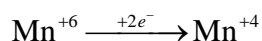
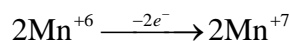
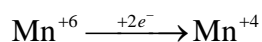
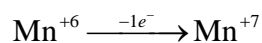


Domaći zadatak 9, Uvod u laboratorijski rad

1. Izračunati zapreminu mangan-dioksida koja nastaje pri normalnim uslovima disproporcionisanjem 15 g manganove kiseline prema sledećoj jednačini:

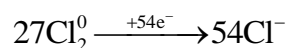
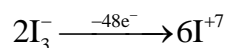
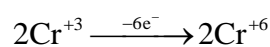
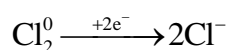
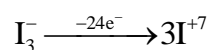
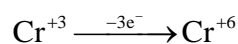


$$n_{\text{H}_2\text{MnO}_4} = \frac{m_{\text{H}_2\text{MnO}_4}}{M(\text{H}_2\text{MnO}_4)} = \frac{15 \text{ g}}{121 \text{ g}} = 0,124 \text{ mol}$$

$$n_{\text{MnO}_2} = \frac{0,124 \text{ mol} \cdot 1 \text{ mol}}{3 \text{ mol}} = 0,041 \text{ mol}$$

$$V_{\text{MnO}_2} = n_{\text{MnO}_2} \cdot V_m = 0,041 \text{ mol} \cdot 22,4 \text{ dm}^3 \text{ mol}^{-1} = 0,92 \text{ dm}^3$$

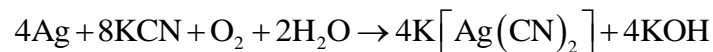
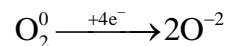
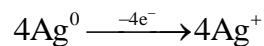
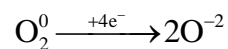
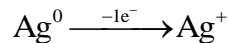
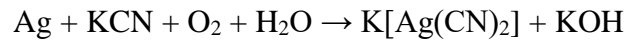
2. Izračunati koncentraciju nastalog kalijum-perjodata ukoliko je rastvoreno 1,3 g hrom(III)-jodida i dovoljna količina ostalih reaktanata u 500 cm³ vode:



$$m_{\text{KIO}_4} = \frac{1,3 \text{ g} \cdot 6 \cdot M(\text{KIO}_4)}{M(\text{CrI}_3)} = \frac{1,3 \text{ g} \cdot 6 \cdot 230 \text{ g mol}^{-1}}{2 \cdot 433 \text{ g mol}^{-1}} = 2,07 \text{ g}$$

$$c_{\text{KIO}_4} = \frac{n_{\text{KIO}_4}}{V} = \frac{m_{\text{KIO}_4}}{M(\text{KIO}_4) \cdot V} = \frac{2,07 \text{ g}}{230 \text{ g mol}^{-1} \cdot 0,5 \text{ dm}^3} = 0,018 \text{ M}$$

3. Oksidacija srebra u prisustvu kalijum-cijanida i gasovitog kiseonika se odigrava prema reakciji u nastavku. Izračunati koliko grama kompleksne soli (kalijum-dicijano-argentata) nastaje nakon uvođenja 15 cm^3 gasovitog kiseonika u rastvor kalijum-cijanida.

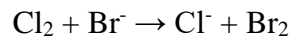


$$n_{\text{O}_2} = \frac{15 \cdot 10^{-3} \text{ dm}^3}{22,4 \text{ dm}^3 \text{ mol}^{-1}} = 6,7 \cdot 10^{-4} \text{ mol}$$

