Rješenja zadataka iz Fizikalne kemije 2

Poglavlje: Termodinamika

Prvi stavak termodinamike

1. a) $w = -q = -7\ p_{atm}V_1$; b) $w = -q = -7\ p_{atm}V_1$; $w = -q = -16{,}64\ p_{atm}V_1$

2. a) $w = -q = -0{,}8\ p_{atm}V_1$; b) $w = -q = -1{,}61\ p_{atm}V_1$

3. a) $w = 0$; b) $w = -2{,}2$ kJ

4. $w = 10{,}33$ kJ

5. $q = 209{,}72$ J; $w = 0{,}277$ J

6. a) $w = -q = -1{,}718$ kJ, $\Delta U = \Delta H = 0$; b) $w = -q = -1{,}135$ kJ, $\Delta U = \Delta H = 0$; c) $w = -q = 0$, $\Delta U = \Delta H = 0$

7. $\Delta U = 3{,}284$ kJ; $\Delta H = 4{,}598$ kJ

8. $w = 3{,}1$ kJ, $\Delta H = q = -40{,}656$ kJ, $\Delta U = -37{,}55$ kJ

9. $q = \Delta H = 2{,}3$ kJ, $c_{p,s} = 5{,}8\ \text{J K}^{-1}\ \text{g}^{-1}$

10. $m(H_2O) = 0{,}048$ kg

11. $w = -101{,}325$ J

12. $q = -w = 123{,}5$ J

13. $\Delta H = q = 2{,}205$ kJ, $\Delta U = 1{,}582$ kJ

14. $q = -w = -3{,}987$ kJ, $\Delta S = 13{,}4\ \text{J K}^{-1}$, $\Delta U = \Delta H = 0$

Entropija

1.a) $\Delta S = 91{,}6\ \text{J K}^{-1}$; b) $\Delta S = 67\ \text{J K}^{-1}$

2. $\Delta S = 26\ \text{J K}^{-1}$

3. $\Delta S = 3{,}68\ \text{J K}^{-1}$

4. a) $\Delta S = 45{,}38\ \text{J K}^{-1}$; b) $\Delta S(H_2O) = 51{,}19\ \text{J K}^{-1}$, $\Delta S(Cu) = 0$

5. $\Delta S = 41{,}4\ \text{J K}^{-1}$

6. $\Delta S = 93{,}79\ \text{J K}^{-1}$

7. a) $\Delta S_{sustav} = -\Delta S_{okolina} = 2{,}88\ \text{J K}^{-1}$ $\Delta S_{ukupno} = 0$; b) $\Delta S_{sustav} = \Delta S_{ukupno} = 2{,}88\ \text{J K}^{-1}$, $\Delta S_{okolina} = 0$

8. a) $\Delta S = 16{,}91\ \text{J K}^{-1}$; b) $\Delta S = 36{,}7\ \text{J K}^{-1}$

Reakcijske veličine, Hessov stavak

1. $\Delta_r H = -1{,}368$ kJ mol^{-1}

2. $\Delta_{vap} H = -98{,}65$ kJ mol^{-1}, $\Delta_{vap} U = -101{,}13$ kJ mol^{-1}

3. $\Delta T = 0{,}205$ K

4. $\Delta_c H = -2147{,}5$ kJ mol^{-1}, $\Delta_c U = -2116{,}7$ kJ mol^{-1}

5.$\Delta_f H(C_{10}H_8) = 62{,}51$ kJ mol^{-1}

6. $\Delta_c H = -2034{,}16$ kJ mol^{-1}

7. $\Delta_r H(1) = -57{,}2$ kJ mol^{-1}

$\Delta_r H(2) = -1375{,}82$ kJ mol^{-1}

$\Delta_r H(3) = -892{,}36$ kJ mol^{-1}

8. $\Delta_r H(298) = -131{,}3$ kJ mol^{-1}, $\Delta_r U(298) = -128{,}8$ kJ mol^{-1}

