

**I – КАТЕГОРИЈА, ОПШТИНСКИ НАТПРЕВАР ПО ХЕМИЈА 2015**  
**Одговори на прашањата со повеќечлен избор**

- |       |       |
|-------|-------|
| 1. B  | 13. D |
| 2. D  | 14. C |
| 3. D  | 15. B |
| 4. E  | 16. D |
| 5. B  | 17. B |
| 6. C  | 18. A |
| 7. E  | 19. D |
| 8. A  | 20. C |
| 9. D  | 21. A |
| 10. C | 22. C |
| 11. A | 23. B |
| 12. C | 24. E |
|       | 25. D |

**Решенија на задачите**

1.  $m = (M \cdot 10) / N_A = (165,2 \text{ g/mol} \cdot 10) / 6,022 \cdot 10^{23} \text{ mol}^{-1}$

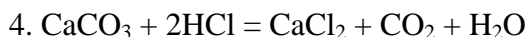
$m(\text{хлорал хидрат}) = 2,74 \cdot 10^{-21} \text{ g}$

2.  $w(\text{N}, \text{NH}_4\text{NO}_3) = 2 \cdot M(\text{N}) / M(\text{NH}_4\text{NO}_3) = 28 \text{ g} \cdot \text{mol}^{-1} / 80 \text{ g} \cdot \text{mol}^{-1} = 0,35$

$w(\text{N}) = 35,00 \%$

3.  $n(\text{I}) = 4 \cdot n(\text{Ag}_2[\text{HgI}_4]) = 4m(\text{Ag}_2[\text{HgI}_4]) / M(\text{Ag}_2[\text{HgI}_4]) = 4 \cdot 12 \text{ g} / 924 \text{ g} \cdot \text{mol}^{-1} = 0,0519 \text{ mol}$

$n(\text{I}) = 0,0519 \text{ mol} = 5,19 \cdot 10^{-2} \text{ mol}$



$n(\text{CaCO}_3) = n(\text{CO}_2) \Rightarrow m(\text{CaCO}_3) = M(\text{CaCO}_3) \cdot V(\text{CO}_2) / V_m = 100,1 \text{ g} \cdot \text{mol}^{-1} \cdot 0,291 \text{ dm}^3 / 22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$

$m(\text{CaCO}_3) = 1,30 \text{ g}$

$w(\text{CaCO}_3) = m(\text{CaCO}_3) / m(\text{проба}) = 1,30 \text{ g} / 1,8 \text{ g} = 0,72$

$w(\text{CaCO}_3) = 72 \%$

5.  $V(\text{CO}_2) = n(\text{CO}_2) \cdot V_m = V_m \cdot m(\text{CO}_2) / M(\text{CO}_2) = 22,4 \text{ dm}^3 \cdot \text{mol}^{-1} \cdot 0,196 \text{ g} / 44 \text{ g} \cdot \text{mol}^{-1} = 0,998 \text{ dm}^3$

$V(\text{CO}_2) = 100 \text{ cm}^3$

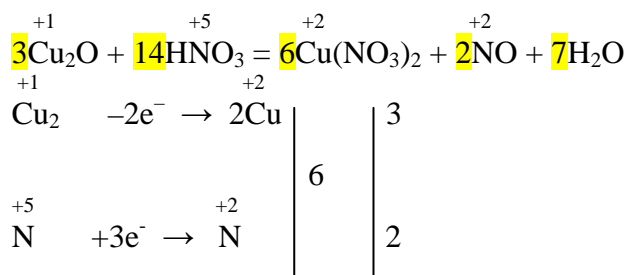
## II – КАТЕГОРИЈА, ОПШТИНСКИ НАТПРЕВАР ПО ХЕМИЈА 2015

### Одговори на прашањата со повеќеклучен избор

- |       |       |
|-------|-------|
| 1. E  | 13. D |
| 2. E  | 14. D |
| 3. B  | 15. E |
| 4. E  | 16. A |
| 5. E  | 17. B |
| 6. C  | 18. B |
| 7. A  | 19. A |
| 8. E  | 20. D |
| 9. D  | 21. D |
| 10. C | 22. D |
| 11. B | 23. B |
| 12. A | 24. E |
|       | 25. A |

### Решенија на задачите

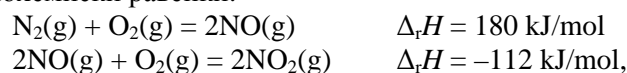
1.