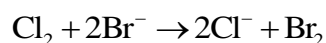
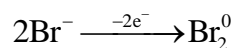
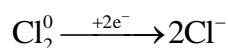
$$n_{\text{K}[\text{Ag}(\text{CN})_2]} = \frac{n_{\text{O}_2} \cdot 4}{1} = 0,0027 \text{ mol}$$

$$m_{\text{K}[\text{Ag}(\text{CN})_2]} = n_{\text{K}[\text{Ag}(\text{CN})_2]} \cdot M(\text{K}[\text{Ag}(\text{CN})_2]) = 0,0027 \text{ mol} \cdot 199 \text{ g mol}^{-1} = 0,537 \text{ g}$$

4. Redukcija hlora u prisustvu broma se može prikazati sledećom reakcijom:



Izračunati koncentraciju hloridnih jona nakon uvođenja dovoljne količine hlora u rastvor kalijum-bromida dobijenog rastvaranjem 1,08 g ove soli u 500 cm^3 vode. Obratiti pažnju da je u zadatku data masa kalijum-bromida, a u jonskoj jednačini prikazan samo bromid.



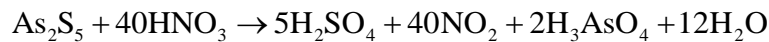
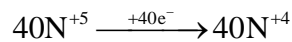
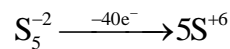
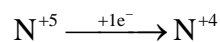
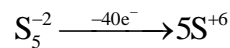
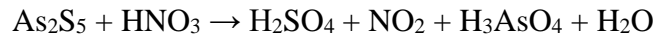
$$m_{\text{Br}^-} = \frac{m_{\text{KBr}} \cdot 80 \text{ gmol}^{-1}}{119 \text{ gmol}^{-1}} = \frac{1,08 \text{ g} \cdot 80 \text{ gmol}^{-1}}{119 \text{ gmol}^{-1}} = 0,73 \text{ g}$$

$$n_{\text{Br}^-} = \frac{m_{\text{Br}^-}}{M(\text{Br})} = \frac{0,73 \text{ g}}{80 \text{ gmol}^{-1}} = 0,009 \text{ mol}$$

$$n_{\text{Br}^-} = n_{\text{Cl}^-}$$

$$c_{\text{Cl}^-} = \frac{n_{\text{Cl}^-}}{V} = \frac{0,009 \text{ mol}}{0,5 \text{ dm}^3} = 0,018 \text{ M}$$

5. Izračunati zapreminu nastalog azot-dioksida u reakciji 15 g arsen(V)-sulfida i 25 g azotne kiseline. Izjednačiti reakciju oksido-redukcije i odrediti koji od dva reaktanta je u višku.



$$n_{\text{As}_2\text{S}_5} = \frac{15 \text{ g}}{M(\text{As}_2\text{S}_5)} = \frac{15 \text{ g}}{310 \text{ gmol}^{-1}} = 0,048 \text{ mol}$$

$$n_{\text{HNO}_3} = \frac{25 \text{ g}}{M(\text{HNO}_3)} = \frac{25 \text{ g}}{63 \text{ gmol}^{-1}} = 0,40 \text{ mol}$$

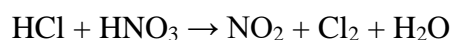
Za reakciju sa 0,40 mol azotne kiseline potrebno je 0,01 mol arsen(V)-sulfida, a za reakciju sa 0,048 mol arsen(V)-sulfida potrebno je 1,92 mol azotne kiseline. U višku je arsen(V)-sulfid.

$$n_{\text{NO}_2} = n_{\text{HNO}_3}$$

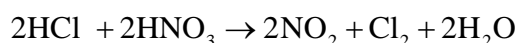
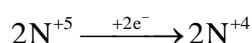
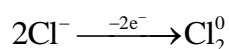
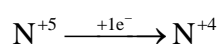
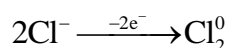
$$V_{\text{NO}_2} = n_{\text{NO}_2} \cdot 22,4 \text{ dm}^3 \text{ mol}^{-1} = 0,40 \text{ mol} \cdot 22,4 \text{ dm}^3 \text{ mol}^{-1} = 8,96 \text{ dm}^3$$

