

4. OKSIDACIJA I REDUKCIJA

Oksidacijski broj atoma svih elemenata u elementarnom stanju je nula (0).

Oksidacijski broj vodika u spojevima je (+1), osim u hidridima metala, gdje je oksidacijski broj vodika (-1).

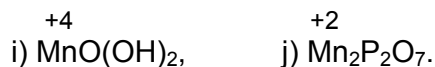
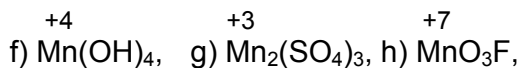
Oksidacijski broj kisika u spojevima je (-2), osim u peroksidima, kod kojih je oksidacijski broj kisika (-1).

Suma svih oksidacijskih brojeva elemenata, koji se nalaze u spoju mora biti jednaka nuli.

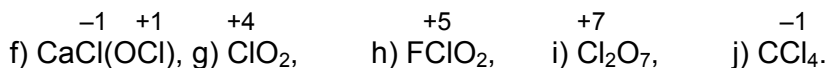
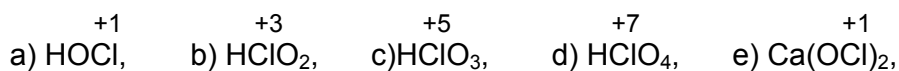
Suma svih oksidacijskih brojeva elemenata u kompleksnim ionima ili radikalima mora biti jednaka naboju iona ili radikala.

U kovalentnim spojevima, čija je strukturna formula poznata, oksidacijski broj pojedinog atoma jest naboj koji ostaje na tom atomu kada sve elektronske parove dodijelimo atomima elektronegativnijih elemenata.

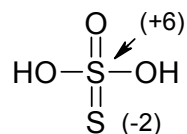
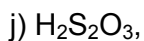
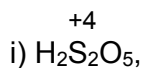
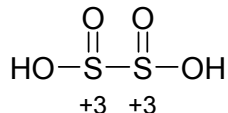
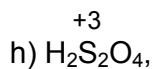
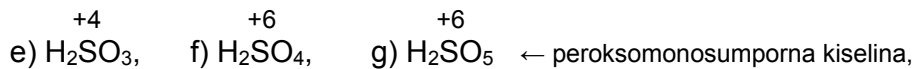
4.1. Vidi STEHIOMETRIJA



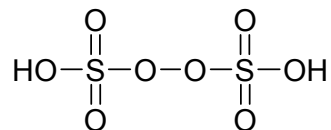
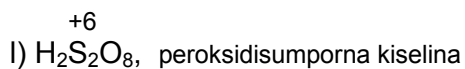
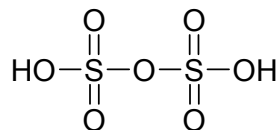
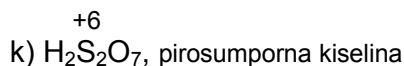
4.2. Vidi STEHIOMETRIJA



4.3. Vidi STEHIOMETRIJA

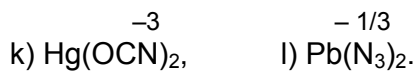
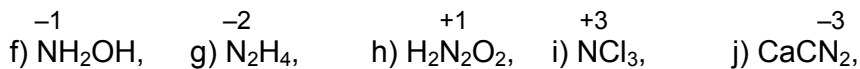
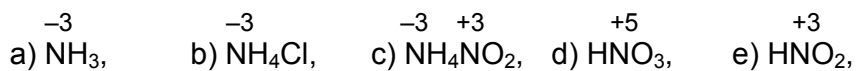


Atomi sumpora nisu ekvivalentni. Centralnom atomu možemo pripisati oksidacijski broj (+6), a onom atomu koji zamjenjuje atom kisika pripisujemo oksidacijski broj (-2).

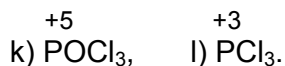
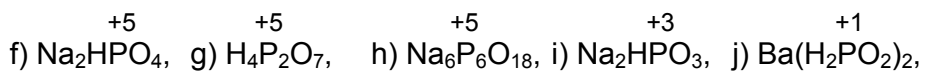
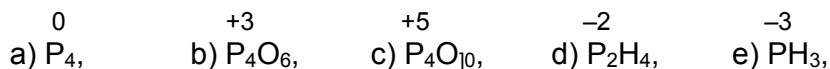


Nisu izolirane slobodne kiseline H_2SO_3 , $H_2S_2O_4$, $H_2S_2O_5$, $H_2S_2O_3$. Poznate su samo njihove soli koje se u kiselim otopinama disproportioniraju.

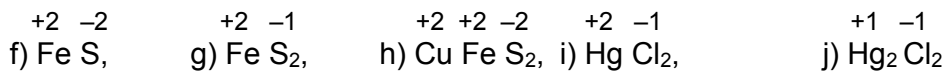
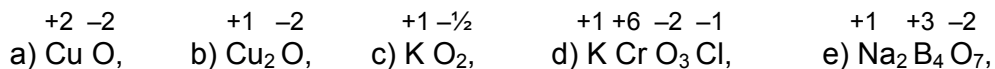
4.4. Vidi STEHIOMETRIJA



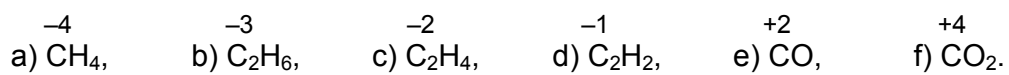
4.5. Vidi STEHIOMETRIJA



4.6. Vidi STEHIOMETRIJA

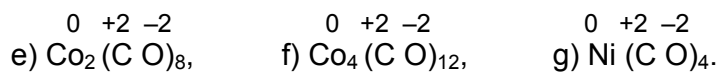
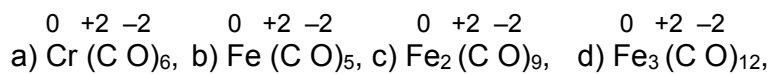


4.7. Vidi STEHIOMETRIJA



4.8. Vidi STEHIOMETRIJA

U svim karbonilima metal ima oksidacijski broj nula, ugljik +2 i kisik -2.

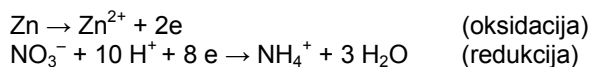


4.9. Vidi STEHIOMETRIJA

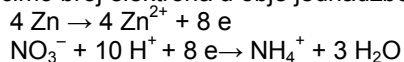
U svim su jednađbama zadani reaktanti i produkti. Treba uskladiti lijevu i desnu stranu jednađbe tako da broj atoma i naboja na lijevoj strani bude jednak broju atoma i naboja na desnoj strani jednađbe. Uvijek treba u zadanoj reakciji uočiti koji se kemijski element oksidira a koji reducira. Potom treba zadanu reakciju rastaviti na polureakcije oksidacije i redukcije. Svaku polureakciju moramo uravnotežiti tako da dodamo potreban broj elektrona, na desnu stranu u polureakciji oksidacije, a na lijevu stranu u polureakciji redukcije. Kad se na desnoj strani polureakcije pojavljuje kisik, a nema ga na lijevoj strani jednađbe onda na lijevu stranu dodajemo vodu. Tad se na desnoj strani jednađbe pojavljuju ioni H^+ koje treba neutralizirati odgovarajućim brojem elektrona. Ako se na lijevoj strani jednađbe pojavljuju ioni H^+ tad ih se na desnoj strani zajedno s kisikom iskazuje kao vodu.

Najbolje je jednađbu rješavati u ionskom obliku, a potom po potrebi napisati u molekulskom obliku. Zadatak ćete naći u STEHIOMETRIJI, a ovdje se navode samo rješenja. Tiskani su materijali zaštićeni izdavačkim pravima i zato se sadržaji iz STEHIOMETRIJE ne mogu reproducirati na internetu.