Оксидационо средство е  $\text{HNO}_3$

Редукционо средство е  $\text{Cu}_2\text{O}$ .

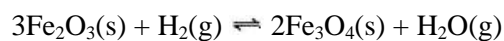
2. Зададени термохемишки равенки:



$$\Delta_r H = \Delta_r H_1 + \Delta_r H_2 = 180 \text{ kJ/mol} + (-112 \text{ kJ/mol}) = 68 \text{ kJ/mol}$$

$$\Delta_r H = 68 \text{ kJ/mol}$$

3.



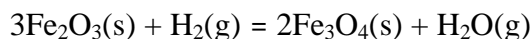
$$T = 303 \text{ K}$$

$$p = 0,016 \text{ atm} = 1621,20 \text{ Pa}$$

$$K_p = 0,23$$

$$p(\text{H}_2)_e = ?$$

$$p(\text{H}_2\text{O})_e = ?$$



$$K_p = \frac{p(\text{H}_2\text{O})_e}{p(\text{H}_2)_e}$$

$$p = p(\text{H}_2)_e + p(\text{H}_2\text{O})_e$$

$$K_p = \frac{p(\text{H}_2\text{O})_e}{p - p(\text{H}_2\text{O})_e}$$

$$K_p \cdot p - K_p \cdot p(\text{H}_2\text{O})_e = p(\text{H}_2\text{O})_e$$

$$K_p \cdot p = [K_p + 1] \cdot p(\text{H}_2\text{O})_e$$

$$p(\text{H}_2\text{O})_e = \frac{K_p \cdot p}{K_p + 1} = \frac{1621,2 \text{ Pa} \cdot 0,23}{0,23 + 1}$$

$$p(\text{H}_2\text{O})_e = 303,15 \text{ Pa}$$

$$p(\text{H}_2)_e = p - p(\text{H}_2\text{O})_e = 1621,20 \text{ Pa} - 303,15 \text{ Pa}$$

$$p(\text{H}_2)_e = 1318,05 \text{ Pa}$$

#### 4. Решение:

$$c_1(\text{NaOH}) = 0,002 \text{ mol/dm}^3$$

$$c_2(\text{NaOH}) = 0,020 \text{ mol/dm}^3$$

$$V_1(\text{NaOH}) = 20 \text{ mL} = 0,020 \text{ dm}^3$$

$$V_2(\text{NaOH}) = 15 \text{ mL} = 0,015 \text{ dm}^3$$

pH = ?

$$n(\text{OH}^-) = n_1(\text{OH}^-) + n_2(\text{OH}^-)$$

$$n(\text{OH}^-) = c_1(\text{OH}^-) \cdot V_1(\text{NaOH}) + c_2(\text{OH}^-) \cdot V_2(\text{KOH})$$

$$n(\text{OH}^-) = 0,002 \text{ mol/dm}^3 \cdot 0,020 \text{ dm}^3 + 0,020 \text{ mol/dm}^3 \cdot 0,015 \text{ dm}^3$$

$$n(\text{OH}^-) = 3,4 \cdot 10^{-4} \text{ mol}$$

$$c(\text{OH}^-) = \frac{n(\text{OH}^-)}{V} = \frac{n(\text{OH}^-)}{V_1(\text{NaOH}) + V_2(\text{NaOH})}$$

$$c(\text{OH}^-) = \frac{3,4 \cdot 10^{-4} \text{ mol}}{0,020 \text{ dm}^3 + 0,015 \text{ dm}^3} = \frac{3,4 \cdot 10^{-4} \text{ mol}}{3,5 \cdot 10^{-2} \text{ dm}^3}$$

$$c(\text{OH}^-) = 9,7 \cdot 10^{-3} \text{ mol/dm}^3$$

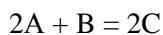
$$\text{pH} = \text{p}K_w + \log c(\text{OH}^-) / (\text{mol dm}^{-3})$$

$$\text{pH} = 14 + \log 9,7 \cdot 10^{-3}$$

$$\text{pH} = 14 - 2,01$$

$$\text{pH} = 11,99 \approx 12$$

5.