Domaći zadatak 9, Uvod u laboratorijski rad

6. Izračunati mase nastalih gasova (NO_2 i Cl_2) u reakciji 15 mL rastvora hlorovodonične kiseline (maseni procenat 40% i gustina $1,195 \text{ gcm}^{-3}$) i 10 mL rastvora azotne kiseline (maseni procenat 70% i gustina $1,42 \text{ gcm}^{-3}$)



Obratiti pažnju da prvo treba odrediti koji od dva reaktanta je u višku.



$$m_{\text{HCl}} = \frac{w\% \cdot m_{\text{rastvora}}}{100\%} = \frac{w\% \cdot V_{\text{rastvora}} \cdot \rho_{\text{rastvora}}}{100\%} = \frac{40\% \cdot 15 \text{ cm}^3 \cdot 1,195 \text{ gcm}^{-3}}{100\%} = 7,17 \text{ g}$$

$$m_{\text{HNO}_3} = \frac{w\% \cdot m_{\text{rastvora}}}{100\%} = \frac{w\% \cdot V_{\text{rastvora}} \cdot \rho_{\text{rastvora}}}{100\%} = \frac{70\% \cdot 10 \text{ cm}^3 \cdot 1,42 \text{ gcm}^{-3}}{100\%} = 9,94 \text{ g}$$

$$n_{\text{HCl}} = \frac{m_{\text{HCl}}}{M(\text{HCl})} = \frac{7,17 \text{ g}}{36,5 \text{ gmol}^{-1}} = 0,196 \text{ mol}$$

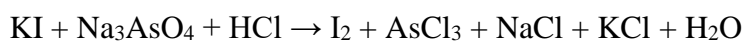
$$n_{\text{HNO}_3} = \frac{m_{\text{HNO}_3}}{M(\text{HNO}_3)} = \frac{9,94 \text{ g}}{63 \text{ gmol}^{-1}} = 0,158 \text{ mol}$$

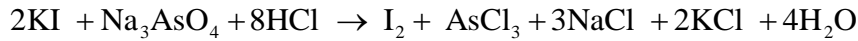
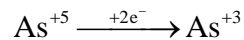
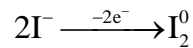
U višku je HCl.

$$m_{\text{NO}_2} = n_{\text{NO}_2} \cdot M(\text{NO}_2) = n_{\text{HNO}_3} \cdot M(\text{NO}_2) = 0,158 \text{ mol} \cdot 46 \text{ gmol}^{-1} = 7,27 \text{ g}$$

$$m_{\text{Cl}_2} = n_{\text{Cl}_2} \cdot M(\text{Cl}_2) = \frac{n_{\text{HNO}_3}}{2} \cdot M(\text{Cl}_2) = 0,079 \text{ mol} \cdot 71 \text{ gmol}^{-1} = 5,61 \text{ g}$$

7. Dodatkom KI u 150 mL rastvora Na_3AsO_4 , u prisustvu HCl, izdvojilo se 15,8 g I_2 . Izračunati molaritet rastvora Na_3AsO_4 .



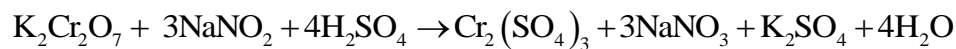
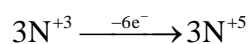
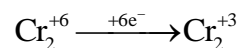
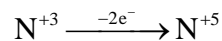
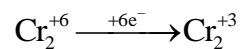
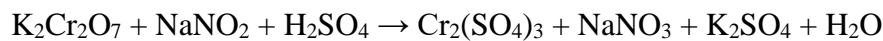


$$n_{\text{I}_2} = \frac{m_{\text{I}_2}}{M(\text{I}_2)} = \frac{15,8 \text{ g}}{254 \text{ gmol}^{-1}} = 0,0622 \text{ mol}$$

$$n_{\text{I}_2} = n_{\text{Na}_3\text{AsO}_4}$$

$$c_{\text{Na}_3\text{AsO}_4} = \frac{n_{\text{Na}_3\text{AsO}_4}}{V} = \frac{0,0622 \text{ mol}}{0,150 \text{ dm}^3} = 0,415 \text{ M}$$

