

**Prirodno-matematički fakultet**  
**Društvo matematičara i fizičara Crne Gore**

**OLIMPIJADA ZNANJA 2019.**

**Rješenja zadataka iz HEMIJE**  
**za II razred srednje škole**

1. U koliko grama vode treba rastvoriti 12g gvožđe(II)-sulfata-heptahidrata da bi se dobio rastvor u kome je maseni udio gvožđe(II)-sulfata 3,8%?

Ar(Fe)=55.84; Ar(S)=32.07; Ar(O)=16; Ar(H)=1.01.

**Rješenje:**

Mr(FeSO<sub>4</sub>)=151.92    Mr(FeSO<sub>4</sub>·7H<sub>2</sub>O)=278.06  
ω=3,8%=0.038

$$\omega = \frac{m(\text{FeSO}_4)}{m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) + m(\text{H}_2\text{O})} \dots\dots\dots 2 \text{ boda}$$

$$m(\text{FeSO}_4) = \frac{m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) \cdot \text{Mr}(\text{FeSO}_4)}{\text{Mr}(\text{FeSO}_4 \cdot 7\text{H}_2\text{O})} = 6.55\text{g} \quad \dots\dots\dots 2 \text{ boda}$$

$$0.038 = \frac{6.55\text{g}}{12\text{g} + m(\text{H}_2\text{O})} \dots\dots\dots 4 \text{ boda}$$

$$m(\text{H}_2\text{O}) = 160.36\text{g} \dots\dots\dots 2 \text{ boda}$$

ukupno: **10 bodova**

2. Koje od navedenih soli usled hidrolize reaguju bazno:

a) CaCO<sub>3</sub> b) CH<sub>3</sub>COONa    c) (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>    d) CH<sub>3</sub>COONH<sub>4</sub>    e) KHCO<sub>3</sub>

Ka(NH<sub>4</sub><sup>+</sup>)=5·10<sup>-10</sup>    Ka(CH<sub>3</sub>COONH<sub>4</sub>)=2·10<sup>-5</sup>

**Rješenje:**

b) i e)    4 x 2 = **8 bodova**

3. Na osnovu datih vrijednosti za Ka, odrediti kojakiselina je najjača u vodenom rastvoru.

Ka(HCN)=7.9·10<sup>-9</sup>; Ka(CH<sub>3</sub>COOH)=1.8·10<sup>-5</sup>; Ka(HClO)=5·10<sup>-5</sup>; Ka(HNO<sub>2</sub>)=4·10<sup>-4</sup>; Ka(HF)=6.6·10<sup>-4</sup>

a) HCN    b) CH<sub>3</sub>COOH    c) HClO    d) HNO<sub>2</sub>    e) HF

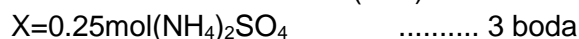
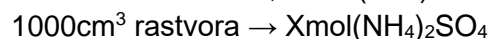
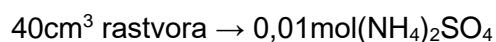
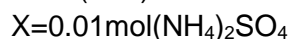
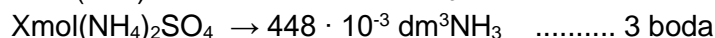
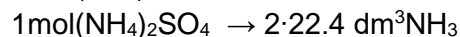
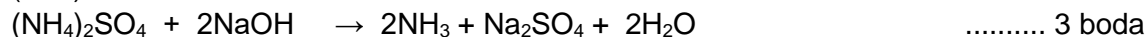
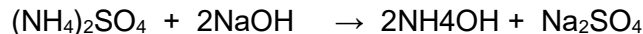
**Rješenje:**

e)

4 x 1 = **4 boda**

4. Koliko ima molova amonijum-sulfata u 1 l rastvora ako 40cm<sup>3</sup> tog rastvora pri reakciji sa natrijum-hidroksidom oslobađa 448cm<sup>3</sup> amonijaka? Reakcija se odigrava pri normalnim uslovima.

**Rješenje:**



ukupno: **9 bodova**

5. Dva puta pozitivan jon E<sup>2+</sup> nekog elementa ima elektronsku konfiguraciju: 1s<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>3s<sup>2</sup>3p<sup>6</sup>. Napisati elektronsku konfiguraciju tog elementa i navesti u kojoj grupi i u kojoj periodi se on nalazi u Periodnom sistemu elemenata?