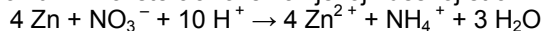
4.9.a) Vidi STEHIOMETRIJA



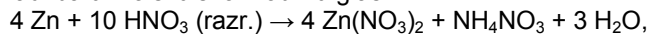
Izjednačimo broj elektrona u obje jednađbe.



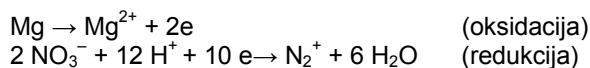
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani.



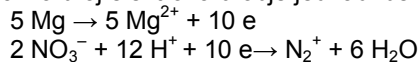
Ista jednađba u molekulskom obliku glasi:



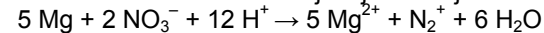
4.9.b) Vidi STEHIOMETRIJA



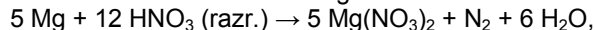
Izjednačimo broj elektrona u obje jednađbe



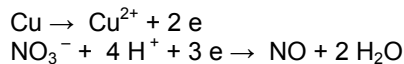
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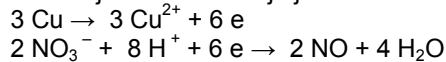
Ista jednađba u molekulskom obliku glasi:



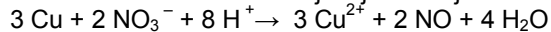
4.9.c) Vidi STEHIOMETRIJA



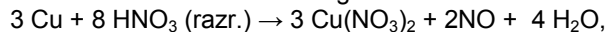
Izjednačimo broj elektrona u obje jednađbe

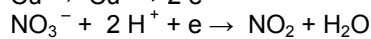


Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani.

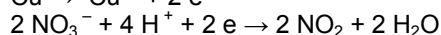
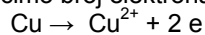


Ista jednađba u molekulskom obliku glasi:

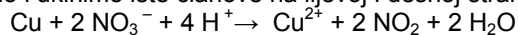


4.9.d) Vidi STEHIOMETRIJA

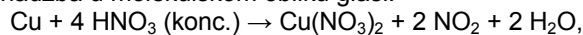
Izjednačimo broj elektrona u obje jednađžbe



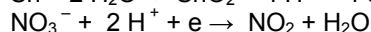
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani.



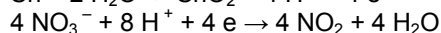
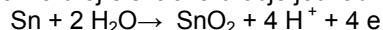
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**4.9.e)** Vidi STEHIOMETRIJA

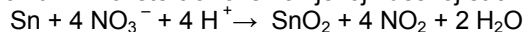
Kad se na desnoj strani jednađžbe pojavljuje kisik, a nema ga na lijevoj strani jednađžbe onda na lijevu stranu dodajemo vodu. Tad se na desnoj strani jednađžbe pojavljuju ioni H^+ koje treba neutralizirati odgovarajućim brojem elektrona. Ako se na lijevoj strani jednađžbe pojavljuju ioni H^+ tad ih se na desnoj strani zajedno s kisikom iskazuje kao vodu.



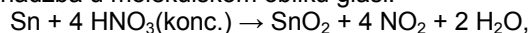
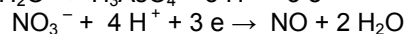
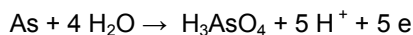
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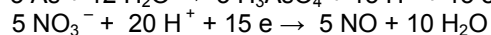
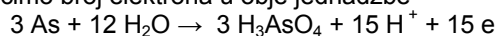
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani.



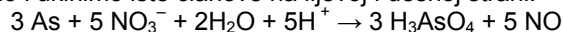
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**4.9.f)** Vidi STEHIOMETRIJA

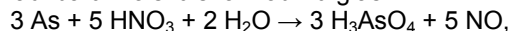
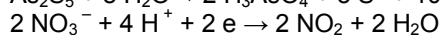
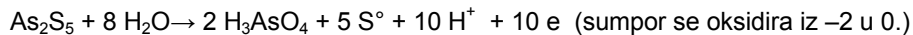
Izjednačimo broj elektrona u obje jednađžbe



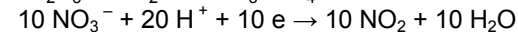
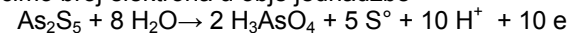
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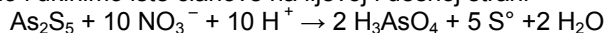
Ista jednađžba u molekulskom obliku glasi

**4.9.g)** Vidi STEHIOMETRIJA

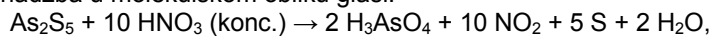
Izjednačimo broj elektrona u obje jednađžbe

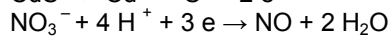


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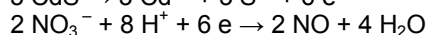
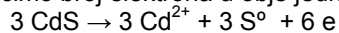


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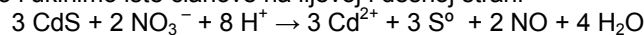


4.9.h) Vidi STEHIOMETRIJA

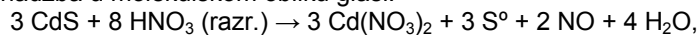
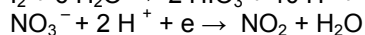
Izjednačimo broj elektrona u obje jednačbe



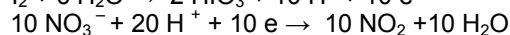
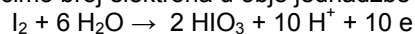
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



Ista jednačba u molekulskom obliku glasi:

**4.9.i)** Vidi STEHIOMETRIJA

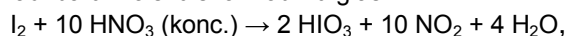
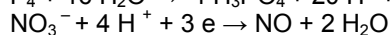
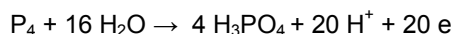
Izjednačimo broj elektrona u obje jednačbe



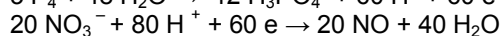
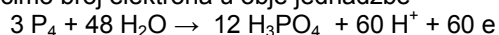
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



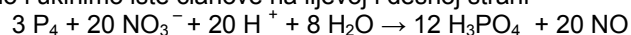
Ista jednačba u molekulskom obliku glasi:

**4.9.j)** Vidi STEHIOMETRIJA

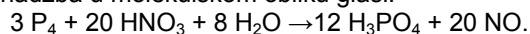
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



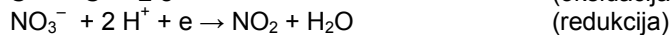
Ista jednačba u molekulskom obliku glasi:



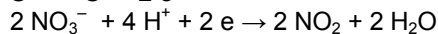
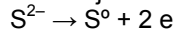
4.10.

U reakciji sa sulfidima koncentrirana dušična kiselina se reducira do dušikova dioksida. Pritom se sumpor oksidira iz oksidacijskog stanja (-2) u elementarni sumpor. Ako se na lijevoj strani jednadžbe pojavljuju ioni H^+ tad ih se na desnoj strani zajedno s kisikom iskazuje kao vodu.