8. Izračunati koncentraciju rastvora kalijum-dihromata potrebnog za oksidaciju 50 cm³ rastvora natrijum-nitrita koncentracije 0,2 M, ako je utrošeno 80 mL ovog rastvora, a prema sledećoj reakciji:

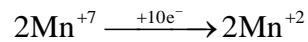
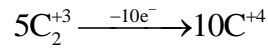
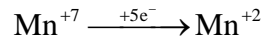
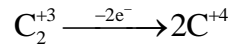


$$n_{\text{NaNO}_2} = 0,2 \text{ M} \cdot 0,05 \text{ dm}^3 = 0,01 \text{ mol}$$

$$n_{\text{K}_2\text{Cr}_2\text{O}_7} = \frac{n_{\text{NaNO}_2}}{3} = \frac{0,01 \text{ mol}}{3} = 0,0033 \text{ mol}$$

$$c_{\text{K}_2\text{Cr}_2\text{O}_7} = \frac{0,0033 \text{ mol}}{0,08 \text{ dm}^3} = 0,041 \text{ M}$$

9. Izračunati molaritet rastvora kalijum-permanganata ako se 50 cm³ ovog rastvora prvo razblaži do 1000 cm³, a nakon toga 20 cm³ novog rastvora redukuje sa 15 cm³ rastvora natrijum-oksalata koncentracije 0,03 moldm⁻³, prema sledećoj reakciji:



$$n_{\text{Na}_2\text{C}_2\text{O}_4} = 0,03\text{M} \cdot 0,015\text{dm}^3 = 4,5 \cdot 10^{-4}\text{ mol}$$

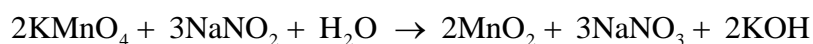
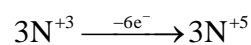
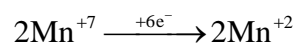
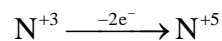
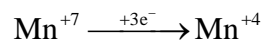
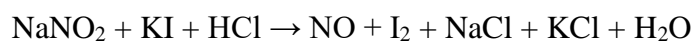
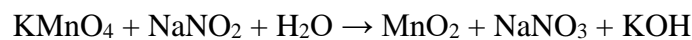
$$n_{\text{KMnO}_4} = \frac{2}{5} n_{\text{Na}_2\text{C}_2\text{O}_4} = \frac{2}{5} \cdot 4,5 \cdot 10^{-4}\text{ mol} = 1,8 \cdot 10^{-4}\text{ mol}$$

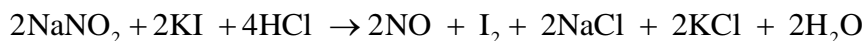
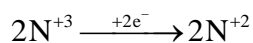
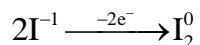
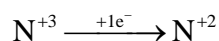
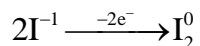
$$c_{\text{KMnO}_4} = \frac{n_{\text{KMnO}_4}}{V_{\text{KMnO}_4}} = \frac{1,8 \cdot 10^{-4}\text{ mol}}{0,02\text{dm}^3} = 0,009\text{ M}$$

Pre razblaženja:

$$c_{\text{KMnO}_4, \text{prerazblaženja}} = \frac{c_{\text{KMnO}_4} \cdot 1000\text{cm}^3}{50\text{cm}^3} = 0,18\text{ M}$$

