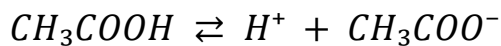


1–MASALA. Kuchsiz kislota pH

Shart: 0,10 M konsentratsiyali sirka kislotasi (CH_3COOH) eritmasi berilgan. Uning $K_a = 1,8 \cdot 10^{-5}$. Eritmaning pH qiymatini toping.

Yechim:



$$(H^+) \approx \sqrt{K_a \cdot C_0}$$

$$(H^+) \approx \sqrt{1,8 \cdot 10^{-5} \cdot 0,10}$$

$$(H^+) \approx \sqrt{1,8 \cdot 10^{-6}}$$

$$(H^+) \approx 1,34 \cdot 10^{-3}$$

$$pH = -\lg(1,34 \cdot 10^{-3})$$

$$pH \approx 3 - \lg(1,34)$$

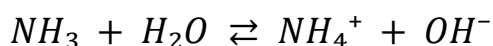
$$\lg(1,34) \approx 0,13$$

$$pH \approx 3 - 0,13 = 2,87$$

2–MASALA. Zaif asos pH

Shart: 0,20 M NH_3 eritmasi berilgan. $K_b(NH_3) = 1,8 \cdot 10^{-5}$. Eritmaning pH ni hisoblang.

Yechim:



$$(OH^-) \approx \sqrt{K_b \cdot C_0}$$

$$(OH^-) \approx \sqrt{1,8 \cdot 10^{-5} \cdot 0,20}$$

$$(OH^-) \approx \sqrt{3,6 \cdot 10^{-6}}$$

$$(OH^-) \approx 1,90 \cdot 10^{-3}$$

$$pOH = -\lg(1,90 \cdot 10^{-3}) \approx 3 - \lg(1,90)$$

$$\lg(1,90) \approx 0,28 \rightarrow 3 - 0,28 = 2,72$$

$$pH = 14 - 2,72 = 11,28$$

3–MASALA. Kuchsiz kislota–kuchli asos reaksiyasi

Shart: 50 ml 0,10 M CH_3COOH ga 25 ml 0,10 M $NaOH$ qo'shildi. Hosil bo'lgan eritmaning pH qiymatini hisoblang. $K_a = 1,8 \cdot 10^{-5}$.

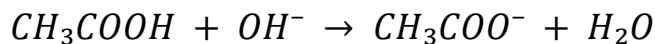
Yechim:

1. Moddalar miqdori:

$$CH_3COOH = 0,10 \cdot 0,050 = 0,0050 \text{ mol}$$

$$NaOH = 0,10 \cdot 0,025 = 0,0025 \text{ mol}$$

2. Neytrallanish:



OH^- to'liq sarflanadi.

Qoldiq:

$$CH_3COOH: 0,0050 - 0,0025 = 0,0025 \text{ mol}$$

CH_3COO^- : 0,0025 mol hosil bo'ladi

Bu tampon eritma! $\rightarrow$ formuladan foydalanamiz:

$$V_{yangi} = 50 + 25 = 75 \text{ ml} = 0,075 \text{ L}$$

$$[A^-] = 0,0025 / 0,075 = 0,0333 \text{ M}$$

$$[HA] = 0,0025 / 0,075 = 0,0333 \text{ M}$$

$$pH = pK_a + \lg([A^-]/[HA])$$

$$pK_a = -\lg(1,8 \cdot 10^{-5}) \approx 4.74$$

$$[A^-]/[HA] = 1 \rightarrow \lg(1) = 0$$

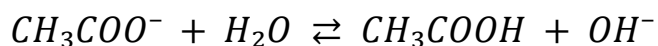
$$pH = 4.74$$

4–MASALA. Gidroliz — zaif kislota anioni

Shart: 0,10 M natriy atsetat (CH_3COONa) eritmasining pH ni toping.

$$K_a(CH_3COOH) = 1,8 \cdot 10^{-5}.$$

Yechim:



$$K_{gidr} = K_w / K_a$$

$$K_{gidr} = (1,0 \cdot 10^{-14}) / (1,8 \cdot 10^{-5})$$

$$K_{gidr} \approx 5.56 \cdot 10^{-10}$$

$$(OH^-) \approx \sqrt{K_{gidr} \cdot C_0} \approx \sqrt{5.56 \cdot 10^{-10} \cdot 0,10} \approx \sqrt{5.56 \cdot 10^{-11}} \approx 7.45 \cdot 10^{-6}$$

$$pOH = -\lg(7.45 \cdot 10^{-6}) \approx 6 - \lg(7.45) \approx 6 - 0,87 = 5.13$$

$$pH = 14 - 5.13 = 8.87$$

5–MASALA. Kuchli kislota–zaif asos aralashmasi

Shart: 100 ml 0,10 M NH_3 eritmasiga 50 ml 0,10 M HCl qo‘shildi. $K_b = 1,8 \cdot 10^{-5}$. Eritmaning pH sini toping.