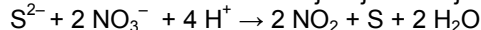
4.10.a) Vidi STEHIOMETRIJA



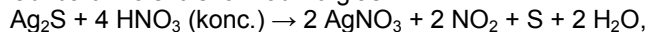
Izjednačimo broj elektrona u obje jednadžbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

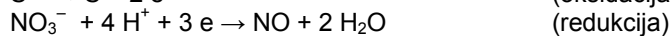


Ista jednadžba u molekulskom obliku glasi:

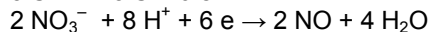
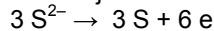


4.10.b) Vidi STEHIOMETRIJA

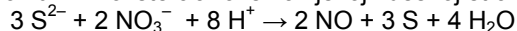
U reakciji sa sulfidima razrijeđena se dušična kiselina reducira do dušikova monoksida. Pritom se sumpor oksidira iz oksidacijskog stanja (-2) u elementarni sumpor



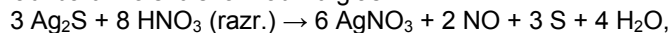
Izjednačimo broj elektrona u obje jednadžbe



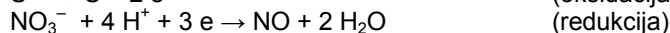
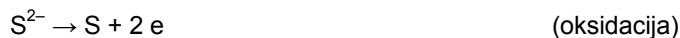
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



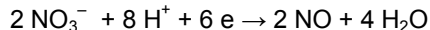
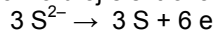
Ista jednadžba u molekulskom obliku glasi:



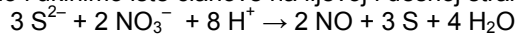
4.10.c) Vidi STEHIOMETRIJA



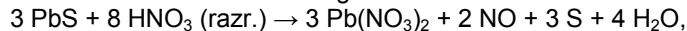
Izjednačimo broj elektrona u obje jednadžbe



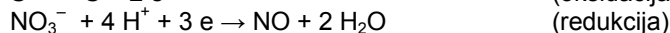
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



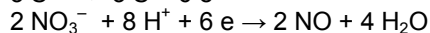
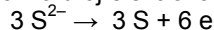
Ista jednadžba u molekulskom obliku glasi:



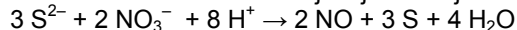
4.10.d) Vidi STEHIOMETRIJA



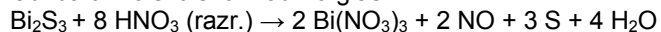
Izjednačimo broj elektrona u obje jednadžbe

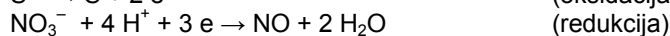


Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

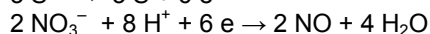
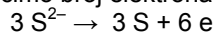


Ista jednadžba u molekulskom obliku glasi:

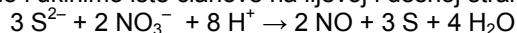


4.10.e) Vidi STEHIOMETRIJA

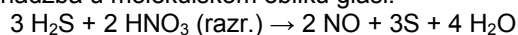
Izjednačimo broj elektrona u obje jednađžbe



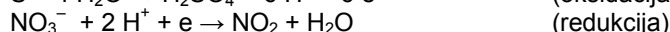
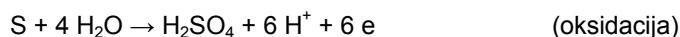
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



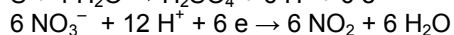
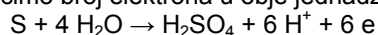
Ista jednađžba u molekulskom obliku glasi:

**4.10.f)** Vidi STEHIOMETRIJA

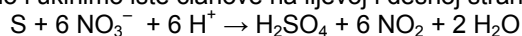
Koncentrirana dušična kiselina može oksidirati sumpor do sulfata, a sama se pritom reducira do dušikova dioksida. Kad se na desnoj strani jednađžbe pojavljuje kisik, a nema ga na lijevoj strani jednađžbe onda na lijevu stranu dodajemo vodu. Tad se na desnoj strani jednađžbe pojavljuju ioni H^+ koje treba neutralizirati odgovarajućim brojem elektrona. Ako se na lijevoj strani jednađžbe pojavljuju ioni H^+ tad ih se na desnoj strani zajedno s kisikom iskazuje kao vodu.



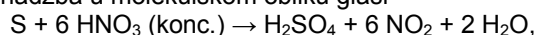
Izjednačimo broj elektrona u obje jednađžbe



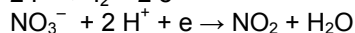
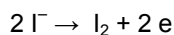
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



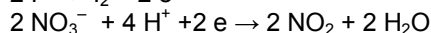
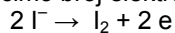
Ista jednađžba u molekulskom obliku glasi

**4.10.g)** Vidi STEHIOMETRIJA

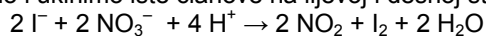
Koncentrirana dušična kiselina oksidira jodidne i kloridne ione u elementarni jod, odnosno klor, a sama se pritom reducira u dušikov dioksid.



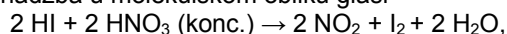
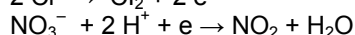
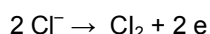
Izjednačimo broj elektrona u obje jednađžbe



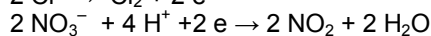
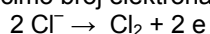
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



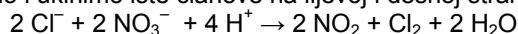
Ista jednađžba u molekulskom obliku glasi

**4.10.h)** Vidi STEHIOMETRIJA

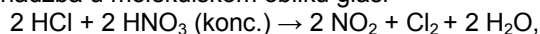
Izjednačimo broj elektrona u obje jednađžbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

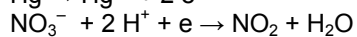
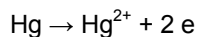


Ista jednađžba u molekulskom obliku glasi

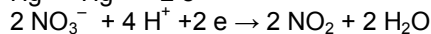
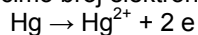


4.10.i) Vidi STEHIOMETRIJA

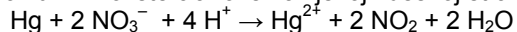
Koncentrirana dušična kiselina oksidira elementarnu živu u ione Hg^{2+} , a sama se pritom reducira do dušikova dioksida.



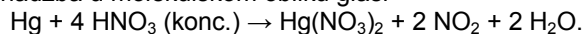
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



Ista jednačba u molekulskom obliku glasi

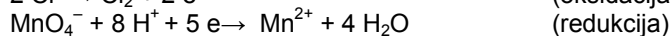


4.11. Vidi STEHIOMETRIJA

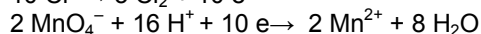
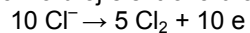
Kalijev permanganat jako je oksidacijsko sredstvo. U kiselim otopinama mangan se iz oksidacijskog stanja (+7) reducira u oksidacijsko stanje (+2).

Postupamo na jednak način. Napišimo najprije polureakcije oksidacije i redukcije u ionskom obliku.

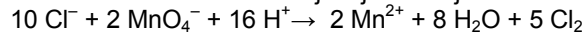
Ako na lijevoj strani polureakcije imamo višak kisika tad dodajemo ione H^+ koje na desnoj strani polureakcije iskazujemo kao vodu. Nesmijemo zaboraviti da broj atoma i naboja na lijevoj strani jednačbe svake polureakcije oksidacije ili redukcije mora biti jednak broju atoma i naboja na desnoj strani jednačbe polureakcije oksidacije ili redukcije.

