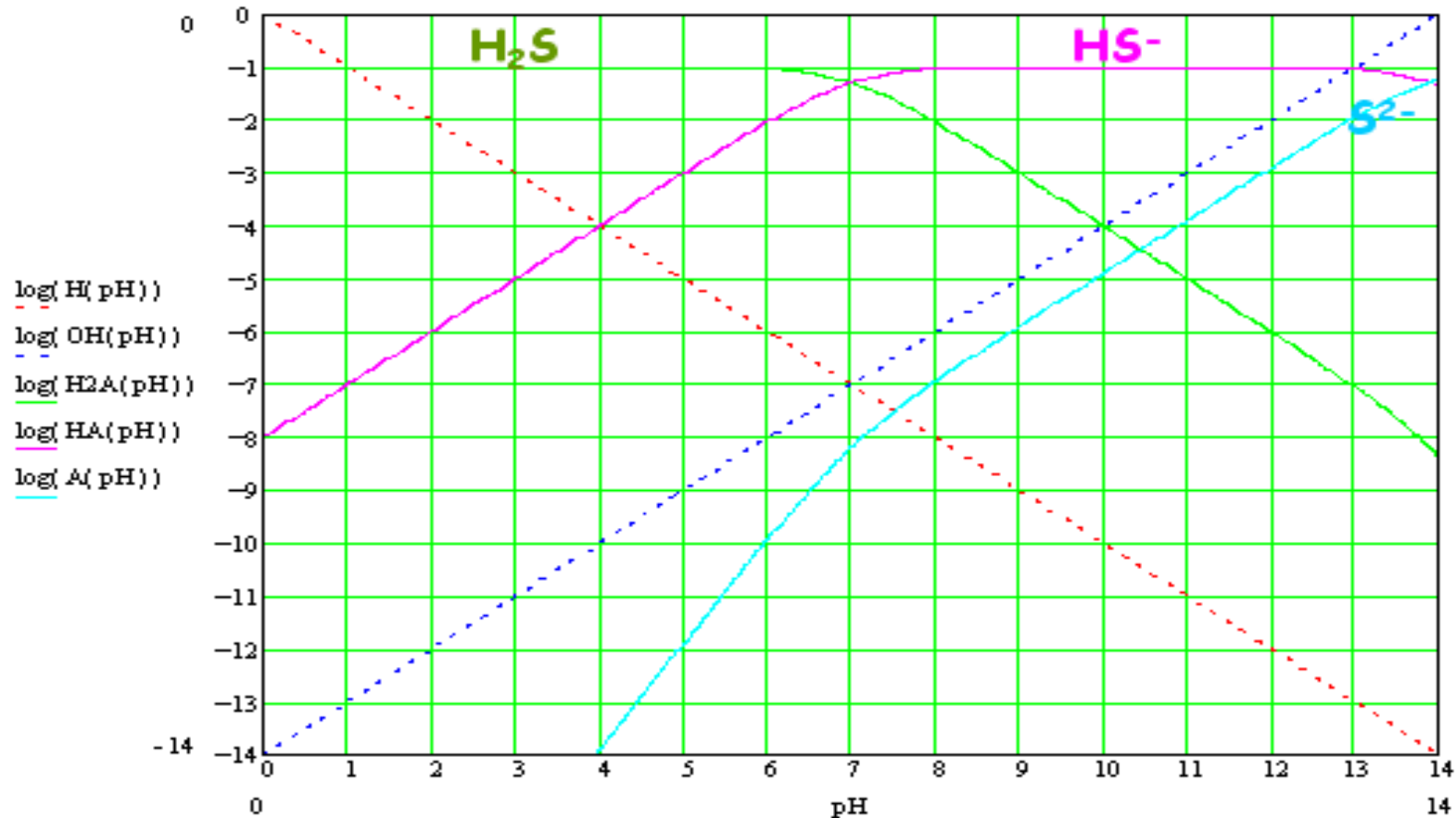
a) $[\text{H}^+] + [\text{H}_3\text{Y}^-] + 2[\text{H}_4\text{Y}] = [\text{OH}^-] + [\text{HY}^{3-}] + 2[\text{Y}^{4-}]$; $[\text{H}_3\text{Y}^-] = [\text{HY}^{3-}] = 10^{-2.9}$; $\text{pH} = 4.4$



b) $[\text{H}^+] + [\text{H}_2\text{Y}^{2-}] + 2[\text{H}_3\text{Y}^-] + 3[\text{H}_4\text{Y}] = [\text{OH}^-] + [\text{Y}^{4-}]$; $[\text{H}_2\text{Y}^{2-}] = [\text{Y}^{4-}] = 10^{-3.5}$; $\text{pH} = 8.65$



19. a) NaHS 0.1 M



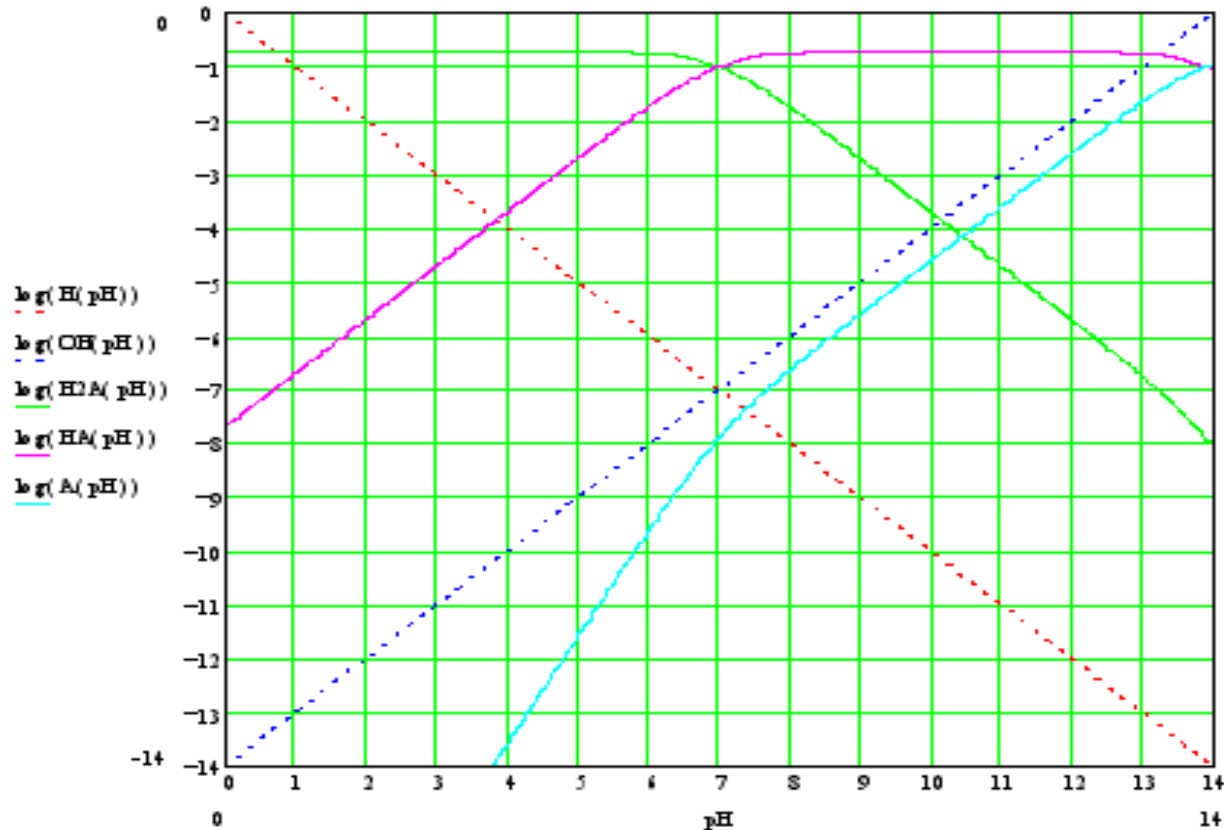
$$[\text{OH}^-] + [\text{S}_2^-] = [\text{H}^+] + [\text{H}_2\text{S}] \quad \Rightarrow \quad \text{pH} = 10$$

$$\text{pH} := 9.974$$

$$\text{root}(\text{OH}(\text{pH}) + \text{A}(\text{pH}) - \text{H}(\text{pH}) - \text{H2A}(\text{pH}), \text{pH}) = 9.974$$



19. b) $\text{NaHS } 0.1 \text{ M} + \text{H}_2\text{S } 0.1 \text{ M}$



$$C_a + C_b = 0.2 = [\text{H}_2\text{S}] + [\text{HS}^-] + [\text{S}^{2-}]$$

$$\text{Na}^+ = 0.1 = \frac{1}{2} (C_a + C_b); [\text{Na}^+] + [\text{H}^+] = [\text{OH}^-] + [\text{HS}^-] + 2[\text{S}^{2-}]$$

$$[\text{H}_2\text{S}] + 2[\text{H}^+] = 2[\text{OH}^-] + [\text{HS}^-] + 3[\text{S}^{2-}]$$