**Решение:**

$$V = 5 \text{ L}$$

$$n_0(\text{A}) = 18 \text{ mol}$$

$$n(\text{A}) = 0 \text{ mol}$$

$$\Delta t = 25 \text{ h} = 90\,000 \text{ s} = 9 \cdot 10^4 \text{ s}$$

$$\Delta n(\text{A}) = n(\text{A}) - n_0(\text{A}) = 0 \text{ mol} - 18 \text{ mol}$$

$$\Delta n(\text{CO}) = -18 \text{ mol}$$

$$\Delta \xi = \Delta n(\text{A}) / \nu(\text{A}) = -18 \text{ mol} / (-2)$$

$$\Delta \xi = 9 \text{ mol}$$

$$J = \Delta \xi / \Delta t = 9 \text{ mol} / 9 \cdot 10^4 \text{ s} = 10^{-4} \text{ mol/s} = 0,1 \text{ mmol/s}$$

$$v(\text{A}) = \Delta c(\text{A}) / \Delta t = (3,6 \text{ mol/L}) / (90\,000 \text{ s}) = 0,04 \text{ mmol s}^{-1} \text{ L}^{-1}$$

### III – КАТЕГОРИЈА, ОПШТИНСКИ НАТПРЕВАР ПО ХЕМИЈА 2015

#### Одговори на прашањата со повеќечлен избор

- |       |       |
|-------|-------|
| 1. B  | 12. B |
| 2. C  | 13. D |
| 3. C  | 14. C |
| 4. E  | 15. E |
| 5. D  | 16. A |
| 6. A  | 17. D |
| 7. A  | 18. C |
| 8. B  | 19. A |
| 9. D  | 20. B |
| 10. E | 21. D |
| 11. A | 22. A |
|       | 23. E |
|       | 24. A |
|       | 25. B |

#### Решенија на задачите

1. Колкав број атоми хлор се содржат во 307,2 g тетрахлорометан?

$$N(\text{Cl}) = ?$$

$$M(\text{CCl}_4) = 307,2 \text{ g}$$

$$N(\text{Cl}) = 4 \cdot N(\text{CCl}_4)$$

$$N(\text{Cl}) = 4 \cdot n(\text{CCl}_4) \cdot N_A$$

$$N(\text{Cl}) = 4 \cdot \frac{m(\text{CCl}_4)}{M(\text{CCl}_4)} \cdot N_A$$

$$N(\text{Cl}) = 4 \cdot \frac{307,2 \text{ g}}{153,6 \text{ g/mol}} \cdot 6,022 \cdot 10^{23} \text{ mol}^{-1}$$

$$N(\text{Cl}) = 4,82 \cdot 10^{24}$$

2. Пресметај ги молските и масените удели на елементите во дихлоробензен!

$$x(\text{C}; \text{C}_6\text{H}_4\text{Cl}_2) = ? \quad w(\text{C}; \text{C}_6\text{H}_4\text{Cl}_2) = ?$$

$$x(\text{H}; \text{C}_6\text{H}_4\text{Cl}_2) = ? \quad w(\text{H}; \text{C}_6\text{H}_4\text{Cl}_2) = ?$$

$$x(\text{Cl}; \text{C}_6\text{H}_4\text{Cl}_2) = ? \quad w(\text{Cl}; \text{C}_6\text{H}_4\text{Cl}_2) = ?$$

$$x(\text{C}; \text{C}_6\text{H}_4\text{Cl}_2) = \frac{6}{12} = 0,5 = 50 \%$$

$$x(\text{C}; \text{C}_6\text{H}_4\text{Cl}_2) = 50 \%$$

$$x(\text{H}; \text{C}_6\text{H}_4\text{Cl}_2) = \frac{4}{12} = 0,33 = 33 \%$$

$$x(\text{H}; \text{C}_6\text{H}_4\text{Cl}_2) = 33 \%$$

$$x(\text{Cl}; \text{C}_6\text{H}_4\text{Cl}_2) = \frac{2}{12} = 0,17 = 17 \%$$

$$x(\text{Cl}; \text{C}_6\text{H}_4\text{Cl}_2) = 17 \%$$

$$M_r(\text{C}_6\text{H}_4\text{Cl}_2) = 146,84 \text{ g/mol}$$

$$w(\text{C}; \text{C}_6\text{H}_4\text{Cl}_2) = \frac{6 \cdot 12}{146,84} = 0,49033$$

$$w(\text{C}; \text{C}_6\text{H}_4\text{Cl}_2) = 49,03 \%$$

$$w(\text{H}; \text{C}_6\text{H}_4\text{Cl}_2) = \frac{4 \cdot 1,01}{146,84} = 0,0275$$

$$w(\text{H}; \text{C}_6\text{H}_4\text{Cl}_2) = 2,75 \%$$

$$w(\text{Cl}; \text{C}_6\text{H}_4\text{Cl}_2) = \frac{2 \cdot 35,4}{146,84} = 0,4822$$

$$w(\text{Cl}; \text{C}_6\text{H}_4\text{Cl}_2) = 48,22 \%$$

3. Масените удели на елементите во едно органско соединение изнесуваат:  $w(\text{C}) = 65,4\%$ ,  $w(\text{H}) = 5,5\%$  и  $w(\text{O}) = 29,1\%$ . Определи ја емпириската формула на соединението!