4.11. a) Vidi STEHIOMETRIJA

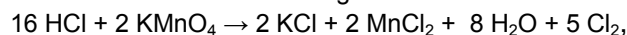
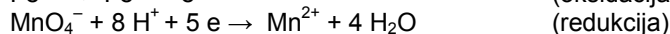
Izjednačimo broj elektrona u obje jednačbe



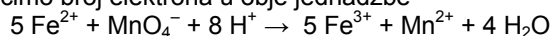
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



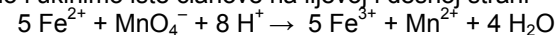
Ista jednačba u molekulskom obliku glasi

**4.11. b)** Vidi STEHIOMETRIJA

Izjednačimo broj elektrona u obje jednačbe



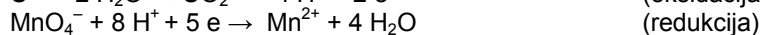
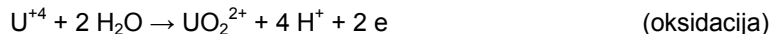
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



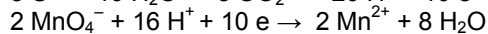
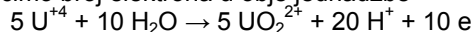
Ista jednačba u molekulskom obliku glasi

**4.11. c)** Vidi STEHIOMETRIJA

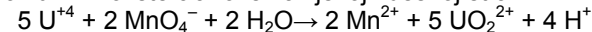
Uranij u spojevima može poprimiti oksidacijska stanja +3, +4, +5 i +6. U kiselim otopinama kalijev permanganat oksidira uranij do najvišeg oksidacijskog stanja, +6. U oksidacijskom stanju +6 uranij se javlja kao UF_6 i UO_3 , te u obliku uranil-soli, UO_2^{2+} , koje nastaju otapanjem UO_3 u kiselinama.



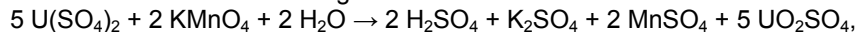
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

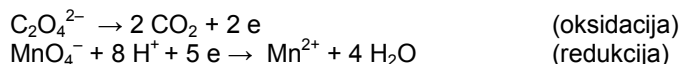


Ista jednačba u molekulskom obliku glasi

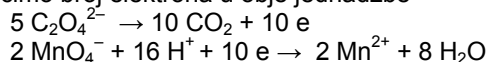


4.11.d) Vidi STEHIOMETRIJA

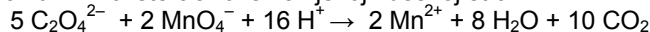
U kiseloj otopini permanganat oksidira oksalatne ione, $C_2O_4^{2-}$, u ugljikov dioksid. Pritom se permanganatni ioni reduciraju u ione Mn^{2+} .



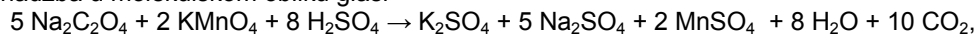
Izjednačimo broj elektrona u obje jednačbe



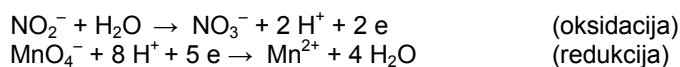
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



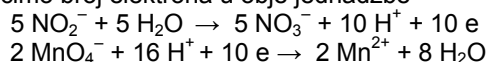
Ista jednačba u molekulskom obliku glasi

**4.11.e)** Vidi STEHIOMETRIJA

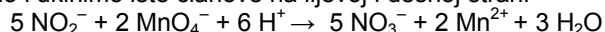
:



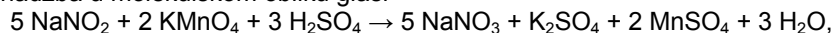
Izjednačimo broj elektrona u obje jednačbe



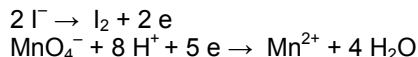
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



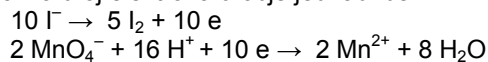
Ista jednačba u molekulskom obliku glasi

**4.11.f)** Vidi STEHIOMETRIJA

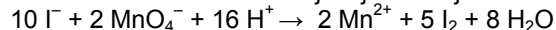
U kiseloj otopini permanganatni ioni oksidiraju jodidne, bromidne i kloridne ione u elementarni jod, odnosno brom i klor.



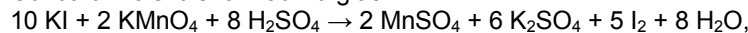
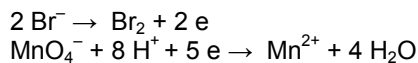
Izjednačimo broj elektrona u obje jednačbe



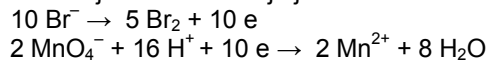
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



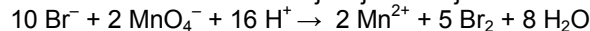
Ista jednačba u molekulskom obliku glasi

**4.11.g)** Vidi STEHIOMETRIJA

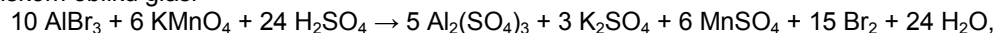
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



S obzirom da nam je kao reaktant zadan $AlBr_3$, sumarnu jednačbu množimo s 3, pa jednačba u molekulskom obliku glasi



4.11.h) Vidi STEHIOMETRIJA

Kalijev permanganat je jako oksidacijsko sredstvo koje oksidira sulfidne ione djelomično u elementarni sumpor, a djelomično u sulfatne ione. Nastali ioni Mn^{2+} reagiraju sa sulfidnim ionima tako da nastaje netopljivi MnS .

Moguće je više redoks-reakcija:

Oksidacija iona S^{2-} permanganatnim ionima u elementarni sumpor.

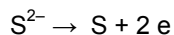
Oksidacija iona S^{2-} permanganatnim ionima u sulfatne ione.

Oksidacija iona S^{2-} permanganatnim ionima u sulfidne ione koji sa elementarnim sumporom daju tiosulfate. U tiosulfatima centralni atom sumpora ima oksidacijski broj +6, a onaj atom sumpora koji zamjenjuje atom kisika ima oksidacijski broj -2, kao što smo već kazali u zadatku 4.3.j.

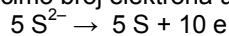
Pretpostavimo da se oksidacija odvija tako da nastaju samo elementarni sumpor i sulfatni ioni.

Možemo napisati dvije redoks-jednadžbe:

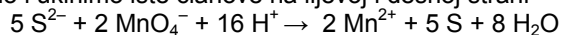
1.



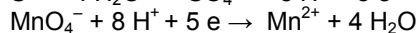
Izjednačimo broj elektrona u obje jednadžbe



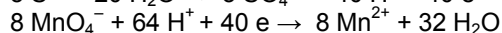
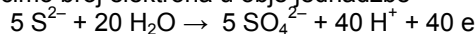
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



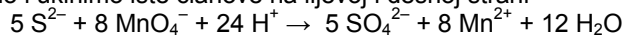
2.



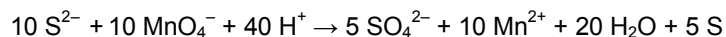
Izjednačimo broj elektrona u obje jednadžbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



Zbrojimo jednadžbe 1. i 2. pa dobivamo:

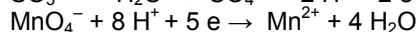
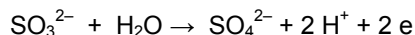


Ista jednadžba u molekulskom obliku glasi

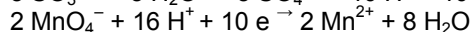
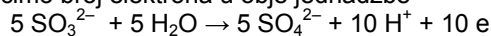


4.11.i) Vidi STEHIOMETRIJA

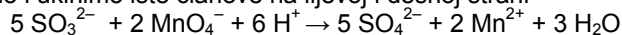
Sulfiti se kalijevim permanganatom oksidiraju u sulfate.