$$[\text{H}_2\text{S}] = [\text{HS}^-] \Rightarrow \text{pH} = 7$$

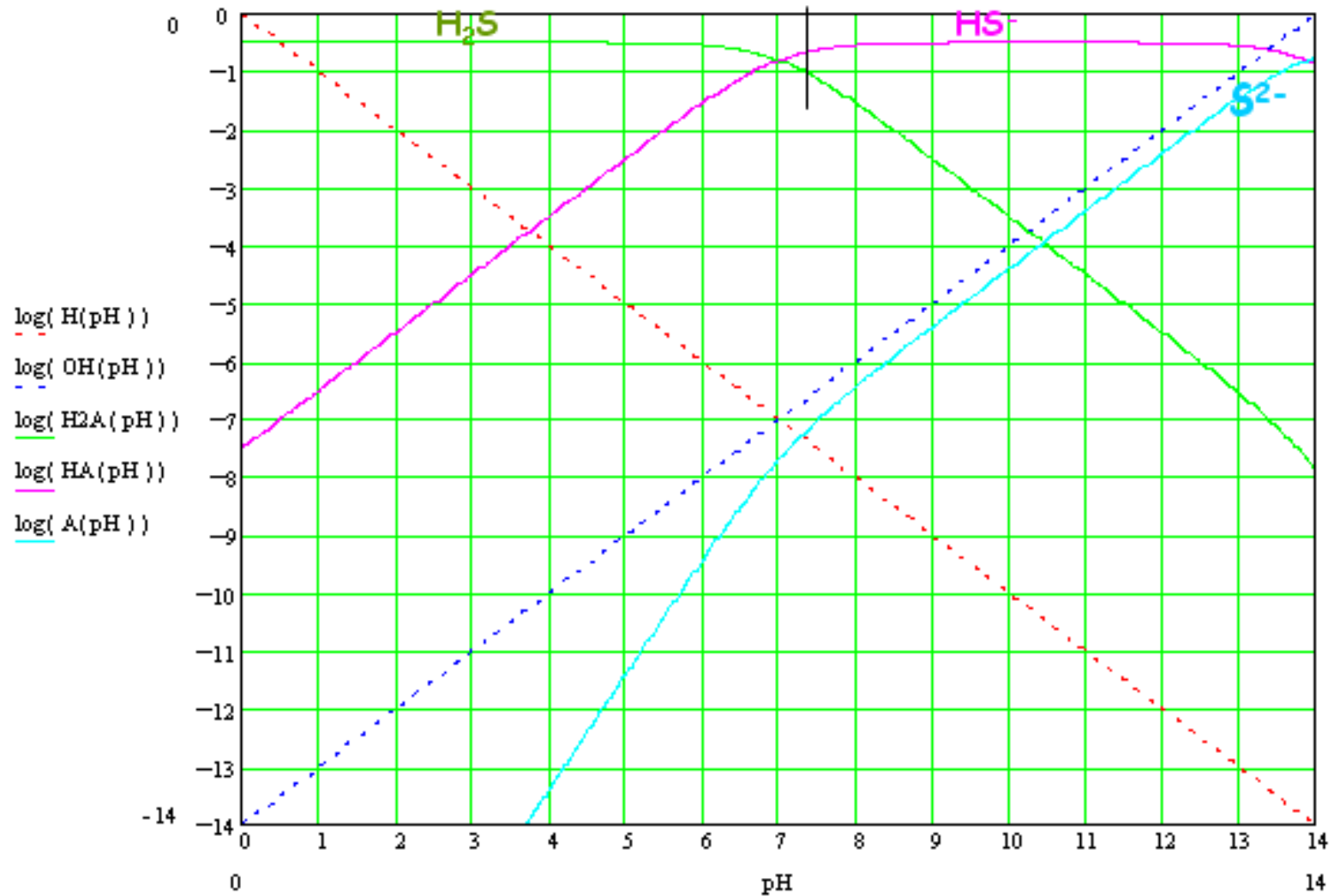


21. H_2S 0.1 M + NaHS 0.2 M

- $C_a = \text{H}_2\text{S}$ 0.1 M; NaHS 0.2 M $\rightarrow \text{Na}^+(0.2) + \text{HS}^-(0.2)$ (C_b)
- $C_a + C_b = 0.3 = [\text{H}_2\text{S}] + [\text{HS}^-] + [\text{S}^{2-}]$
- $[\text{Na}^+] = 0.2 \text{ M}$
- $[\text{Na}^+] = 2/3 \{[\text{H}_2\text{S}] + [\text{HS}^-] + [\text{S}^{2-}]\}$
- $[\text{Na}^+] + [\text{H}^+] = [\text{OH}^-] + [\text{HS}^-] + 2 [\text{S}^{2-}]$
- $2 [\text{H}_2\text{S}] + 2 [\text{HS}^-] + 2 [\text{S}^{2-}] + 3 [\text{H}^+] = 3 [\text{OH}^-] + 3 [\text{HS}^-] + 6 [\text{S}^{2-}]$
 - $2 [\text{H}_2\text{S}] + 3 [\text{H}^+] = 3 [\text{OH}^-] + [\text{HS}^-] + 4 [\text{S}^{2-}]$
 - $2 [\text{H}_2\text{S}] = [\text{HS}^-]$
- (ver gráfico en pag. siguiente)
- $[\text{H}^+] = K_1 C_a/C_b = 10^{-7} (0.1/0.2); \quad \text{pH} = 7.3$

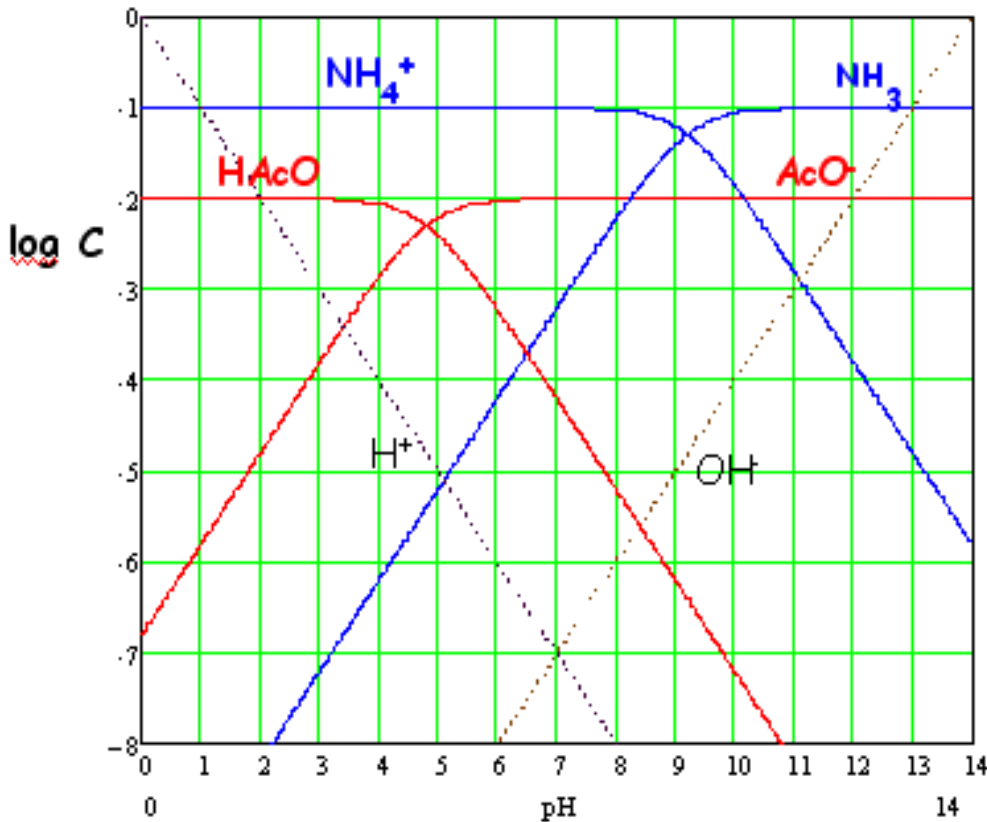


21. H_2S 0.1 M + NaHS 0.2 M





22. HAc 0.01 M + NH_4Cl 0.1 M



$$[\text{H}^+] = [\text{Ac}^-] + [\text{NH}_3] + [\text{OH}^-]$$

$$[\text{Ac}^-] = [\text{H}^+] = 10^{-3.4}$$

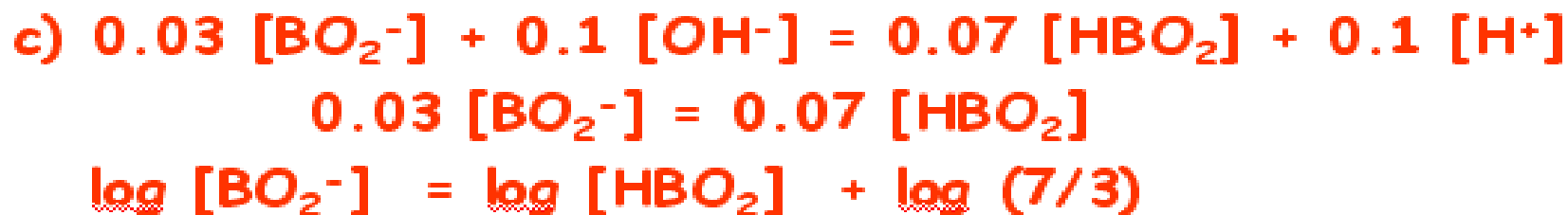
$$\text{pH} = 3.4 \quad [\text{HAc}] = 10^{-2}$$

$$[\text{NH}_4^+] = 10^{-1}$$

$$[\text{NH}_3] = 10^{-6.8}$$



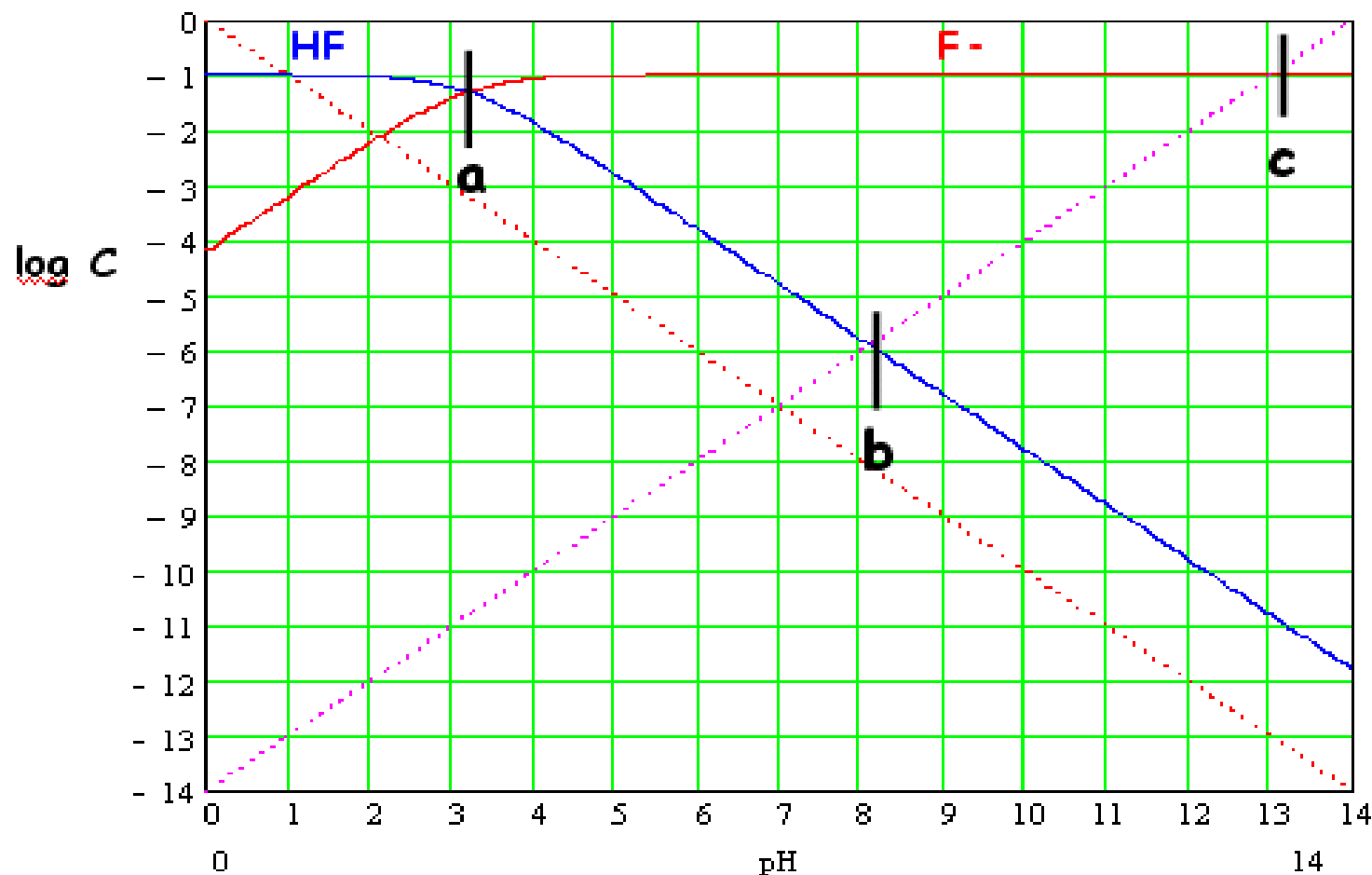
a) HCl 0.2 M + NaBO_2 0.1 M
b) HCl 0.1 M + NaBO_2 0.1 M
c) HCl 0.03 M + NaBO_2 0.1 M





24.

