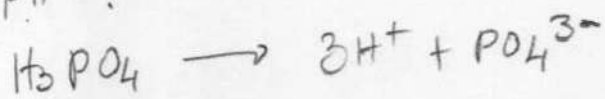


Domaći zadatak 7, Uvod u laboratorijski rad

1. Izračunati pH vrednost rastvora karbonatne kiseline koncentracije 0,06 M. Pretpostaviti potpunu jonizaciju. Pretpostaviti potpunu jonizaciju karbonatne kiseline.
2. Izračunati masu natrijum-hidroksida potrebnu za pripremanje 100 mL rastvora pH=9,3.
3. Rastvor NaOH ima pH vrednost 9,58. Izračunati koncentracije hidroksilnih jona, hidronijum jona i pOH.
4. Koliko puta se promeni koncentracija hidronijum jona pri promeni pH od 2,5 do 5,8?
5. Izračunati pH vrednost rastvora nakon dodatka 5 mg KOH u 100 mL 0,02 M rastvora fosforne kiseline. Pretpostaviti potpunu jonizaciju.
6. Izračunati pH vrednost rastvora dobijenog mešanjem 300 mL 0,15 M rastvora NaOH i 200 mL 0,1 M rastvora H₂SO₄. Pretpostaviti potpunu jonizaciju sumporne kiseline.
7. Izračunati zapreminu 0,2 M rastvora sumporne kiseline koju je potrebno dodati u 150 mL 0,5 M rastvora KOH da bi se dobio rastvor pH vrednosti 8,2. Pretpostaviti potpunu jonizaciju sumporne kiseline.

1. $c(\text{H}_3\text{PO}_4) = 0,06 \text{ M}$
 $\text{pH} = ?$



$$[\text{H}^+] = 3 \cdot c(\text{H}_3\text{PO}_4) = 3 \cdot 0,06 \text{ M} = 0,18 \text{ M}$$

$$\text{pH} = -\log [\text{H}^+] = -\log 0,18 \text{ M} = 0,745$$

2. $w(\text{NaOH}) = ? \text{ g}$

$$V_R = 100 \text{ ml} = 0,1 \text{ l}$$

$$\text{pH} = 9,3$$

$$\text{pOH} = 14 - \text{pH} = 14 - 9,3 = 4,7$$

$$\text{pOH} = -\log [\text{OH}^-]$$

$$[\text{OH}^-] = 10^{-\text{pOH}} = 10^{-4,7} = 1,99 \cdot 10^{-5} \text{ M}$$

$$n(\text{OH}^-) = [\text{OH}^-] \cdot V_R = 1,99 \cdot 10^{-5} \text{ M} \cdot 0,1 \text{ l} = 1,99 \cdot 10^{-6} \text{ mol}$$

$$n(\text{NaOH}) = n(\text{OH}^-)$$

$$M(\text{NaOH}) = A(\text{Na}) + A(\text{O}) + A(\text{H}) = 23 \text{ g/mol} + 16 \text{ g/mol} + 1 \text{ g/mol} = 40 \text{ g/mol}$$

$$w(\text{NaOH}) = n(\text{OH}^-) \cdot M(\text{NaOH}) = 1,99 \cdot 10^{-6} \text{ mol} \cdot 40 \text{ g/mol} = 7,96 \cdot 10^{-5} \text{ g}$$

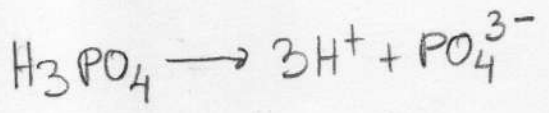
3. $pH = 9,58$ $pOH = 14 - pH = 14 - 9,58 = 4,42$
 $[OH^-] = ?$ $[OH^-] = 10^{-pOH} = 10^{-4,42} = 3,80 \cdot 10^{-5} M$
 $[H^+] = ?$ $[H^+] = 10^{-pH} = 10^{-9,58} = 2,63 \cdot 10^{-10} M$
 $pOH = ?$