**Rješenje:**



2. grupa i 4. perioda ..... 3 boda

ukupno: **6 bodova**

6. Bikarbonatni pufer se priprema tako što se u vodeni rastvor NaHCO<sub>3</sub> uvodi CO<sub>2</sub>. Koja komponenta puferske smjese reaguje sa H<sup>+</sup> jonima pri dodatku kiseline?

a) CO<sub>2</sub>; b) H<sub>2</sub>CO<sub>3</sub>; c) NaHCO<sub>3</sub>; d) Na<sub>2</sub>CO<sub>3</sub>; e) H<sub>2</sub>O.

**Rješenje:**

c) 4x1=4boda

7. Neki uzorak mangan-oksida mase 542.3g ima odnos broja atoma Mn:O 1.00 : 1.42 i sastoji se od Mn<sub>2</sub>O<sub>3</sub> i MnO. Kolika je masa Mn<sub>2</sub>O<sub>3</sub> u uzorku?  
Ar(Mn)=55; Ar(O)=16.00.

**Rješenje:**

u  $\text{Mr}(\text{Mn}_2\text{O}_3)$  ima 2 mol atoma Mn i 3 mol atoma O

a u  $m(\text{Mn}_2\text{O}_3)$  ima  $x_1$  mol atoma Mn i  $y_1$  mol atoma O ..... 2 boda

$$N(\text{Mn} / \text{Mn}_2\text{O}_3) = \frac{2 \cdot m(\text{Mn}_2\text{O}_3)}{Mr(\text{Mn}_2\text{O}_3)}$$

$$N(\text{O} / \text{Mn}_2\text{O}_3) = \frac{3 \cdot m(\text{Mn}_2\text{O}_3)}{Mr(\text{Mn}_2\text{O}_3)}$$

..... 2 boda

u  $\text{Mr}(\text{MnO})$  ima 1 mol atoma Mn i 1 mol atoma O

a u  $m(\text{MnO})$  ima  $x_2$  mol atoma Mn i  $y_2$  mol atoma O

$$N(\text{Mn} / \text{MnO}) = \frac{m(\text{MnO})}{Mr(\text{MnO})}$$

$$N(\text{O} / \text{MnO}) = \frac{m(\text{MnO})}{Mr(\text{MnO})}$$

..... 2 boda

$$N(\text{Mn}) = N(\text{Mn iz Mn}_2\text{O}_3) + N(\text{Mn iz MnO})$$

$$N(\text{O}) = N(\text{O iz Mn}_2\text{O}_3) + N(\text{O iz MnO})$$

$$N(\text{Mn}) = \frac{2 \cdot m(\text{Mn}_2\text{O}_3)}{Mr(\text{Mn}_2\text{O}_3)} + \frac{m(\text{MnO})}{Mr(\text{MnO})} \quad \text{..... 2 boda}$$

$$N(\text{O}) = \frac{3 \cdot m(\text{Mn}_2\text{O}_3)}{Mr(\text{Mn}_2\text{O}_3)} + \frac{m(\text{MnO})}{Mr(\text{MnO})}$$

..... 2 boda

uz uslov  $N(\text{Mn})/N(\text{O})=1/1.42$  i uz smjenu:  $m(\text{Mn}_2\text{O}_3) + m(\text{MnO}) = 542.3\text{g}$

dobija se:  $m(\text{Mn}_2\text{O}_3)=463\text{g}$

..... 2 boda

ukupno: **12 bodova**

**8.** Odrediti pH puferske smješe koja sadrži  $1\text{mol/dm}^3$  amonijum-hidroksida i  $0,5\text{mol/dm}^3$  amonijum-hlorida.  $K_{\text{NH}_4\text{OH}}=1.79 \cdot 10^{-5} \text{ mol/dm}^3$ .

**Rješenje:**

$$[\text{NH}_4\text{OH}]=1\text{mol/dm}^3$$

$$[\text{NH}_4^+]=0,5\text{mol/dm}^3$$

$$\frac{[\text{NH}_4^+] \cdot [\text{OH}^-]}{[\text{NH}_4\text{OH}]} = K_{\text{NH}_4\text{OH}} \quad \text{..... 2 boda}$$

$$[\text{OH}^-] = \frac{[\text{NH}_4\text{OH}]}{[\text{NH}_4^+]} K_{\text{NH}_4\text{OH}} \quad \text{..... 2 boda}$$

$$[\text{OH}^-] = 3.58 \cdot 10^{-5} \quad \text{..... 2 boda}$$

pOH=4.45 ..... 2 boda

pH=9.55 ..... 2 boda

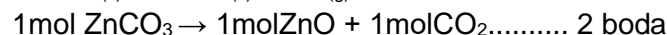
ukupno: **10 bodova**

**9.**Uzorak cink-karbonata žaren je i pri tome se odigrala hemijska reakcija:

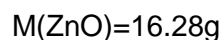
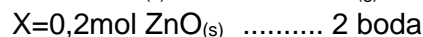
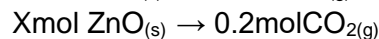
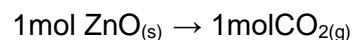
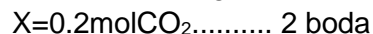
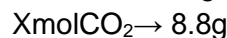
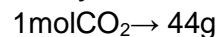