- a) HF 0.1 M + NaOH 0.05 M
- b) HF 0.1 M + NaOH 0.1 M
- c) HF 0.1 M + NaOH 0.3 M



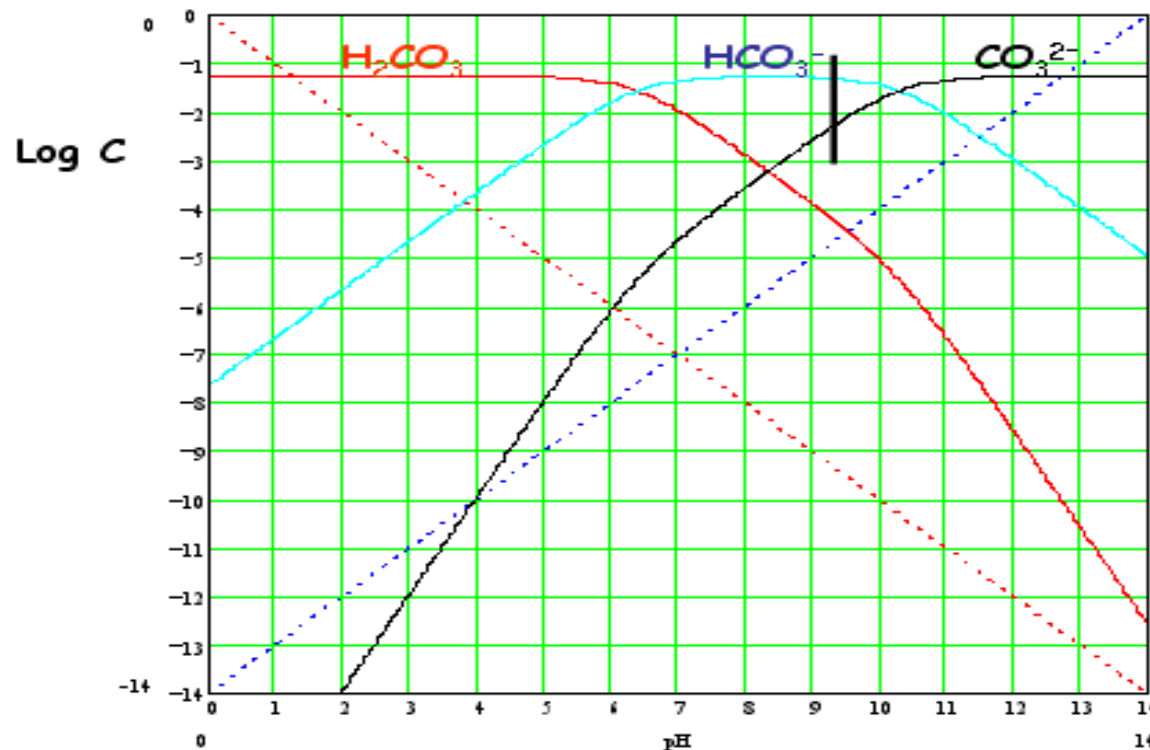
a) $[HF] = [F^-] = 5 \cdot 10^{-2}$



27. 50 mL NaHCO_3 0.1 M + 50 mL Na_2CO_3 0.01 M

$$C_a + C_b = 0.055 = [\text{H}_2\text{CO}_3] + [\text{HCO}_3^-] + [\text{CO}_3^{2-}]; \quad [\text{Na}^+] = 0.06$$

$$[\text{Na}^+] + [\text{H}^+] = [\text{OH}^-] + [\text{HCO}_3^-] + 2[\text{CO}_3^{2-}]$$



$$[\text{H}^+] = K_2 \frac{(C_a)(C_b)}{C_b} = 10^{-10.3} (0.05/0.005)$$

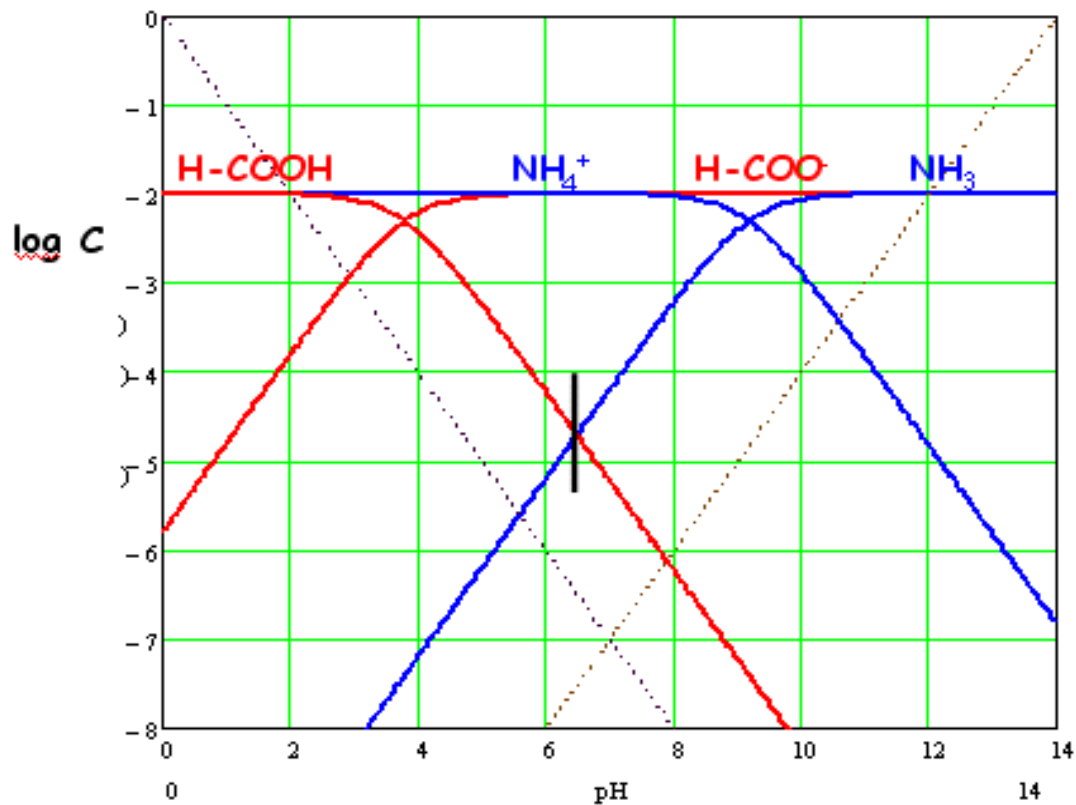
$$\text{pH} = 9.3$$

$$5.5[\text{H}^+] + 6[\text{H}_2\text{CO}_3] + 0.5[\text{HCO}_3^-] = 5.5[\text{OH}^-] + 5[\text{CO}_3^{2-}]$$

$$0.5[\text{HCO}_3^-] = 5[\text{CO}_3^{2-}]; \quad \log [\text{HCO}_3^-] = \log [\text{CO}_3^{2-}] + 1$$



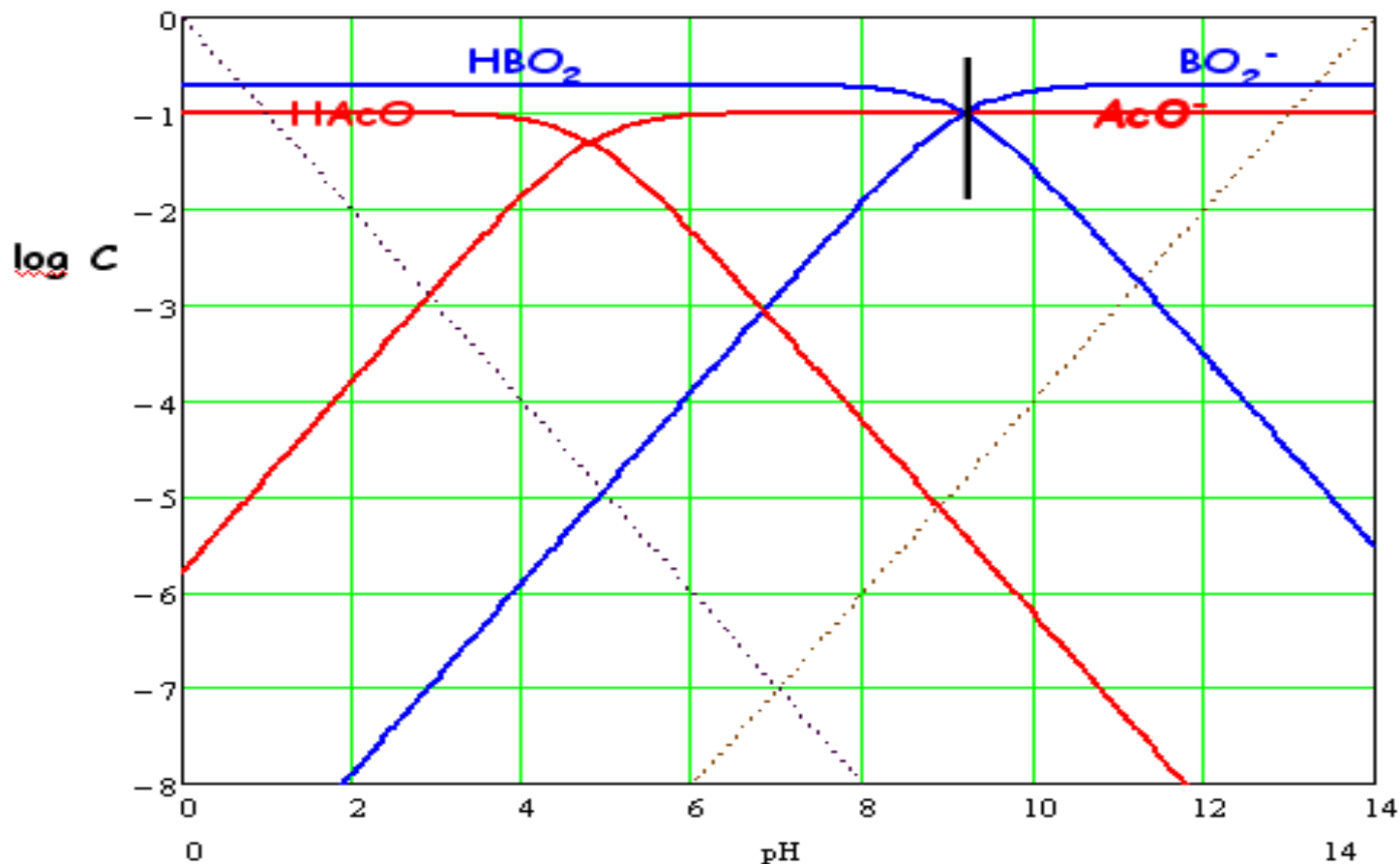
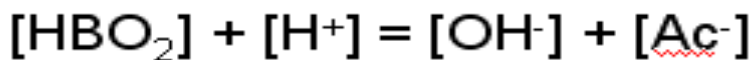
28.a). $\text{NH}_4\text{Cl } 10^{-2} \text{ M} + \text{H-COONa } 10^{-2} \text{ M}$