4. $pH_1 = 2,5$ $[H^+]_1 = 10^{-pH_1} = 10^{-2,5} = 3,16 \cdot 10^{-3} M$
 $pH_2 = 5,8$ $[H^+]_2 = 10^{-pH_2} = 10^{-5,8} = 1,58 \cdot 10^{-6} M$

$$\frac{[H^+]_1}{[H^+]_2} = \frac{3,16 \cdot 10^{-3} M}{1,58 \cdot 10^{-6} M} = 2 \cdot 10^3$$

концентрација $[H^+]$ јона се смањуи $2 \cdot 10^3$ пута

5. $m(KOH) = 5 mg$
 $V_R(H_3PO_4) = 100 ml = 0,1 l$
 $C_R(H_3PO_4) = 0,02 M$
 $M(KOH) = A(K) + A(O) + A(H) = 39,1 g/mol + 16 g/mol + 1 g/mol$
 $M(KOH) = 56,1 g/mol$
 $n(KOH) = \frac{m(KOH)}{M(KOH)} = \frac{5 \cdot 10^{-3} g}{56,1 g/mol} = 8,91 \cdot 10^{-5} mol$



$$[H^+] = 3 \cdot C_R(H_3PO_4) = 3 \cdot 0,02 M = 0,06 M$$

$$n(H^+) = [H^+] \cdot V_R(H_3PO_4) = 0,06 M \cdot 0,1 l = 6 \cdot 10^{-3} mol$$

$$\Delta n(H^+) = n(H^+) - n(OH^-) = 6 \cdot 10^{-3} mol - 8,91 \cdot 10^{-5} mol = 5,911 \cdot 10^{-3} mol$$

$$\Delta [H^+] = \frac{\Delta n(H^+)}{V_R(H_3PO_4)} = \frac{5,911 \cdot 10^{-3} mol}{0,1 l} = 5,911 \cdot 10^{-2} M$$

$$pH = -\log \Delta [H^+] = -\log 5,911 \cdot 10^{-2} M = 1,228$$

6. pH₃

$$V_1(\text{NaOH}) = 300 \text{ ml} = 0,3 \text{ l}$$

$$c_1(\text{NaOH}) = 0,15 \text{ M}$$

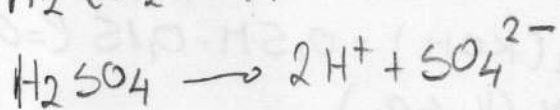
$$V_2(\text{H}_2\text{SO}_4) = 200 \text{ ml} = 0,2 \text{ l}$$

$$c_2(\text{H}_2\text{SO}_4) = 0,1 \text{ M}$$

$$n_1(\text{NaOH}) = c_1(\text{NaOH}) \cdot V_1(\text{NaOH}) = 0,15 \text{ M} \cdot 0,3 \text{ l} = 0,045 \text{ mol}$$

$$n_1(\text{OH}^-) = n_1(\text{NaOH}) = 0,045 \text{ mol}$$

$$n_2(\text{H}_2\text{SO}_4) = c_2(\text{H}_2\text{SO}_4) \cdot V_2(\text{H}_2\text{SO}_4) = 0,1 \text{ M} \cdot 0,2 \text{ l} = 0,02 \text{ mol}$$



$$n_2(\text{H}^+) = 2 \cdot n(\text{H}_2\text{SO}_4) = 2 \cdot 0,02 \text{ mol} = 0,04 \text{ mol}$$

$$n_3(\text{OH}^-) = n_1(\text{OH}^-) - n_2(\text{H}^+) = 0,045 \text{ mol} - 0,04 \text{ mol} = 0,005 \text{ mol}$$