Pri žarenju masa čvrstefaze smanjila se za 8.8g. Izračunati količinu i masu dobijenog cink-oksida.  $\text{Ar}(\text{Zn})=65.38$ ;  $\text{Ar}(\text{C})=12.00$ ;  $\text{Ar}(\text{O})=16.00$ .

**Rješenje:**



Čvrsta supstanca se smanjuje samo na račun izdvajanja  $\text{CO}_2$ . Kako je smanjena za 8.8g to je izdvojena količina  $\text{CO}_2$



..... 2 boda

ukupno: **8 bodova**

**10.**Napisati konjugovane baze sledećim kiselinama (orema protolitičkoj teoriji kiselina i baza):

$\text{H}_3\text{O}^+$ ,  $\text{HCl}$ ,  $\text{NH}_4^+$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HSO}_4^-$ ,  $\text{H}_2\text{O}$ .

**Rješenje:**

$\text{H}_2\text{O}$ ..... 2 boda

$\text{Cl}^-$ ..... 2 boda

$\text{NH}_3$ ..... 2 boda

$\text{HSO}_4^-$ ..... 2 boda

$\text{SO}_4^{2-}$ ..... 2 boda

$\text{OH}^-$ ..... 2 boda

ukupno: **12 bodova**

**11.**Kolika je koncentracija acetatnih jona u rastvoru tehničke sirćetne kiseline koncentracije  $0,05\text{mol/dm}^3$  ako je pH takvog rastvora 3.  $K_{\text{CH}_3\text{COOH}} = 1.75 \cdot 10^{-5} \text{ mol/dm}^3$ .

**Rješenje:**

$\text{CH}_3\text{COOH} \rightleftharpoons \text{H}^+ + \text{CH}_3\text{COO}^- \dots\dots\dots 2 \text{ boda}$   
 $\text{pH}=3, [\text{H}^+]=10^{-3}$

$$K_c = \frac{c(\text{H}^+) \cdot c(\text{CH}_3\text{COO}^-)}{c(\text{CH}_3\text{COOH})} \dots\dots\dots 2 \text{ boda}$$

$$[\text{CH}_3\text{COOH}]=0.05 \text{ mol/dm}^3$$

$$[\text{CH}_3\text{COO}^-]=x$$

$$1.75 \cdot 10^{-5} = \frac{10^{-3} \cdot x}{0.05} \dots\dots\dots 2 \text{ boda}$$

$$x = 8.75 \cdot 10^{-5} \text{ mol/dm}^3 \dots\dots\dots 2 \text{ boda}$$

ukupno: **8 bodova**

**12.** Legura bakra i cinka sadrži 74.5% bakra. Koliki je maseni a koliki količinski udio bakra u leguri?  $A_r(\text{Zn})=65.38$ ;  $A_r(\text{Cu})=63.55$

**Rješenje:**

$$\omega(\text{Cu}) = 74.5\% = 0.745$$
$$\omega(\text{Zn}) = 1 - 0.745 = 0.255 \dots\dots\dots 2 \text{ boda}$$

U 100g legure imamo 74.5g Cu i 25.5g Zn

$$n(\text{Cu}) = \frac{m(\text{Cu})}{M(\text{Cu})}$$

$$n(\text{Cu}) = 1.172 \text{ mol} \dots\dots\dots 2 \text{ boda} \quad n(\text{Zn}) = \frac{m(\text{Zn})}{M(\text{Zn})}$$

$$n(\text{Zn}) = 0.390 \text{ mol} \dots\dots\dots 2 \text{ boda}$$

$$n(\text{legure}) = n(\text{Cu}) + n(\text{Zn}) = 1.562 \text{ mol} \dots\dots\dots 1 \text{ bod}$$

$$x(\text{Cu}) = \frac{n(\text{Cu})}{n(\text{legure})}$$

$$x(\text{Cu}) = 0.750 \dots\dots\dots 1 \text{ bod}$$

$$x(\text{Zn}) = \frac{n(\text{Zn})}{n(\text{legure})}$$

$$x(\text{Zn}) = 0.250 \dots\dots\dots 1 \text{ bod}$$

ukupno: **9 bodova**