$\text{pH} = 6.5; [\text{H-COOH}] = [\text{NH}_3] = 10^{-4.7} \text{ M}; [\text{H-COO}^-] = [\text{NH}_4^+] = 10^{-2} \text{ M}$



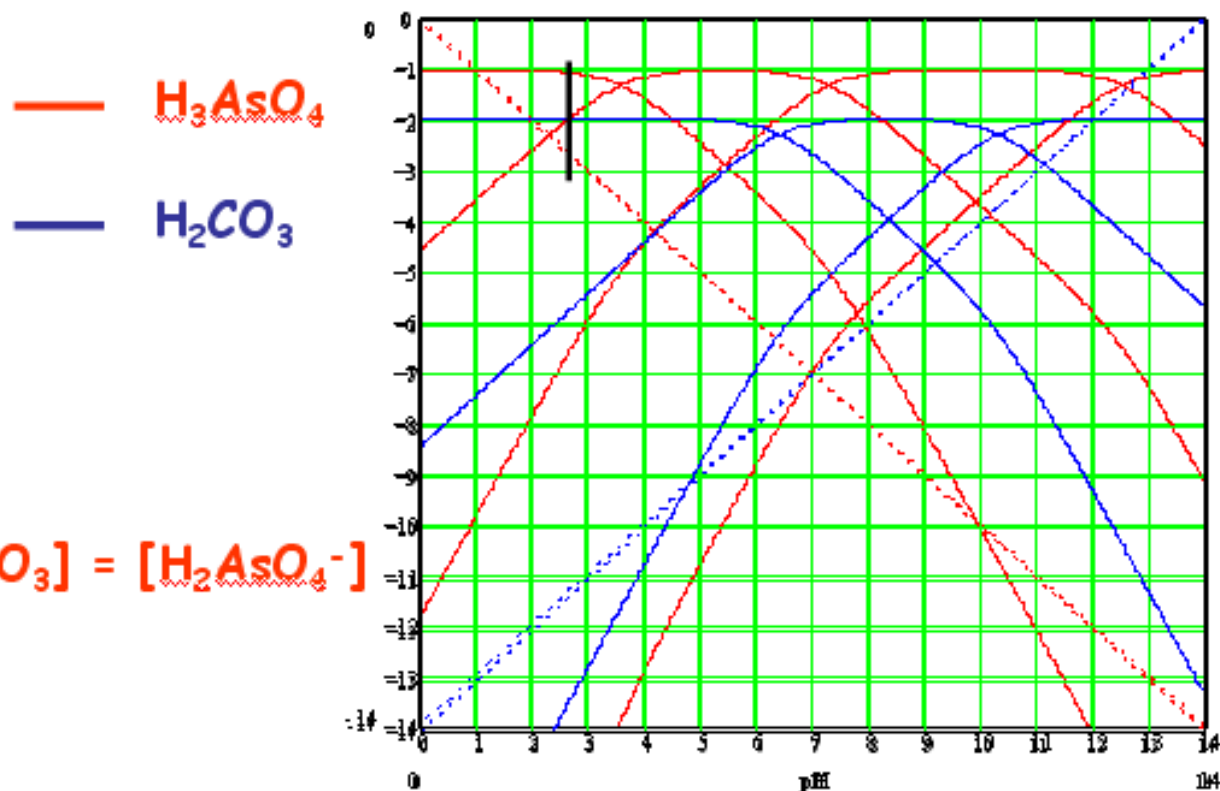
28.b). NaBO_2 0.2 M + HAc 0.1 M



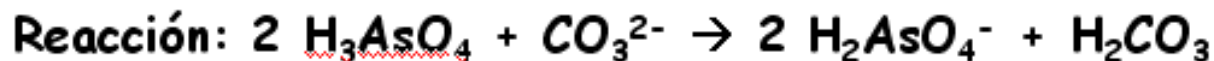
$\text{pH} = 9.2$; $[\text{HBO}_2] = [\text{Ac}^-] = 0.1 \text{ M}$; $[\text{HAc}] = 10^{-5.4} \text{ M}$



28.c). H_3AsO_4 0.1 M + Na_2CO_3 0.01 M

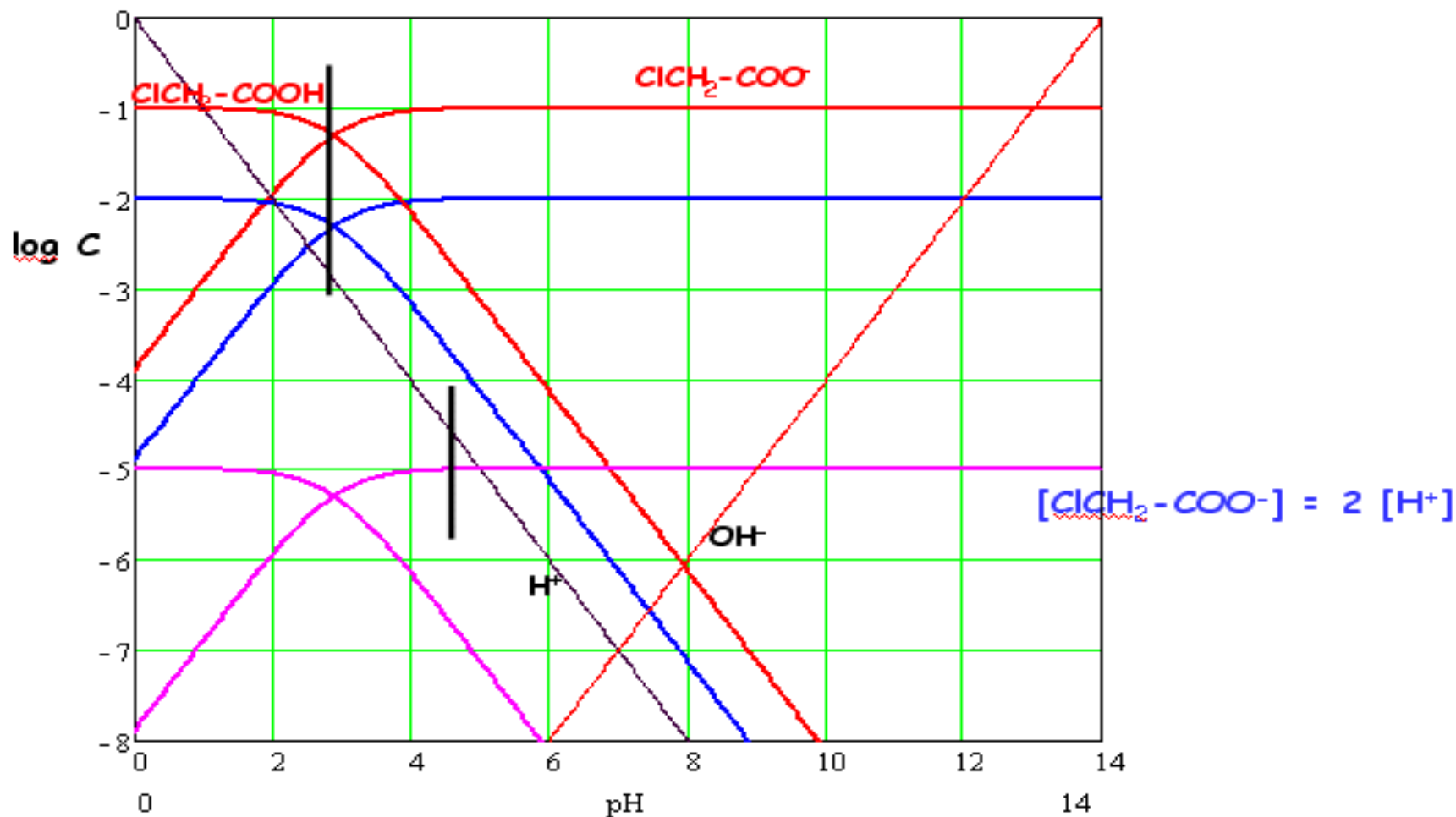


$[\text{H}_2\text{CO}_3] = 10^{-2}$ M; $[\text{H}_2\text{AsO}_4^-] = 2 \cdot 10^{-2}$ M; $[\text{H}_3\text{AsO}_4] = 8 \cdot 10^{-2}$ M; pH = 2.90