$$w(\text{C}; \text{C}_x\text{H}_y\text{O}_z) = 65,4\%$$

$$w(\text{H}; \text{C}_x\text{H}_y\text{O}_z) = 5,5\%$$

$$w(\text{O}; \text{C}_x\text{H}_y\text{O}_z) = 29,1\%$$

$$\text{C}_x\text{H}_y\text{O}_z = ?$$

$$x : y : z = n(\text{C}) : n(\text{H}) : n(\text{O})$$

$$x : y : z = \frac{65,4 \text{ g}}{12 \text{ g/mol}} : \frac{5,5 \text{ g}}{1,01 \text{ g/mol}} : \frac{29,1 \text{ g}}{16 \text{ g/mol}}$$

$$x : y : z = 5,45 \text{ mol} : 5,45 \text{ mol} : 1,82 \text{ mol} \quad /:1,82 \text{ mol}$$

$$x : y : z = 3 : 3 : 1$$

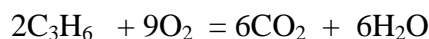
**Емпириска формула:  $\text{C}_3\text{H}_3\text{O}$**

4. При согорување на 33,5 g пропен, се издвоиле 16,1 g вода. Колкав е приносот на реакцијата изразен во проценти?

$$m(\text{C}_3\text{H}_6) = 33,5 \text{ g}$$

$$m(\text{H}_2\text{O}) = 16,1 \text{ g}$$

$$\text{принос} = ?$$



$$n(\text{H}_2\text{O}) : n(\text{C}_3\text{H}_6) = 6 : 2 = 3$$

$$\frac{m(\text{H}_2\text{O})}{M(\text{H}_2\text{O})} = 3 \cdot \frac{m(\text{C}_3\text{H}_6)}{M(\text{C}_3\text{H}_6)}$$

$$m(\text{H}_2\text{O}) = 3 \cdot \frac{m(\text{C}_3\text{H}_6) \cdot M(\text{H}_2\text{O})}{M(\text{C}_3\text{H}_6)} = 3 \cdot \frac{33,5 \text{ g} \cdot 18,02 \text{ g/mol}}{42,06 \text{ g/mol}} = 43,06 \text{ g}$$

$$\text{теоретски: } m(\text{H}_2\text{O}) = 43,06 \text{ g}$$

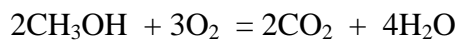
$$\text{принос} = \frac{\text{експер.}m(\text{H}_2\text{O})}{\text{теор.}m(\text{H}_2\text{O})} = \frac{16,1 \text{ g}}{43,06 \text{ g}} = 0,3739$$

$$\text{принос} = 37,39\%$$

5. Колкава маса вода ќе се добие при согорување на 209 g метанол?

$$m(\text{H}_2\text{O}) = ?$$

$$m(\text{CH}_3\text{OH}) = 209 \text{ g}$$



$$n(\text{H}_2\text{O}) : n(\text{CH}_3\text{OH}) = 4 : 2 = 2$$

$$\frac{m(\text{H}_2\text{O})}{M(\text{H}_2\text{O})} = 2 \cdot \frac{m(\text{CH}_3\text{OH})}{M(\text{CH}_3\text{OH})}$$

$$m(\text{H}_2\text{O}) = 2 \cdot \frac{m(\text{CH}_3\text{OH}) \cdot M(\text{H}_2\text{O})}{M(\text{CH}_3\text{OH})} = 2 \cdot \frac{209 \text{ g} \cdot 18,02 \text{ g/mol}}{32,04 \text{ g/mol}} = 235,09 \text{ g}$$

$$m(\text{H}_2\text{O}) = 235,09 \text{ g}$$

Податоци што може да ти бидат потребни:

$$A_r(\text{H}) = 1,01; \quad A_r(\text{C}) = 12,0; \quad A_r(\text{O}) = 16,0; \quad A_r(\text{Cl}) = 35,4;$$