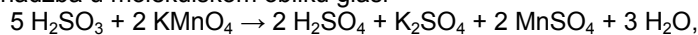
Izjednačimo broj elektrona u obje jednadžbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

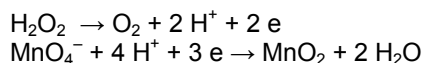


Ista jednadžba u molekulskom obliku glasi

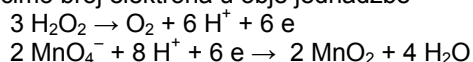


4.11.j) Vidi STEHIOMETRIJA

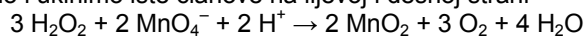
Vodikov peroksid može djelovati kao oksidan ili reducens. Kalijev je permanganat jače oksidacijsko sredstvo od vodikova peroksida pa ga oksidira u elementarni kisik. Ako se reakcija odvija u lužnatoj otopini, kalijev se permanganat reducira samo do oksidacijskog stanja +4 u lužinama netopljivom manganovu dioksidu.



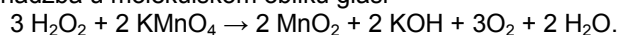
Izjednačimo broj elektrona u obje jednačbe



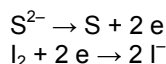
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



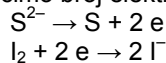
Ista jednačba u molekulskom obliku glasi



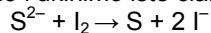
4.12.a) Vidi STEHIOMETRIJA



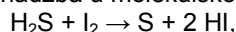
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

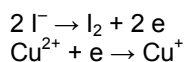


Ista jednačba u molekulskom obliku glasi

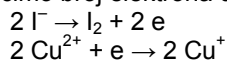


4.12.b) Vidi STEHIOMETRIJA

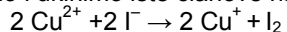
Kad se u otopinu koja sadržava ione Cu^{2+} doda otopina kalijeva jodida izluči se elementarni jod i netopljivi bijeli talog bakrova(I) jodida. Izlučeni se jod može titrirati otopinom tiosulfata pa ta reakcija često služi za kvantitavno određivanje sadržaja iona Cu^{2+} .



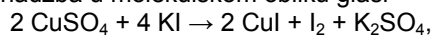
Izjednačimo broj elektrona u obje jednačbe



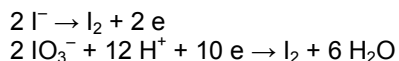
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



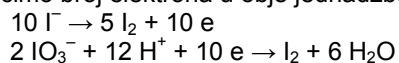
Ista jednačba u molekulskom obliku glasi



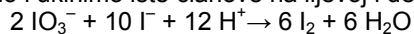
4.12.c) Vidi STEHIOMETRIJA



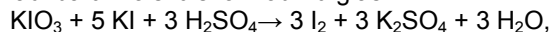
Izjednačimo broj elektrona u obje jednačbe



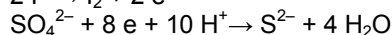
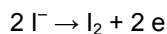
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



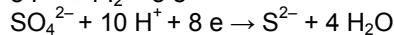
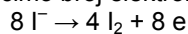
Ista jednačba u molekulskom obliku glasi



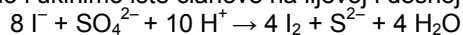
4.12.d) Vidi STEHIOMETRIJA



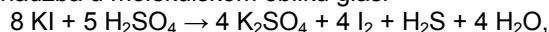
Izjednačimo broj elektrona u obje jednačbe



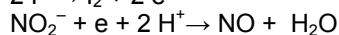
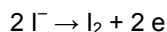
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



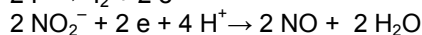
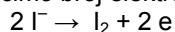
Ista jednačba u molekulskom obliku glasi



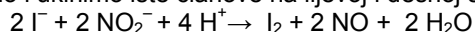
4.12.e) Vidi STEHIOMETRIJA



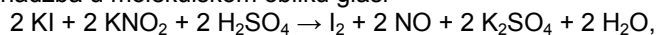
Izjednačimo broj elektrona u obje jednačbe



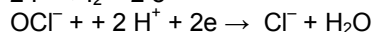
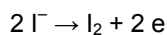
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



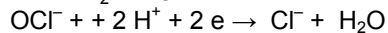
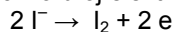
Ista jednačba u molekulskom obliku glasi



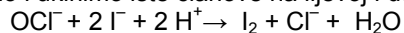
4.12.f) Vidi STEHIOMETRIJA



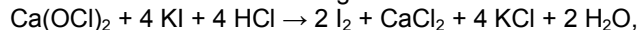
Izjednačimo broj elektrona u obje jednačbe



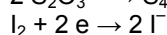
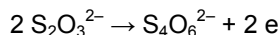
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



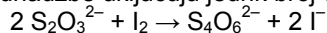
Ista jednačba u molekulskom obliku glasi



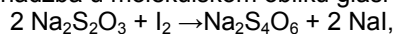
4.12.g) Vidi STEHIOMETRIJA



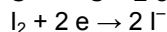
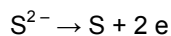
Obje jednačbe uključuju jedn. broj elektrona pa ih možemo zbrojiti



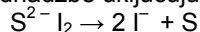
Ista jednačba u molekulskom obliku glasi



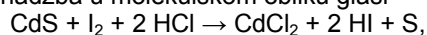
4.12.h) Vidi STEHIOMETRIJA



Obje jednačbe uključuju jedn. broj elektrona pa ih možemo zbrojiti

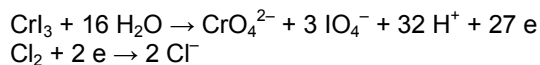


Ista jednačba u molekulskom obliku glasi

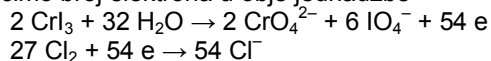


4.12.i) Vidi STEHIOMETRIJA

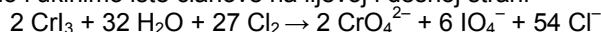
U ovom slučaju imam dvije tvari koje se oksidiraju. Jodidni se ioni oksidiraju u jodate, odnosno iz oksidacijskog stanja (-1) u stanje (+7) pri čemu se oslobađa 8 elektrona po jednom jodidnom ionu. Istodobno se ioni Cr^{3+} oksidiraju u kromatne ione, odnosno iz oksidacijskog stanja (+3) u stanje (+6).



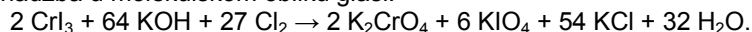
Izjednačimo broj elektrona u obje jednačbe



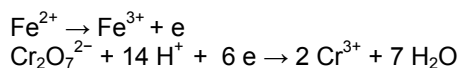
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



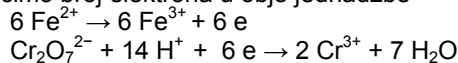
Reakcija se odvija u lužnatoj otopini i zato moramo uključiti odgovarajući broj formulskih jedinica KOH. Ista jednačba u molekulskom obliku glasi:



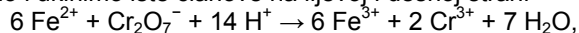
4.13.a) Vidi STEHIOMETRIJA



Izjednačimo broj elektrona u obje jednačbe



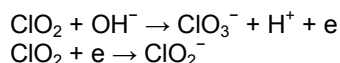
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



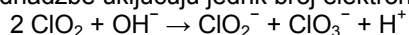
Još jednom provjerimo je li se na obje strane jednačbe nalazi jednak broj atoma i naboja.

4.13. b) Vidi STEHIOMETRIJA

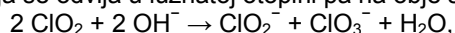
Reakcije ove vrste nazivaju se reakcijama disproporcioniranja, tj. isti se ioni međusobno oksidiraju i reduciraju. Ova se reakcija događa u lužnatoj otopini. Zato umjesto vode na lijevu stranu dodajemo ione OH^- .