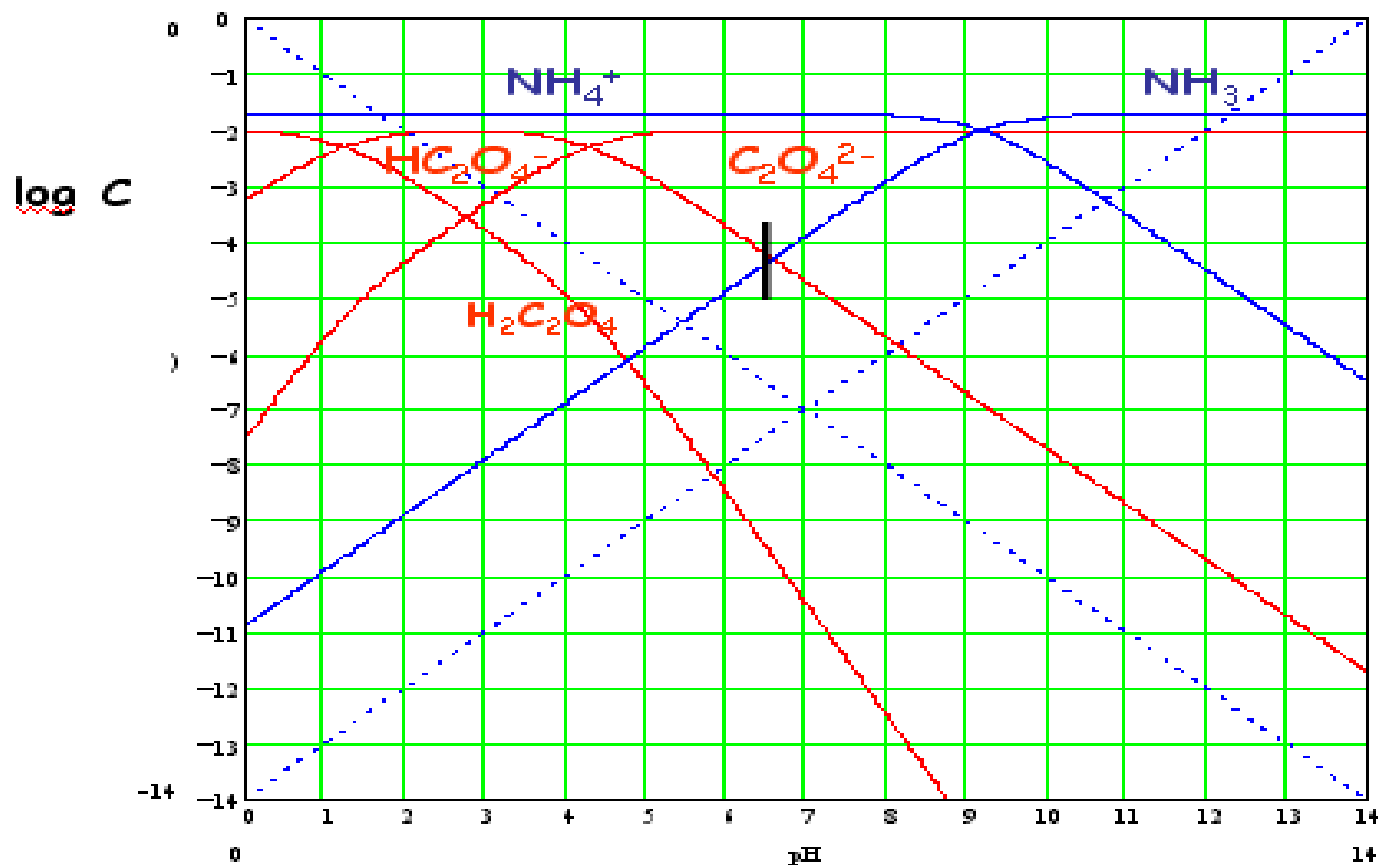


30. $\text{ClCH}_2\text{-COOH}/\text{ClCH}_2\text{-COO}^-$





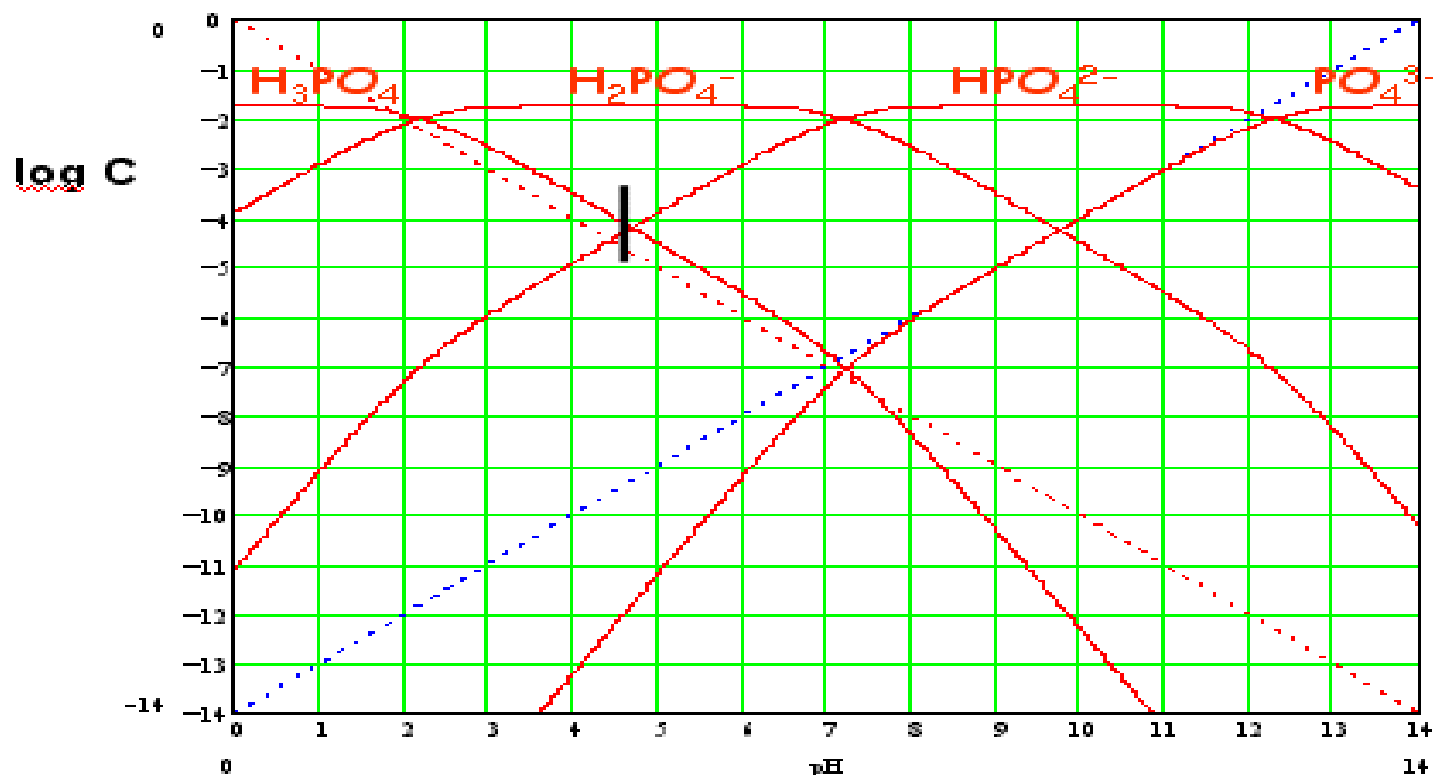
32. $(\text{NH}_4)_2 \text{C}_2\text{O}_4$ 0.01 M



$$\text{pH} = 6.6$$



33. Na_3PO_4 0.02 M + NaOH 0.1 M



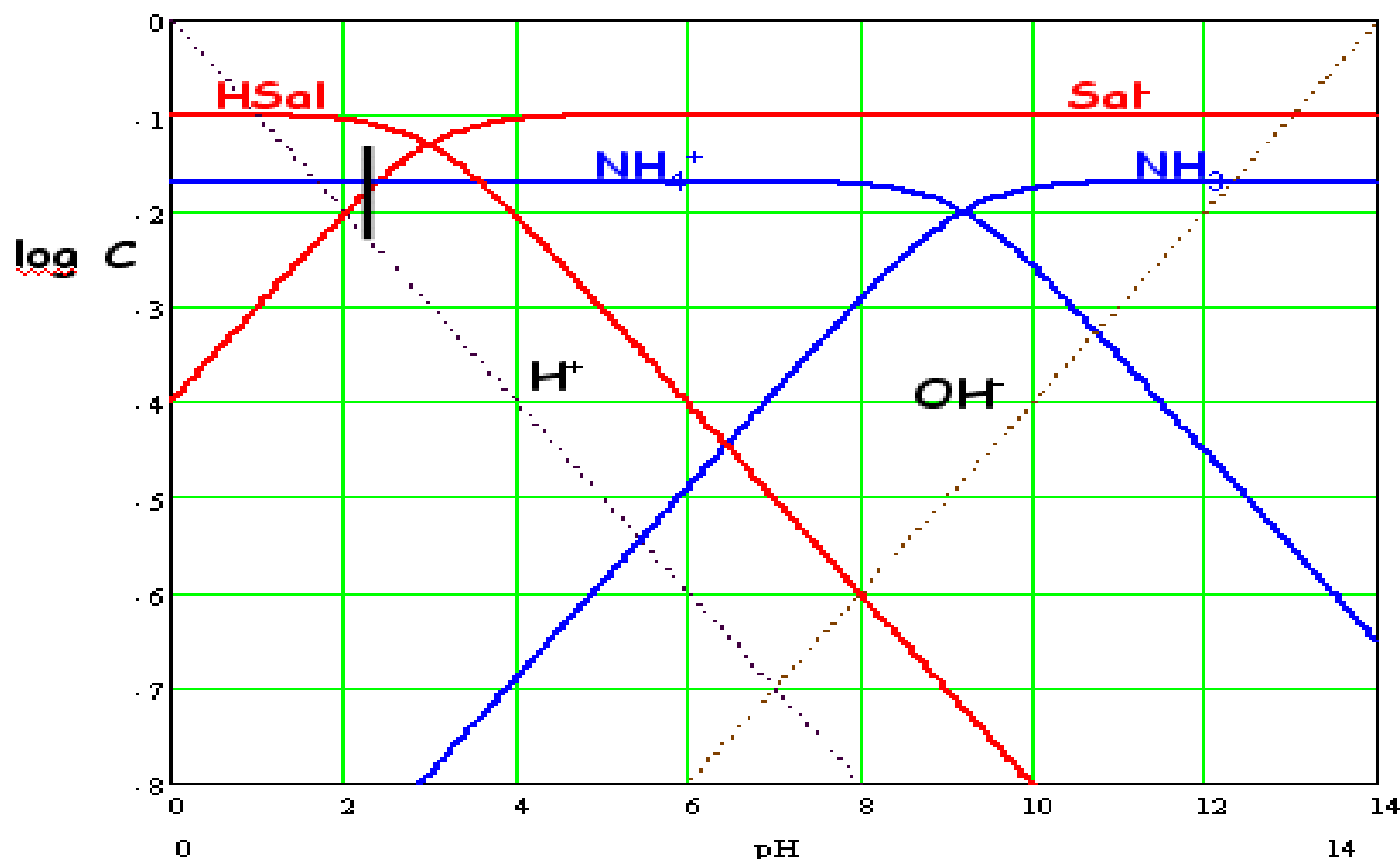
$$\text{b) } [\text{H}^+] + [\text{H}_3\text{PO}_4] = [\text{OH}^-] + [\text{HPO}_4^{2-}] + 2[\text{PO}_4^{3-}]$$