10. Izračunati koncentraciju rastvora kalijum-permanganata, ukoliko 50 cm³ ovog rastvora reaguje sa istom količinom natrijum-nitrita kao 0,150 g kalijum-jodida u prisustvu HCl:





$$n_{\text{KI}} = \frac{0,150 \text{ g}}{166 \text{ g mol}^{-1}} = 0,0009 \text{ mol}$$

$$n_{\text{NaNO}_2} = n_{\text{KI}} = 0,0009 \text{ mol}$$

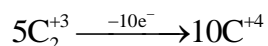
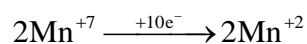
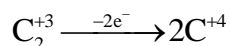
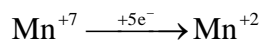
$$n_{\text{KMnO}_4} = \frac{2}{3} n_{\text{NaNO}_2} = 0,0006 \text{ mol}$$

$$c_{\text{KMnO}_4} = \frac{n_{\text{KMnO}_4}}{V} = \frac{0,0006 \text{ mol}}{0,05 \text{ dm}^3} = 0,012 \text{ M}$$

11. Kalcijum je važan element u krvi čija se koncentracija određuje oksidacijom kalcijum-oksalata nakon taloženja ove soli sa natrijum-oksalatom. Oksidacija kalcijum-oksalata se vrši u reakciji sa kalijum-permanganatom u sumpornoj kiselini prema sledećoj reakciji:



Uzet je uzorak od 5 mL krvi, i za potpunu neutralizaciju je utrošeno 33,3 mL rastvora kalijum-permanganata koncentracije $0,15 \cdot 10^{-3}$ M. Izračunati koncentraciju kalcijuma u krvi.



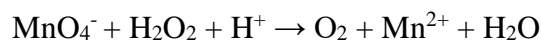
$$n_{\text{KMnO}_4} = 1,5 \cdot 10^{-4} \text{ M} \cdot 33,3 \cdot 10^{-3} \text{ dm}^3 = 5 \cdot 10^{-6} \text{ mol}$$

Domaći zadatak 9, Uvod u laboratorijski rad

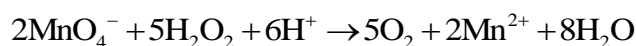
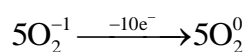
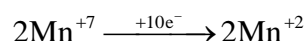
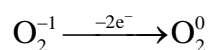
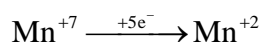
$$n_{\text{Ca}^{2+}} = n_{\text{CaC}_2\text{O}_4} = \frac{5}{2} n_{\text{KMnO}_4} = \frac{5}{2} 5 \cdot 10^{-6} \text{ mol} = 1,25 \cdot 10^{-5} \text{ mol}$$

$$c_{\text{Ca}^{2+}} = \frac{n_{\text{Ca}^{2+}}}{V} = \frac{1,25 \cdot 10^{-5} \text{ mol}}{5 \cdot 10^{-3} \text{ dm}^3} = 2,5 \cdot 10^{-3} \text{ M}$$

12. Količina vodonik-peroksida u izbeljivačima za kosu se određuje redoks titracijom sa kalijum-permanganatom u kiseloj sredini, prema jonskoj jednačini u nastavku:



Analiziran je uzorak izbeljivača od 15,3 g i za potpunu neutralizaciju je potrošeno 48,3 mL rastvora kalijum-permanganata koncentracije 0,113 M. Izračunati maseni procenat vodonik-peroksida u uzorku.



$$n_{\text{MnO}_4^{2-}} = n_{\text{KMnO}_4} = 0,113 \text{ M} \cdot 0,0483 \text{ dm}^3 = 0,0054 \text{ mol}$$

$$n_{\text{H}_2\text{O}_2} = \frac{5}{2} n_{\text{KMnO}_4} = \frac{5}{2} 0,0054 \text{ mol} = 0,0136 \text{ mol}$$