$\Delta_r H(398) = -132{,}88$ kJ mol^{-1}, $\Delta_r U(398) = -129{,}42$ kJ mol^{-1}

9. $\Delta_c H = -205{,}49$ kJ mol^{-1}

10. $\Delta_r S°$ (g) $= -45{,}928$ J K^{-1} mol^{-1}, $\Delta_r G°$(g) $= -228{,}19$ kJ mol^{-1}

$\Delta_r S°$(g) $= -164{,}843$ J K^{-1} mol^{-1}, $\Delta_r G°$(l) $= -236{,}7$ kJ mol^{-1}

11. $\Delta_c H = -562$ kJ mol^{-1}

Kemijski potencijal

1. –

2.a) $\Delta G_m = 1{,}963$ J mol^{-1}

b) $\Delta G_m = 1516{,}5$ J mol^{-1}

3. –

4. $\Delta\mu = -330{,}83$ J mol^{-1}

5. $\Delta\mu = 1{,}8$ J mol^{-1}

6.$\Delta\mu = -543{,}85$ J mol^{-1}

7. $p_{xy} = 0{,}258$ bar, $f = 0{,}237$ bar, $f_{rel} = 0{,}237$

Koligativna svojstva

1. $T_l^* = 273{,}03$ K

2. a) $T_l = 271{,}41$ K; b) $T_v = 373{,}586$; c) $\pi = 2{,}1 \times 10^6$ Pa

3. a) M_r (Y) = 181,2 g mol^{-1}, b) $\Delta_{fus}H = 44{,}87$ kJ mol^{-1}

4. $M_r = 6{,}5 \times 10^6$ g mol^{-1}

5. c(NaCl) = 0,1375 mol dm^{-3}

6. $\pi = 2{,}28 \times 10^6$ Pa uzme li se u obzir doprinos isključivo NaCl

   $\pi = 2{,}67 \times 10^6$ Pa uzme li se u obzir doprinos svih navedenih soli

7. $\alpha = 0{,}08$, $K_c = 6{,}96 \times 10^{-4}$ mol dm^{-3}

Kemijska ravnoteža

1. c(A) = c(B) = $9{,}16 \times 10^{-4}$ mol dm^{-3}, c(C) = $8{,}39 \times 10^{-4}$ mol dm^{-3}

2. a) $\Delta_r G° = 48{,}915$ kJ mol^{-1} b) $\Delta_r G = -8{,}77$ kJ mol^{-1}

3. $K° = 0{,}09898$; $\Delta_r G° = -5{,}733$ kJ mol^{-1}

4. $\Delta_r G° = -501{,}1$ kJ mol^{-1}

5. $K° = 2{,}02 \times 10^{-5}$

6. $\Delta_r H° = 175{,}38$ kJ mol^{-1}

7. $\Delta_r H° = 22{,}57$ kJ mol^{-1}

8. $$\mathrm{CO(g)} + 2\,\mathrm{H_2(g)} \rightleftharpoons \mathrm{CH_3OH(g)}$$

Izraz za standardnu konstantu ravnoteže može se zapisati u sljedećem obliku

$$K^\circ = \frac{p(\mathrm{CH_3OH})}{p(\mathrm{CO}) \times (p(\mathrm{H_2}))^2} \times p^{\circ 2} = \frac{n(\mathrm{CH_3OH})}{n(\mathrm{CO}) \times (n(\mathrm{H_2}))^2} \times \frac{p^{\circ 2} \times n_{uk}{}^2}{p^2}$$

iz čega slijedi:

a) uz povećanje tlaka poveća se n(CH$_3$OH); b)uz povećanje ukupne množine plina smanji se n(CH$_3$OH); c) uz dodatak vodika poveća se n(CH$_3$OH); d) smanjenjem temperature poveća se iznos konstante ravnoteže zbog činjenice da je reakcija egzotermna, što rezultira povećanjem n(CH$_3$OH)