Obje jednačbe uključuju jednaki broj elektrona pa ih možemo zbrojiti

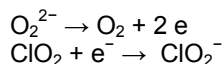


Reakcija se odvija u lužnatoj otopini pa na obje strane dodajemo ion OH^-

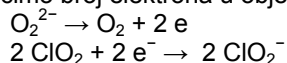


4.13. c) Vidi STEHIOMETRIJA

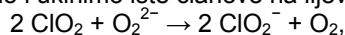
Peroksidni ioni mogu biti oksidansi ili reducensi. ClO_2 je jači oksidans od iona O_2^{2-} . Zato se peroksid oksidira u elementarni kisik (kisik iz oksidacijskog stanja (-1) prelazi u oksidacijsko stanje (0)), a ClO_2 reducira u klorit, ClO_2^- .



Izjednačimo broj elektrona u obje jednačbe



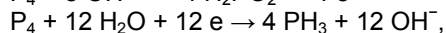
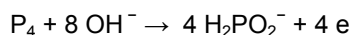
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



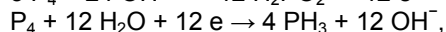
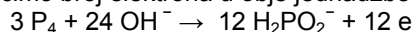
4.13. d) Vidi STEHIOMETRIJA

Ova se reakcija događa u lužnatoj otopini. Zato umjesto vode na lijevu stranu reakcije oksidacije dodajemo ione OH^- .

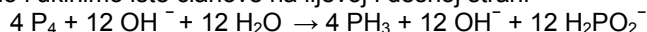
I ovdje dolazi do reakcije disproporcioniranja.



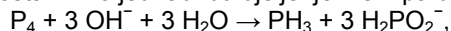
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

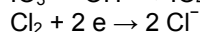
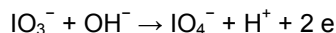


Pojednostavnimo jednačbu djeljenjem s 4 pa dobivamo:

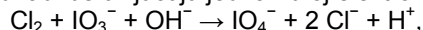


4.13. e) Vidi STEHIOMETRIJA

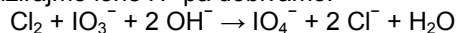
Reakcija se događa u lužnatoj otopini, pa umjesto vode dodajemo ione OH^- .



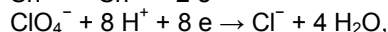
Objе jednačbe uključuju jednak broj elektrona pa ih možemo zbrojiti



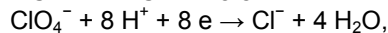
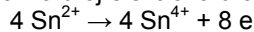
Neutralizirajmo ione H^+ pa dobivamo:



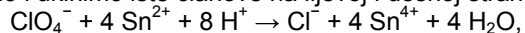
4.13. f) Vidi STEHIOMETRIJA



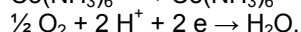
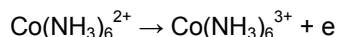
Izjednačimo broj elektrona u obje jednačbe



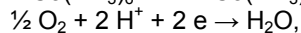
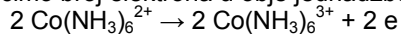
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



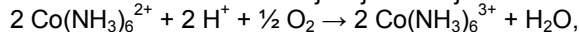
4.13. h) Vidi STEHIOMETRIJA



Izjednačimo broj elektrona u obje jednačbe

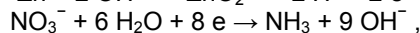
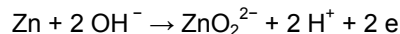


Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

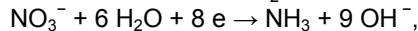
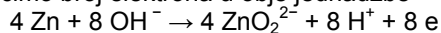


4.13. i) Vidi STEHIOMETRIJA

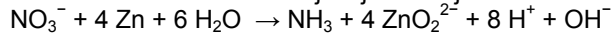
Reakcija se događa u lužnatoj otopini, pa umjesto vode u reakciji oksidacije dodajemo ione OH^- .



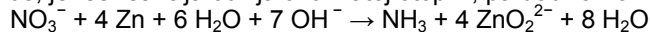
Izjednačimo broj elektrona u obje jednačbe



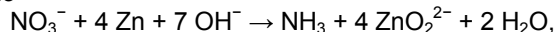
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



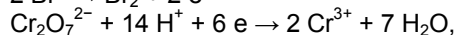
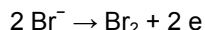
Dodajmo na obje strane jednačbe 7 iona OH^- , kako bismo neutralizirali ione H^+ na desnoj strani jednačbe, jer se reakcija odvija u lužnatoj otopini, pa dobivamo:



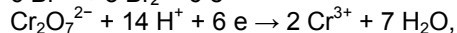
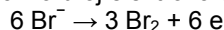
odnosno



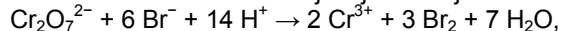
4.13. j) Vidi STEHIOMETRIJA



Izjednačimo broj elektrona u obje jednačbe

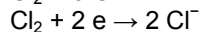
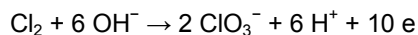


Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani

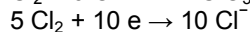
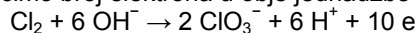


4.13. k) Vidi STEHIOMETRIJA

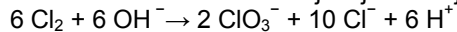
Reakcija se događa u lužnatoj otopini, pa umjesto vode dodajemo ione OH^- .



Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



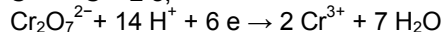
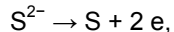
Jednačbu možemo podijeliti s 2 pa dobivamo:



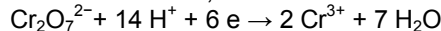
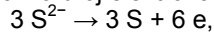
Ako na obje strane jednačbe dodamo 3 iona OH^- , kako bismo neutralizirali ione H^+ na desnoj strani konačno dobivamo:



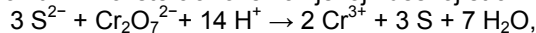
4.13. l) Vidi STEHIOMETRIJA



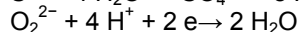
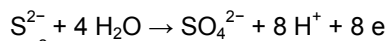
Izjednačimo broj elektrona u obje jednačbe



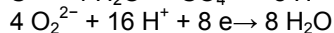
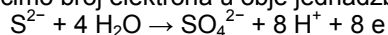
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



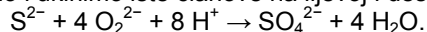
4.13. m) Vidi STEHIOMETRIJA



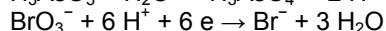
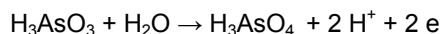
Izjednačimo broj elektrona u obje jednađžbe



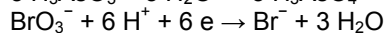
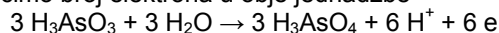
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



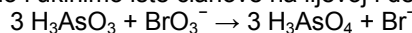
4.14. a) Vidi STEHIOMETRIJA



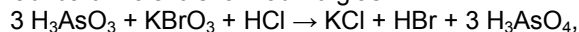
Izjednačimo broj elektrona u obje jednađžbe



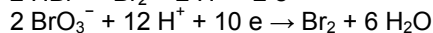
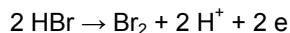
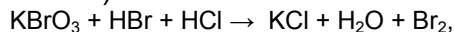
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



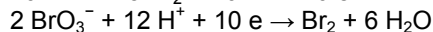
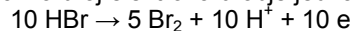
Ista jednađžba u molekulskom obliku glasi



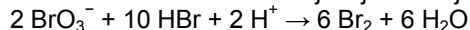
4.14. b) Vidi STEHIOMETRIJA



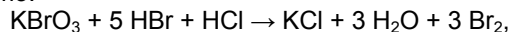
Izjednačimo broj elektrona u obje jednađžbe



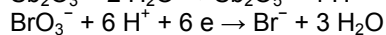
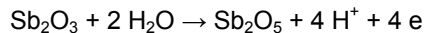
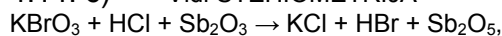
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