$$[\text{H}_3\text{PO}_4] = [\text{HPO}_4^{2-}]$$

$$\text{pH} = 4.7 \quad [\text{HPO}_4^{2-}] = 10^{-4.2} \text{ M}$$

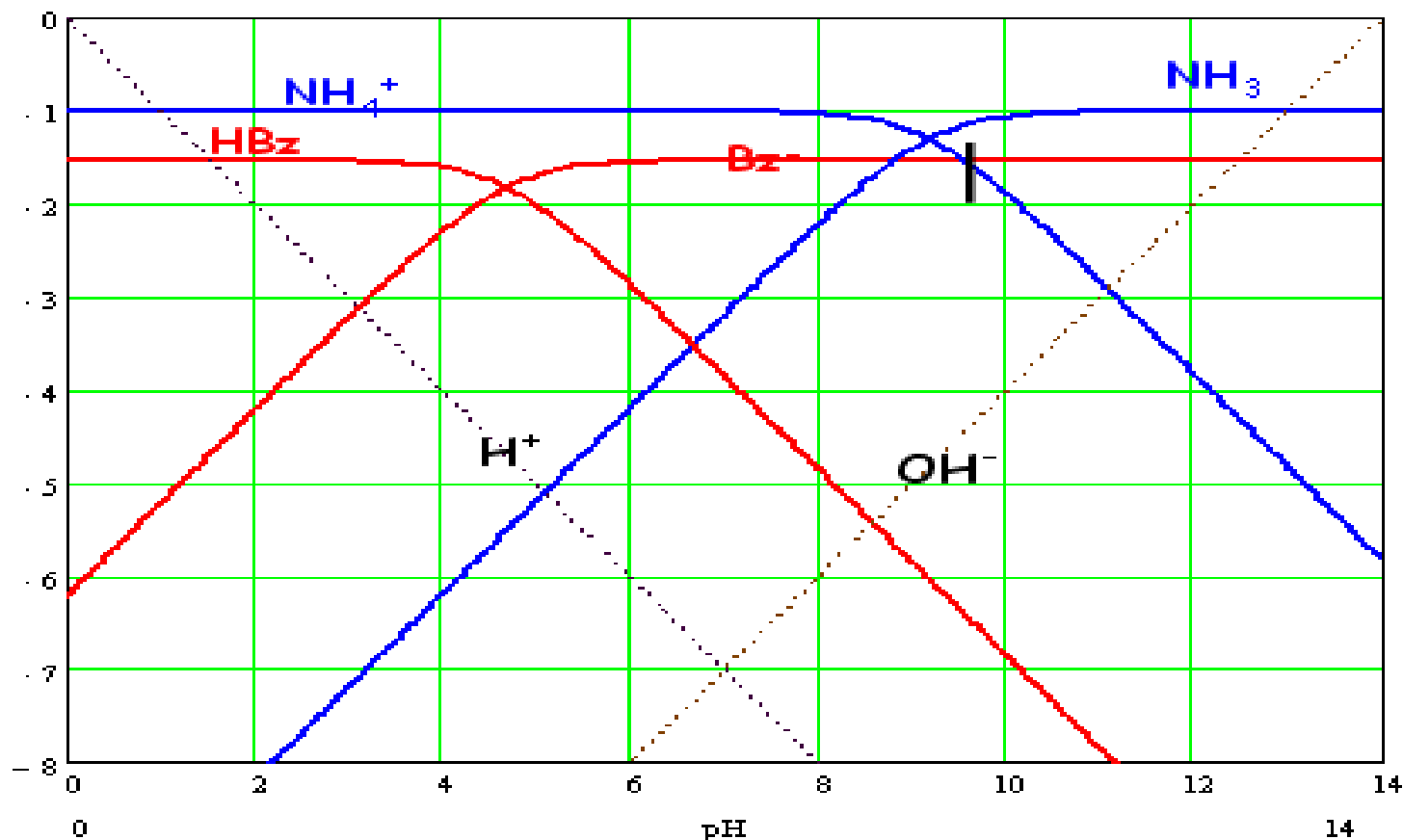


34. NH_3 $2 \cdot 10^{-2} \text{ M}$ + 10 mmoles ac. salicílico





35. ac. benzoico $3 \cdot 10^{-2} \text{ M}$ + 10 mmoles NH_3



$$[\text{H}^+] + [\text{NH}_4^+] = [\text{OH}^-] + [\text{Bz}^-] \quad \Rightarrow \quad \text{pH} = 9.7$$

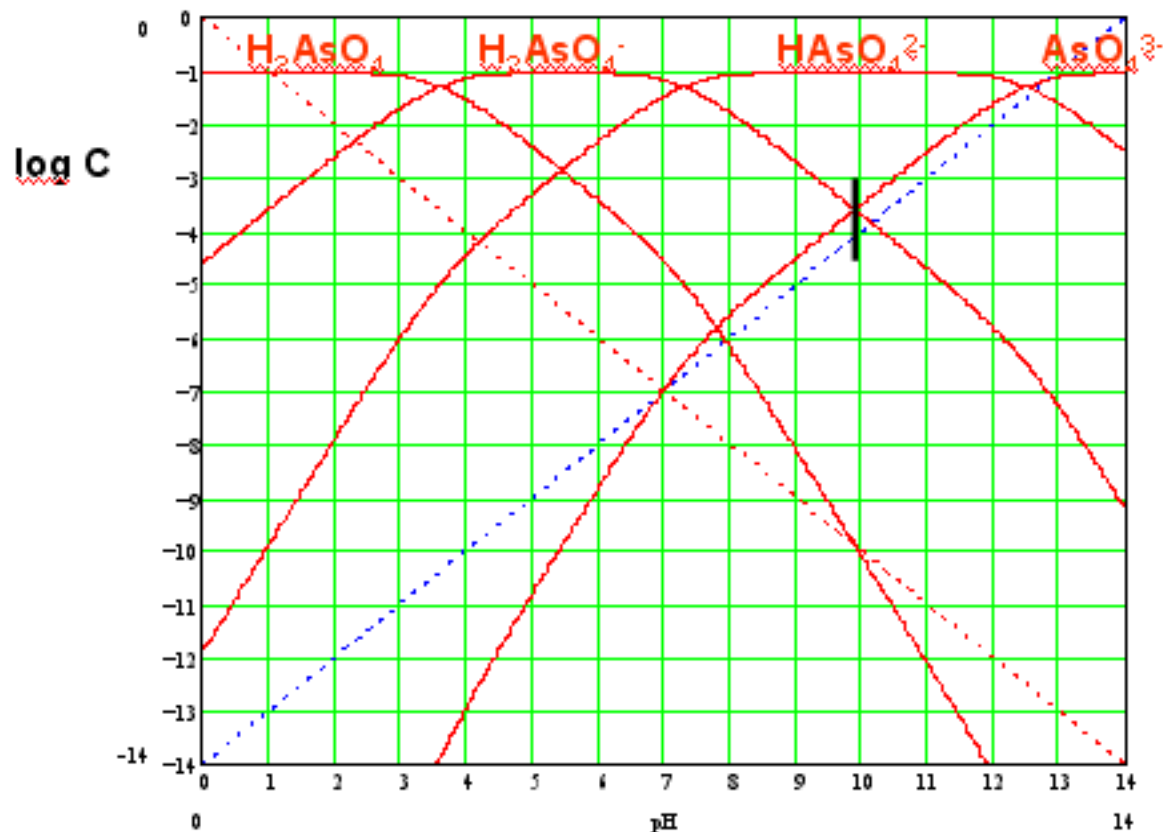




36. Na_2HAsO_4

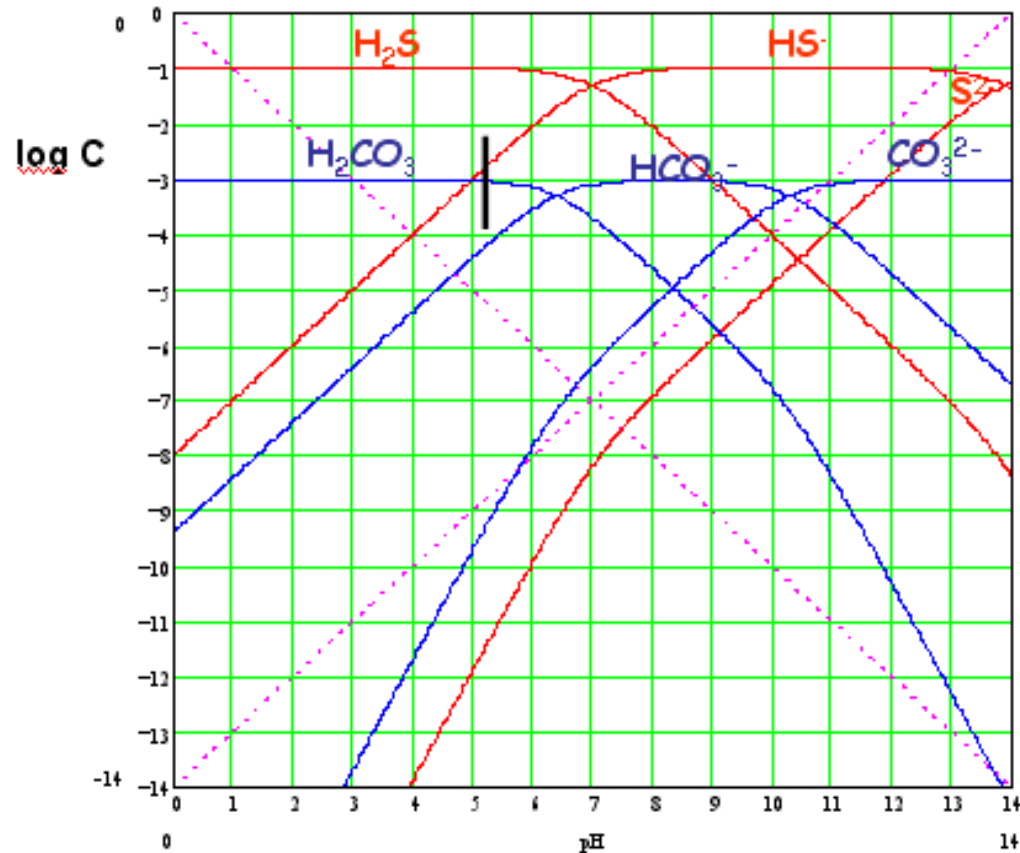
Balance protónico: $[\text{H}^+] + [\text{H}_2\text{AsO}_4^-] + 2 [\text{H}_3\text{AsO}_4] = [\text{OH}^-] + [\text{AsO}_4^{3-}]$