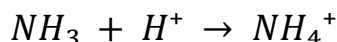
Yechim:

1. Moddalar miqdori:

$$NH_3 = 0,10 \cdot 0,100 = 0,010 \text{ mol}$$

$$HCl = 0,10 \cdot 0,050 = 0,005 \text{ mol}$$

2. Reaksiya:



Qoldiq:

$$NH_3 = 0,010 - 0,005 = 0,005 \text{ mol}$$

$$NH_4^+ = 0,005 \text{ mol hosil bo‘ladi}$$

Tampon eritma: NH_3 / NH_4^+

$$V_{yangi} = 0,150 \text{ L}$$

$$[NH_3] = 0,005 / 0,150 = 0,0333 \text{ M}$$

$$[NH_4^+] = 0,0333 \text{ M}$$

$$pOH = pK_b + \lg([NH_4^+]/[NH_3])$$

$$pK_b = -\lg(1,8 \cdot 10^{-5}) = 4.74$$

$$\lg \text{ nisbati} = \lg(1) = 0$$

$$pOH = 4.74$$

$$pH = 14 - 4.74 = 9.26$$

6–MASALA. Aralashma – qoldiq asos

Shart: 100 ml 0,10 M $NaOH$ eritmasiga 50 ml 0,10 M HCl qo‘shildi. Hosil bo‘lgan eritmaning pH sini toping.

Yechim:

$$NaOH = 0,010 \text{ mol}$$

$$HCl = 0,005 \text{ mol}$$

$$\text{Qoldiq } NaOH = 0,010 - 0,005 = 0,005 \text{ mol}$$

$$V_{yangi} = 0,150 \text{ L}$$

$$(OH^-) = 0,005 / 0,150 = 0,0333 \text{ M}$$

$$pOH = -lg(0,0333) \approx -(lg(3,33) - 2) \approx -(0,522 - 2) = 1,48$$

$$pH = 14 - 1,48 = 12,52$$

7–MASALA. Aralashma – qoldiq kislota

Shart: 80 ml 0,10 M HCl ga 20 ml 0,10 M $NaOH$ qo'shildi. pH ni toping.

Yechim:

$$HCl = 0,10 \cdot 0,080 = 0,0080 \text{ mol}$$

$$NaOH = 0,10 \cdot 0,020 = 0,0020 \text{ mol}$$

$$\text{Qoldiq } HCl = 0,0060 \text{ mol}$$

$$V_{yangi} = 0,100 \text{ L}$$

$$(H^+) = 0,0060 / 0,100 = 0,060$$

$$pH = -lg(0,060) \approx -(lg(6,0) - 2)$$

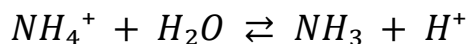
$$lg(6,0) \approx 0,78$$

$$pH = 2 - 0,78 = 1,22$$

8–MASALA. Gidroliz — kation (NH_4^+)

Shart: 0,20 M NH_4Cl eritmasining pH ni toping. $K_b(NH_3) = 1,8 \cdot 10^{-5}$.

Yechim:



$$K_a(NH_4^+) = K_w / K_b = (1,0 \cdot 10^{-14}) / (1,8 \cdot 10^{-5}) \approx 5,56 \cdot 10^{-10}$$

$$(H^+) \approx \sqrt{K_a \cdot C_0} \approx \sqrt{5,56 \cdot 10^{-10} \cdot 0,20} \approx \sqrt{1,11 \cdot 10^{-10}} \approx 1,05 \cdot 10^{-5}$$

$$pH = -lg(1,05 \cdot 10^{-5}) \approx 5 - lg(1,05) \approx 0,02$$

$$pH \approx 5 - 0,02 = 4,98$$

9–MASALA. Tamponni suyultirish pH ga ta'siri

Shart: 0,30 M CH_3COOH va 0,30 M CH_3COONa tampon eritmasi 2 baravar suyultirildi. pH qanday o'zgaradi? $K_a = 1,8 \cdot 10^{-5}$.

Yechim:

Tampon formulasi:

$$pH = pK_a + \lg([A^-]/[HA])$$

Suyultirilgandan keyin:

$$\begin{aligned}[A^-] &\rightarrow 0,30/2 = 0,15 \\ [HA] &\rightarrow 0,30/2 = 0,15\end{aligned}$$

Nisbat: $[A^-]/[HA] = 1$ (o'zgarmadi)

Demak pH o'zgarmaydi.

$$pK_a = 4.74$$

$pH = 4.74$ (o'zgarmaydi)

10–MASALA. Aralash tampon

Shart: 100 ml 0,20 M CH_3COOH ga 50 ml 0,20 M CH_3COONa qo'shildi. pH ni hisoblang. $K_a = 1,8 \cdot 10^{-5}$.

Yechim:

Modda miqdori:

$$\begin{aligned}HA &= 0,20 \cdot 0,100 = 0,020 \text{ mol} \\ A^- &= 0,20 \cdot 0,050 = 0,010 \text{ mol}\end{aligned}$$

Yangi hajm: $V = 0,150 \text{ L}$

$$\begin{aligned}[HA] &= 0,020 / 0,150 = 0,133 \text{ M} \\ [A^-] &= 0,010 / 0,150 = 0,0667 \text{ M}\end{aligned}$$

$$\begin{aligned}pH &= pK_a + \lg([A^-]/[HA]) = 4.74 + \lg(0,0667 / 0,133) \\ &= 4.74 + \lg(0,50) \\ \lg(0,50) &= -0,301\end{aligned}$$

$$pH = 4.74 - 0,301 = 4.44$$