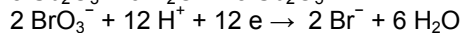
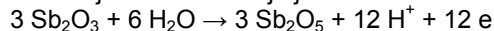
Prema uvjetime zadatka dodajmo ione K^+ i Cl^- . Očito je da cijelu jednađžbu možemo podijeliti s 2 pa dobivamo:



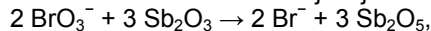
4.14. c) Vidi STEHIOMETRIJA



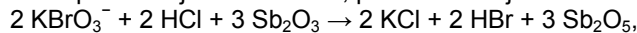
Izjednačimo broj elektrona u obje jednađžbe



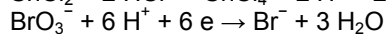
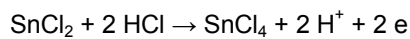
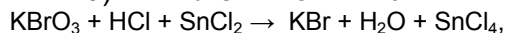
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



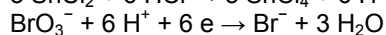
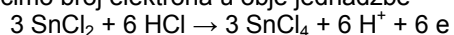
Dodajmo HCl prema uvjetime zadatka, pa dobivamo jednađžbu u molekulskom obliku.



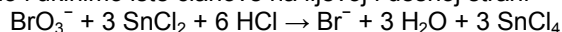
4.14. d) Vidi STEHIOMETRIJA



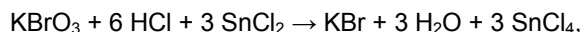
Izjednačimo broj elektrona u obje jednačbe



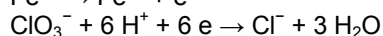
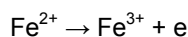
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



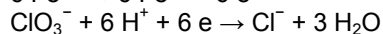
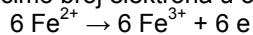
Dodajmo kalijeve ione prema uvjetima zadatka pa dobivamo jednačbu u molekulskom obliku.



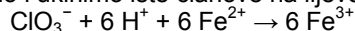
4.14. e) Vidi STEHIOMETRIJA



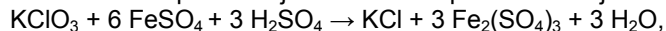
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



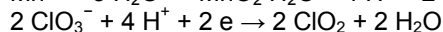
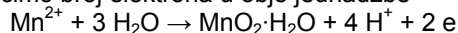
Dodajmo sulfatne ione prema uvjetima zadatka pa dobivamo jednačbu u molekulskom obliku.



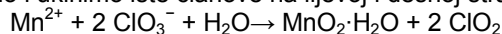
4.14. f) Vidi STEHIOMETRIJA



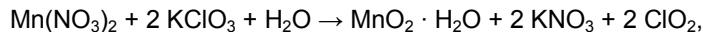
Izjednačimo broj elektrona u obje jednačbe



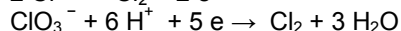
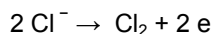
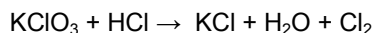
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



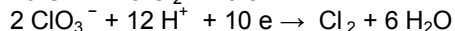
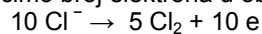
Dodajmo nitratne i kalijeve ione prema uvjetima zadatka pa dobivamo jednačbu u molekulskom obliku



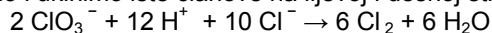
4.14. g) Vidi STEHIOMETRIJA



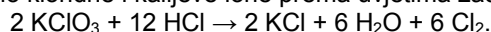
Izjednačimo broj elektrona u obje jednačbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



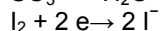
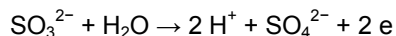
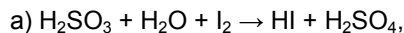
Dodajmo kloridne i kalijeve ione prema uvjetima zadatka pa dobivamo



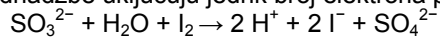
Jednačba je djeljiva s 2 pa konačno dobivamo



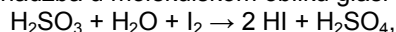
4.15. a) Vidi STEHIOMETRIJA



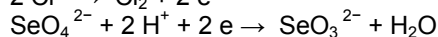
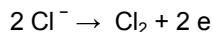
Obje jednađbe ukljućuju jednã broj elektrona pa ih možemo zbrojiti



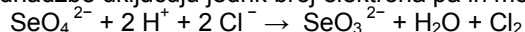
Ista jednađba u molekulskom obliku glasi



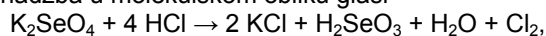
4.15. b) Vidi STEHIOMETRIJA



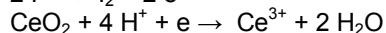
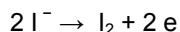
Obje jednađbe ukljućuju jednã broj elektrona pa ih možemo zbrojiti



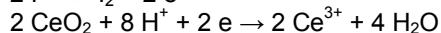
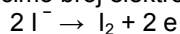
Ista jednađba u molekulskom obliku glasi



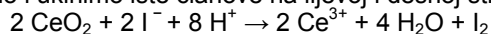
4.15. c) Vidi STEHIOMETRIJA



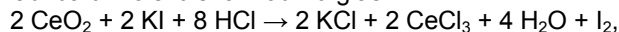
Izjednaćimo broj elektrona u obje jednađbe



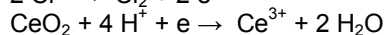
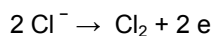
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



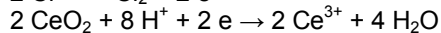
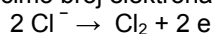
Ista jednađba u molekulskom obliku glasi



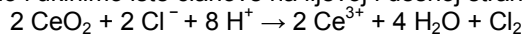
4.15. d) Vidi STEHIOMETRIJA



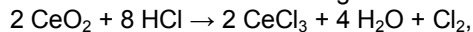
Izjednaćimo broj elektrona u obje jednađbe



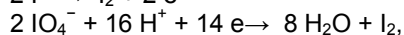
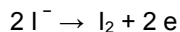
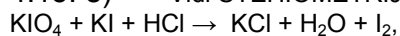
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



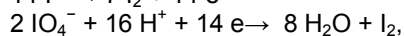
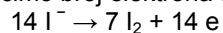
Ista jednađba u molekulskom obliku glasi



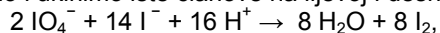
4.15. e) Vidi STEHIOMETRIJA



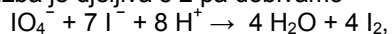
Izjednaćimo broj elektrona u obje jednađbe



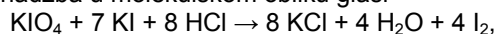
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



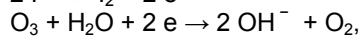
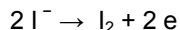
Jednađba je djeljiva s 2 pa dobivamo



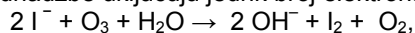
Ista jednađba u molekulskom obliku glasi



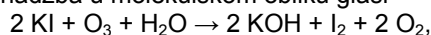
4.15. f) Vidi STEHIOMETRIJA



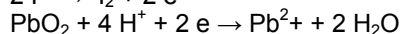
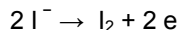
Objе једнадџбе укључују једнк број електрона па их моџемо збројити



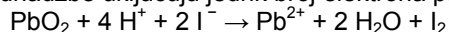
Ista једнадџба u molekulskom obliku glasi



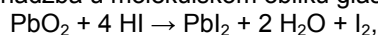
4.15. g) Vidi STEHIOMETRIJA



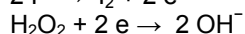
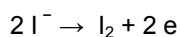
Objе једнадџбе укључују једнк број електрона па их моџемо збројити