$$[\text{H}_2\text{AsO}_4^-] = [\text{AsO}_4^{3-}] \Rightarrow \text{pH} = 9.9$$





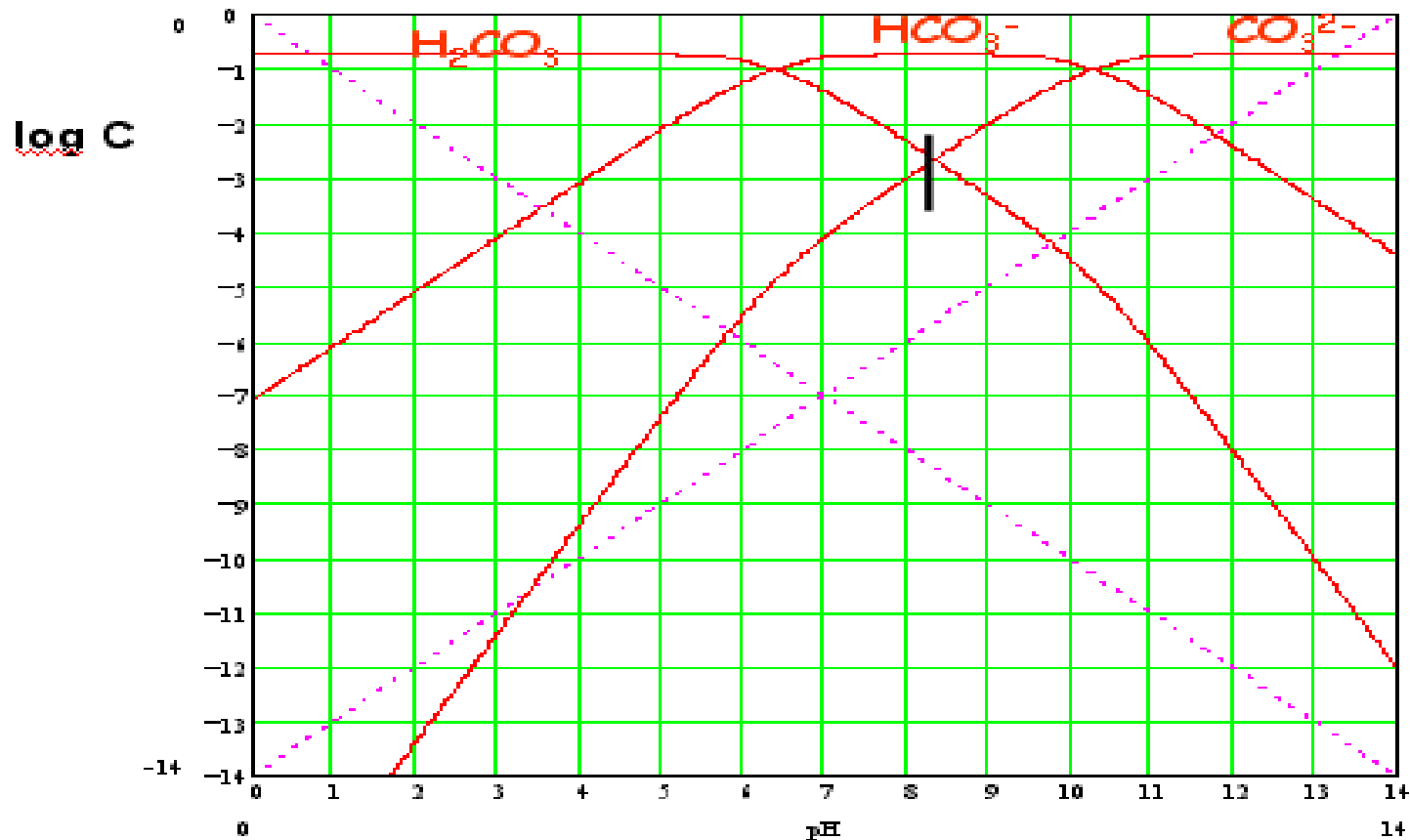
37. H_2S 0.1 M + Na_2CO_3 10^{-3} M



$$\text{pH} = 5.3; [\text{H}_2\text{CO}_3] = 10^{-3} \text{ M}; [\text{H}_2\text{S}] = 10^{-1} \text{ M}; [\text{HS}^-] = 10^{-2.7} \text{ M}; [\text{HCO}_3^-] = 10^{-4} \text{ M}$$



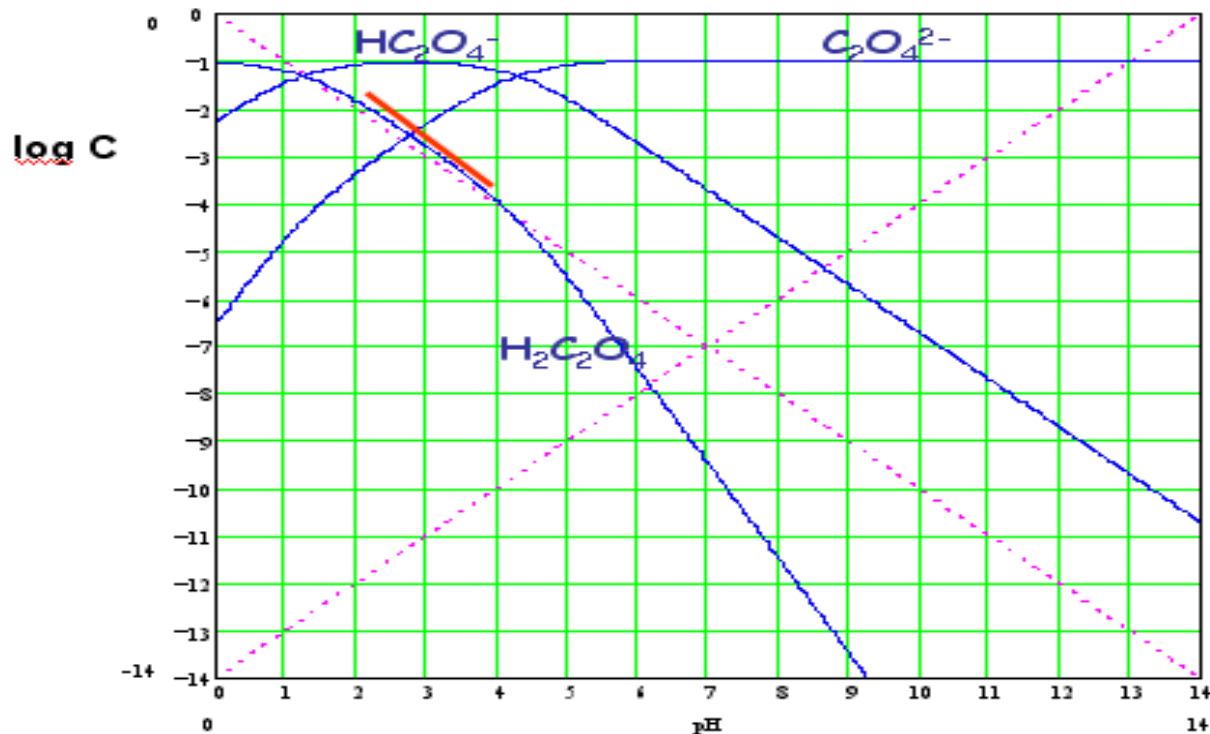
38. a) NaHCO_3 0.2 M



pH = 8.4



38. b) NaHC_2O_4 0.1 M



$$[\text{H}^+] + [\text{H}_2\text{C}_2\text{O}_4] = [\text{OH}^-] + [\text{C}_2\text{O}_4^{2-}] \Rightarrow [\text{H}^+] + [\text{H}_2\text{C}_2\text{O}_4] = [\text{C}_2\text{O}_4^{2-}]$$

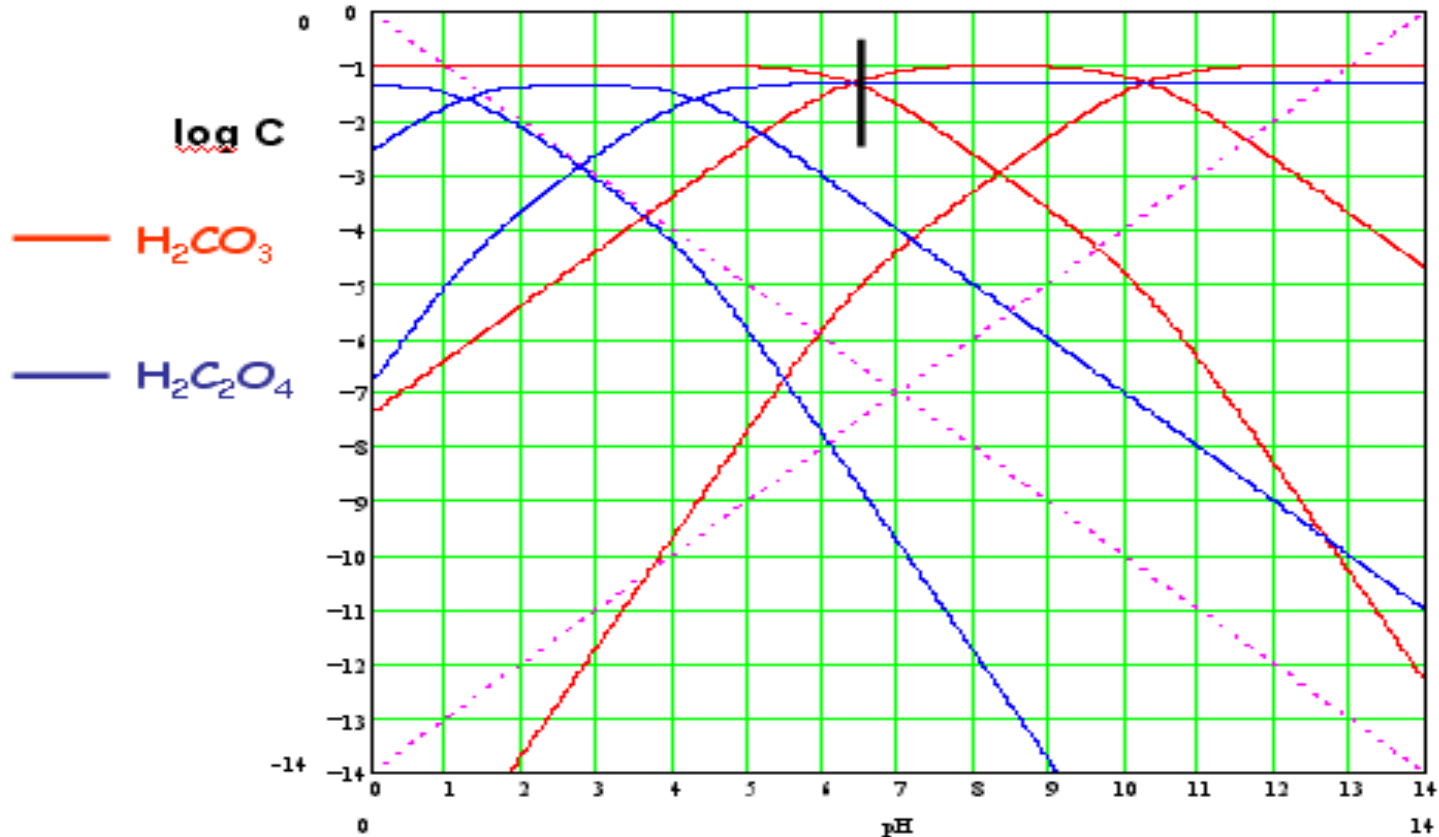
$$\text{Log} \{[\text{H}^+] + [\text{H}_2\text{C}_2\text{O}_4]\} = \log [\text{C}_2\text{O}_4^{2-}]$$