$$V_3 = V_1(\text{NaOH}) + V_2(\text{H}_2\text{SO}_4) = 0,3 \text{ l} + 0,2 \text{ l} = 0,5 \text{ l}$$

$$c_3(\text{OH}^-) = \frac{n_3(\text{OH}^-)}{V_3} = \frac{0,005 \text{ mol}}{0,5 \text{ l}} = 0,01 \text{ M}$$

$$\text{pOH} = -\log c_3(\text{OH}^-) = -\log 0,01 \text{ M} = 2$$

$$\text{pH} = 14 - \text{pOH} = 14 - 2 = 12$$

$$f. C_1(\text{H}_2\text{SO}_4) = 0,2 \text{ M}$$

$$V_1(\text{H}_2\text{SO}_4) = ?$$

$$V_2(\text{KOH}) = 150 \text{ ml} = 0,15 \text{ l}$$

$$C_2(\text{KOH}) = 0,5 \text{ M}$$

$\text{pH}_3 = 8,2$ - АЛКАЛНА СРЕДИНА, ВИШАК OH^- ЈОНА

$$\text{pOH}_3 = 14 - 8,2 = 5,8$$

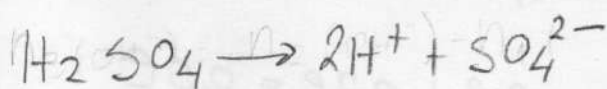
$$[\text{OH}^-]_3 = 10^{-\text{pOH}} = 10^{-5,8} = 1,584 \cdot 10^{-6} \text{ M}$$

$$V_3 = V_1(\text{H}_2\text{SO}_4) + V_2(\text{KOH})$$

$$n_2(\text{KOH}) = n_2(\text{OH}^-) = C_2(\text{KOH}) \cdot V_2(\text{KOH}) = 0,5 \text{ M} \cdot 0,15 \text{ l} = 0,075 \text{ mol}$$

$$n_1(\text{H}_2\text{SO}_4) = C_1(\text{H}_2\text{SO}_4) \cdot V_1(\text{H}_2\text{SO}_4) = 0,2 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4)$$

$$n_3(\text{OH}^-) = [\text{OH}^-]_3 \cdot V_3 = [\text{OH}^-]_3 \cdot (V_1(\text{H}_2\text{SO}_4) + V_2(\text{KOH}))$$



$$n_1(\text{H}^+) = 2 \cdot n_1(\text{H}_2\text{SO}_4) = 2 \cdot 0,2 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4) = 0,4 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4)$$

$$n_3(\text{OH}^-) = n_2(\text{OH}^-) - n_1(\text{H}^+) = 0,075 \text{ mol} - 0,4 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4)$$

$$[\text{OH}^-]_3 = \frac{n_3(\text{OH}^-)}{V_3} = \frac{0,075 \text{ mol} - 0,4 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4)}{V_1(\text{H}_2\text{SO}_4) + V_2(\text{KOH})}$$

$$1,584 \cdot 10^{-6} \text{ M} = \frac{0,075 \text{ mol} - 0,4 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4)}{V_1(\text{H}_2\text{SO}_4) + 0,15 \text{ l}}$$

$$1,584 \cdot 10^{-6} \text{ M} \cdot V_1(\text{H}_2\text{SO}_4) + 1,584 \cdot 10^{-6} \text{ M} \cdot 0,15 \text{ l} = 0,075 \text{ mol} - 0,4 \text{ M} \cdot V_1(\text{H}_2\text{SO}_4)$$

$$V_1(\text{H}_2\text{SO}_4) (1,584 \cdot 10^{-6} + 0,4) \text{ M} = 0,075 \text{ mol} - 2,376 \cdot 10^{-7} \text{ mol}$$

$$V_1(\text{H}_2\text{SO}_4) \approx \frac{0,075 \text{ mol}}{0,4 \text{ M}} = 0,1875 \text{ l} = 187,5 \text{ ml}$$