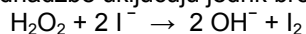
Ista једнадџба u molekulskom obliku glasi



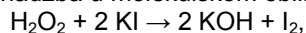
4.15. h) Vidi STEHIOMETRIJA



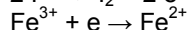
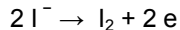
Objе једнадџбе укључују једнк број електрона па их моџемо збројити



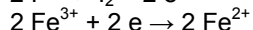
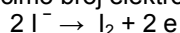
Ista једнадџба u molekulskom obliku glasi



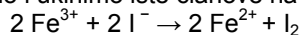
4.15. i) Vidi STEHIOMETRIJA



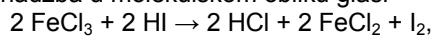
Izјednačimo број електрона u obje једнадџбе



Zbroјimo i ukinimo iste članove na lijevoj i desnoj strani

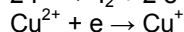
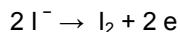


Ista једнадџба u molekulskom obliku glasi

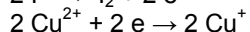
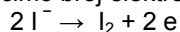


4.15. j) Vidi STEHIOMETRIJA

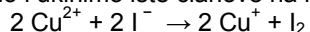
Kad se pomiješa otopina bakrova(II) sulfata i kalijeva jodida izluči se elementarni jod i taloži teško topljivi Cu_2I_2



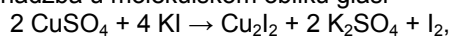
Izјednačimo број електрона u obje једнадџбе



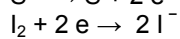
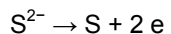
Zbroјimo i ukinimo iste članove na lijevoj i desnoj strani



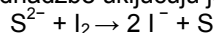
Ista једнадџба u molekulskom obliku glasi



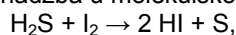
4.15. k) Vidi STEHIOMETRIJA



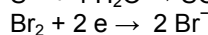
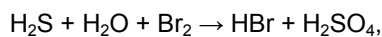
Objednažbe uključuju jednak broj elektrona pa ih možemo zbrojiti



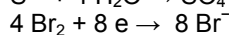
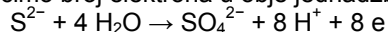
Ista jednažba u molekulskom obliku glasi



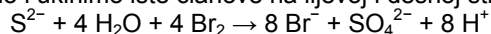
4.15. l) Vidi STEHIOMETRIJA



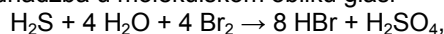
Izjednačimo broj elektrona u obje jednažbe



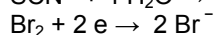
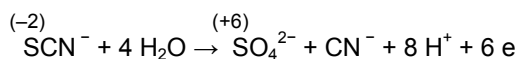
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



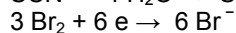
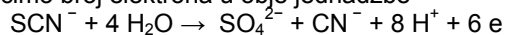
Ista jednažba u molekulskom obliku glasi



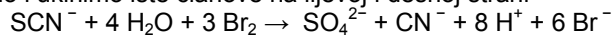
4.15. m) Vidi STEHIOMETRIJA



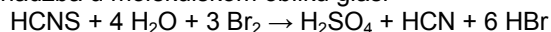
Izjednačimo broj elektrona u obje jednažbe



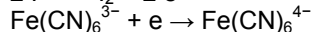
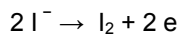
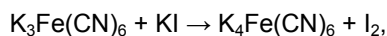
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



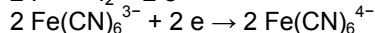
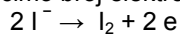
Ista jednažba u molekulskom obliku glasi



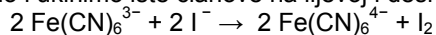
4.15. n) Vidi STEHIOMETRIJA



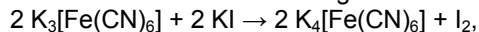
Izjednačimo broj elektrona u obje jednažbe



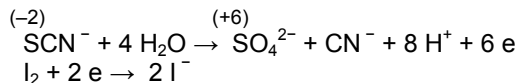
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



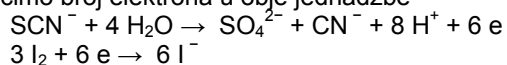
Ista jednažba u molekulskom obliku glasi



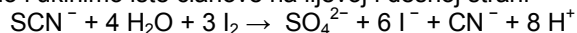
4.15. o) Vidi STEHIOMETRIJA



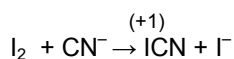
Izjednačimo broj elektrona u obje jednađžbe



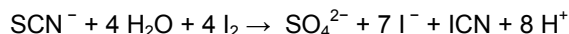
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



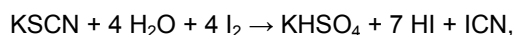
Cijanidni ioni s elementarnim jodom daju jodonijum cijanid, ICN, koji sadržava ion I⁺.



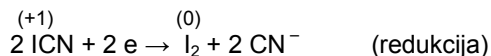
Zbrojimo posljednje dvije jednađžbe dobivamo:



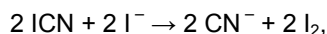
Ista jednađžba u molekulskom obliku glasi:



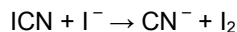
4.15. p) Vidi STEHIOMETRIJA



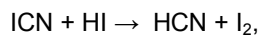
Obje jednađžbe uključuju jednak broj elektrona pa ih možemo zbrojiti



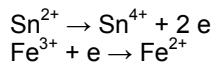
Jednađžba je djeljiva s 2 pa dobivamo:



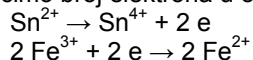
Ista jednađžba u molekulskom obliku glasi:



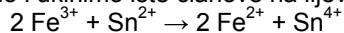
4.15. r) Vidi STEHIOMETRIJA



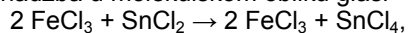
Izjednačimo broj elektrona u obje jednađžbe



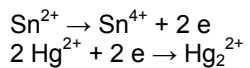
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



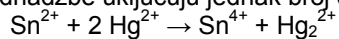
Ista jednađžba u molekulskom obliku glasi



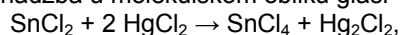
4.15. s) Vidi STEHIOMETRIJA



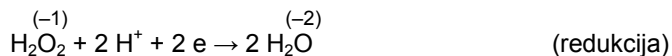
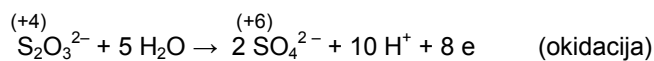
Objednažbe uključuju jednak broj elektrona pa ih možemo zbrojiti



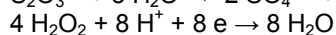
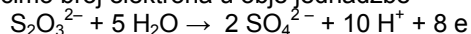
Ista jednažba u molekulskom obliku glasi



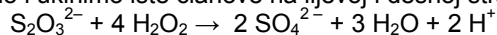
4.15. t) Vidi STEHIOMETRIJA



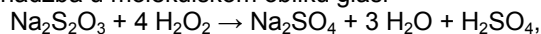
Izjednačimo broj elektrona u obje jednažbe



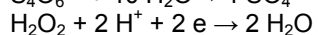
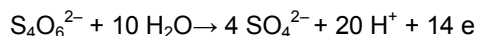
Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



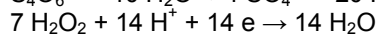
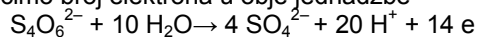
Ista jednažba u molekulskom obliku glasi



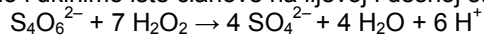
4.15. u) Vidi STEHIOMETRIJA



Izjednačimo broj elektrona u obje jednažbe



Zbrojimo i ukinimo iste članove na lijevoj i desnoj strani



Ista jednažba u molekulskom obliku glasi