$$\log [\text{H}_2\text{C}_2\text{O}_4] = \log [\text{H}^+] + 0.2 \Rightarrow \log [\text{H}_2\text{C}_2\text{O}_4] = 1.6 [\text{H}^+]$$

$$\text{pH} = 2.8$$



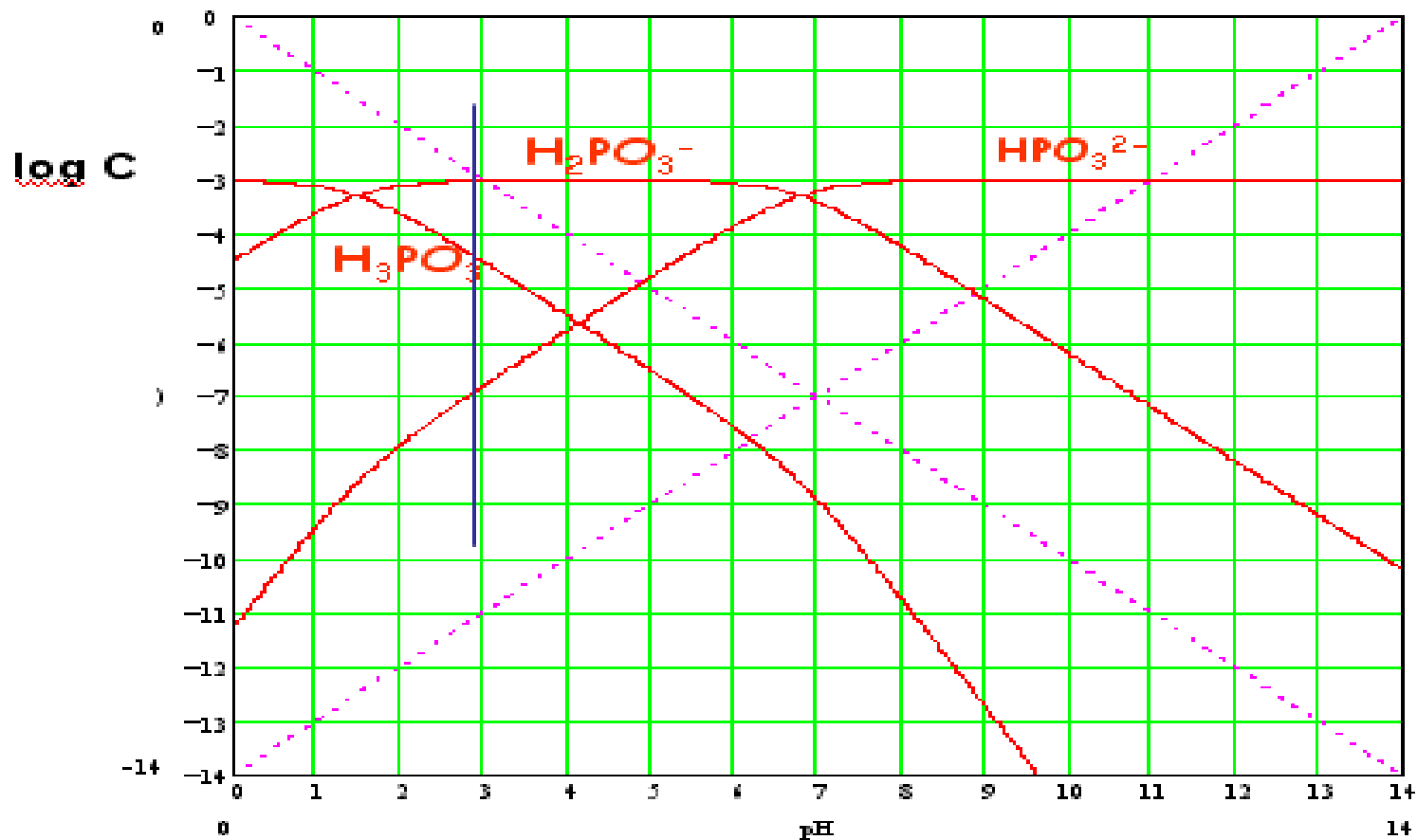
38. c) NaHCO_3 0.1 M + NaHC_2O_4 0.05 M



$$[\text{H}_2\text{CO}_3] = [\text{C}_2\text{O}_4^{2-}] \quad \text{pH} = 6.4$$



39. a) H_3PO_3 10^{-3} M

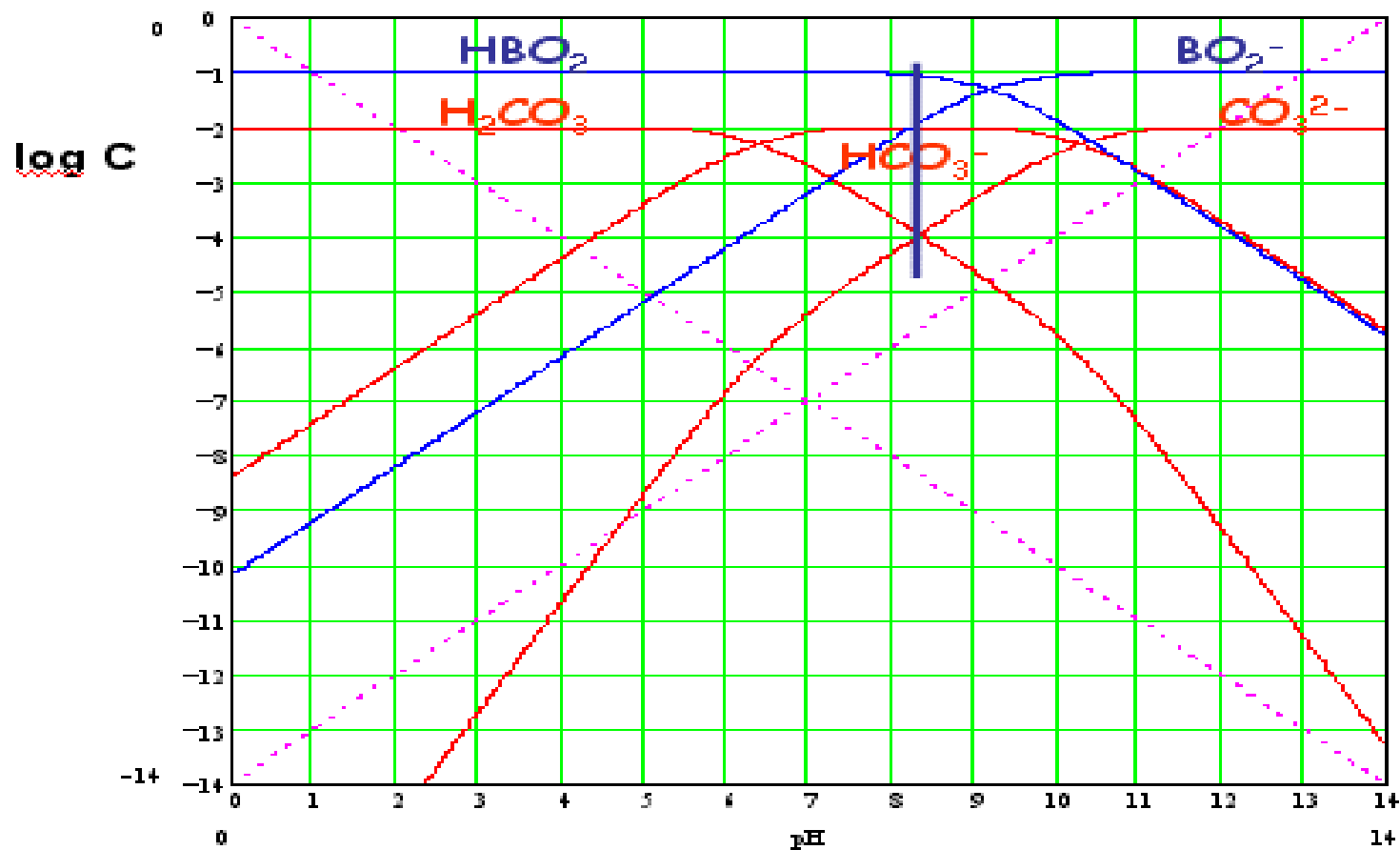


$$[\text{H}^+] = [\text{OH}^-] + [\text{H}_2\text{PO}_3^-] + 2 [\text{HPO}_3^{2-}]$$

$$\text{pH} = 3.0; [\text{H}_2\text{PO}_3^-] = 10^{-3}; [\text{HPO}_3^{2-}] = 10^{-6.8}$$



40.a) y b). Na_2CO_3 10^{-2}M + HBO_2 0.1 M



$$[\text{H}^+] + [\text{HCO}_3^-] + [\text{H}_2\text{CO}_3] = [\text{OH}^-] + [\text{BO}_2^-] \Rightarrow \text{pH} = 8.2$$