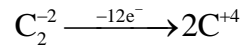
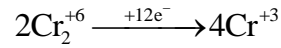
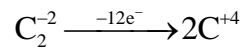
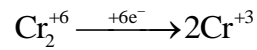
$$m_{\text{H}_2\text{O}_2} = 0,0136 \text{ mol} \cdot 34 \text{ gmol}^{-1} = 0,462 \text{ g}$$

$$\text{procenat peroksida} = \frac{0,462 \text{ g}}{15,3 \text{ g}} \cdot 100\% = 3,02\%$$

13. Alkohol u krvi se može odrediti redok titracijom sa kalijum-dihromatom u kiseloj sredini:



Uzet je uzorak od 35 g krvi i za potpunu oksidaciju je potrebno 50,3 mL 0,0732 M rastvora kalijum-dihromata. Izračunati maseni procenat alkohola u krvi. Ako je gustina krvi 1,06 gcm⁻³, izračunati masenu koncentraciju i molaritet alkohola u krvi.



$$n_{\text{Cr}_2\text{O}_7^{2-}} = n_{\text{K}_2\text{Cr}_2\text{O}_7} = 0,0732 \text{ M} \cdot 0,0503 \text{ dm}^3 = 0,0037 \text{ mol}$$

$$n_{\text{C}_2\text{H}_5\text{OH}} = \frac{n_{\text{Cr}_2\text{O}_7^{2-}}}{2} = \frac{0,0037 \text{ mol}}{2} = 0,00185 \text{ mol}$$

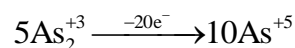
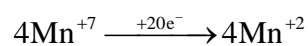
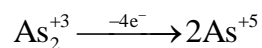
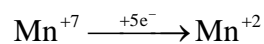
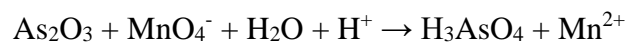
$$m_{\text{C}_2\text{H}_5\text{OH}} = n_{\text{C}_2\text{H}_5\text{OH}} \cdot M(\text{C}_2\text{H}_5\text{OH}) = 0,0851 \text{ g}$$

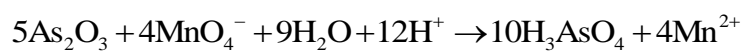
$$w\% = \frac{0,0851 \text{ g}}{35 \text{ g}} \cdot 100\% = 0,24\%$$

$$c_{m,\text{C}_2\text{H}_5\text{OH}} = \frac{m_{\text{C}_2\text{H}_5\text{OH}}}{M\rho} = \frac{0,0851 \text{ g} \cdot 1,06 \text{ gcm}^{-3}}{35 \text{ g}} = 2,58 \text{ gdm}^{-3}$$

$$c_{\text{C}_2\text{H}_5\text{OH}} = \frac{n_{\text{C}_2\text{H}_5\text{OH}}}{M\rho} = \frac{0,00185 \text{ mol} \cdot 1,06 \text{ gcm}^{-3}}{35 \text{ g}} = 0,056 \text{ mol dm}^{-3}$$

14. Rastvor kalijum-permanganata može biti standardizovan titracijom sa As_2O_3 . Ako je 20,86 mL rastvora kalijum-permanganata potrebno za reakciju sa 0,2069 g As_2O_3 , izračunati koncentraciju rastvora.





$$n_{\text{As}_2\text{O}_3} = \frac{m_{\text{As}_2\text{O}_3}}{M(\text{As}_2\text{O}_3)} = \frac{0,2069 \text{ g}}{198 \text{ g mol}^{-1}} = 0,00105 \text{ mol}$$

$$n_{\text{MnO}_4^-} = n_{\text{KMnO}_4} = \frac{4}{5} n_{\text{As}_2\text{O}_3} = 0,00084 \text{ mol}$$

$$c_{\text{KMnO}_4} = \frac{n_{\text{KMnO}_4}}{V} = \frac{0,00084 \text{ mol}}{0,02086 \text{ dm}^3} = 0,04 \text{ M}$$