**42nd Austrian Chemistry Olympiad**

**National Competition**



**SOLUTIONS**

**Practical Competition**

# Task 9 39 bp ≙ 13 rp; $f=\frac{13}{39}$

**Qualitative analysis**

|  |  |  |
| --- | --- | --- |
| **sample** | **cation** | **anion** |
| **1** | K+ | OH– |
| **2bp** | **0.5bp** |
| **2** | Ag+ | NO3– |
| **1bp** | **1.5bp** |
| **3** | Zn2+ | Br–  |
| **3bp** | **2bp** |
| **4** | Ba2+ | I– |
| **2bp** | **2bp** |
| **5** | H3O+, K+ | SO42– |
| **0.5bp, 2bp** | **2bp** |
| **6** | Pb2+ | CH3COO– |
| **2bp** | **3bp** |
| **7** | Fe3+ | NO3– |
| **1bp** | **1.5bp** |
| **8** | Na+ | C2O42– |
| **2bp** | **3.5bp** |
| **9** | H3O+ | ClO4– |
| **0.5bp** | **3bp** |
| **10** | NH4+ | CO32– |
| **2bp** | **2bp** |

# Task 10 41 bp ≙ 14 rp; $f=\frac{14}{41}$

**Determination of an analgesic drug**

*Fill in the* ***protocol****:*

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| Tick the right inequation: |
|  | $E^{O}\left((Aminophenol\right)>E^{O}\left(Ce(III\right)>E^{O}\left((Fe(II)Phe\right)$  |
|  | $E^{O}\left((Fe(II)Phe\right)>E^{O}\left(Ce(III\right)>E^{O}\left((Aminophenol\right)$  |
| **X** | $E^{O}\left(Ce(III\right)>E^{O}\left((Fe(II)Phe\right)>E^{O}\left((Aminophenol\right)$  |
|  | $E^{O}\left((Aminophenol\right)>E^{O}\left((Fe(II)Phe\right)>E^{O}\left(Ce(III\right)$  |

|  |
| --- |
| The addition of the ice cubes is done, because (tick the right statement) |
|  | the Ce(IV)-solution reacts more quickly at low temperatures. |
| **X** | the oxygen from air, which is agitated into the solution while titrating, oxidises the p-aminophenol. |
|  | the Ce(IV)-solution more slowly at low temperatures. |
|  | the indicator changes its colour mor effectively using the ice.  |

**For each right X: 1bp**

|  |  |
| --- | --- |
| Chosen *V1*: 9.95 mL **max.18bp1** | Chosen *V2*: 12.1 mL **max.14bp2** |
| Balanced equation Ce(IV) - iodide: 2 [Ce(NO3]62- + 2 I- ⇄ I2 + Ce3+ + 6 NO3- **1bp** |
| Balanced equation I2 - thiosulphate: 2 S2O32- + I2 ⇄ 2 I- + S4O62- **1bp** |
| proportion Ce(IV) - thiosulphate: 1:1 **1bp** |
| Calculation of the concentration of the Ce(IV)-solution: **1,5bp**$c\left(S\_{2}O\_{3}^{2-}\right)∙V\left(S\_{2}O\_{3}^{2-}\right)=c(Ce\left(IV\right))∙V(Ce\left(IV\right))$ ⇒ $c\left(Ce\left(IV\right)\right)=\frac{0.0490∙9.95}{10}=0.0488$ mol·L- |
| Calculation of the amount of paracetamol in the measuring flask:$n\left(PAR\right)=\frac{n(Ce(IV))}{2}=\frac{10∙0.0488∙12.1}{2}=2.9524$ mmol **1,5bp** |
| Calculation of the content of paracetamol in the sample in mass percentage:$\frac{2.9524 ∙151.2}{500}∙100=89.3\% $paracetamol **1bp** |

**1:** $\left|V\_{soll}-V\_{ist}\right|\leq 0,15 mL⇒18bp$ **2:** $\left|V\_{soll}-V\_{ist}\right|\leq 0,5 mL⇒14bp$

$ \left|V\_{soll}-V\_{ist}\right|>0,60 mL⇒0bp$ **2:** $\left|V\_{soll}-V\_{ist}\right|\leq 1,3 mL⇒0bp$

 **In between:** $bp=18-\frac{18}{0,45}∙\left(\left|∆V\right|-0,15\right)$ **In between:** $bp=14-\frac{14}{0,80}∙\left(\left|∆V\right|-0,5\right)$

# Task 11 35 bp ≙ 13 rp; $f=\frac{13}{35}$

**Synthesis of yellow crystals**

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| *3.1. Write down the reaction equation for this synthesis using constitutional formulae.* |
|  **2bp** |

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| *3.2. Tick the right answers concerning the following question. Why was the starting substance 1,2-dimethoxybenzene not brought into reaction with nitrosulphuric acid, a mixture of nitric acid and sulphuric acid?* |
|  *…to cause multiple nitration, because nitrosulphuric acid is less reactive than nitric acid.***X***…..to avoid multiple nitration, because methoxy groups activate the aromatic.*  *… to avoid multiple nitration, because methoxy groups have a (-M)-effect.* *… to avoid multiple nitration, because nitrosulphuric is less reactive than nitric acid.* **1bp** |

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| --- |
| *3.3. Calculate the yield in g and % of the theory.* |
| *Mass of product: 4,10 g* **18bp\****Calculation:* $3.45∙\frac{183.16}{138.17}=4.59$g $\%=\frac{4.10}{4.59}∙100=89.3$**2bp** |

|  |
| --- |
| *3.4. Determine the melting point of your product:95-98 °C* **3bp***Appearance: yellow crystals* **3bp** |

|  |
| --- |
| *3.5. Calculate the RF-values.* |
| *Rf-value of sstartin material: 0.44* **1bp***Rf-value of product: 0.22* **1bp***DC-appearance: 2 lines (***1bp***), marking (***1bp***), seize of spots (***2bp***),*  |

**\*** $bp=18-\frac{18}{4,.10}∙(\left|4.10-m\right|)$