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44th Austrian Chemistry Olympiad

Federal Competition

Practical Part

June 1st, 2018

Solutions

Problem 6 56 bp ≙ 16 rp

Synthesis of a Sweetener

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| 6.1 Present your raw product to the supervisor to obtain confirmation. |
| Raw product was obtained: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (paraph)  **3 bp\*** |
| 6.2 Caclulate your yield in g and % of theory. |
| mass tara: 48.32 g mass product *m*p: 1.76 g **2 bp**  rating of the yield **0-29 bp\***  theor. yield.: *m* = (KOCN - 17 mmol excess )  own yield in **2 bp**  appearance of the product: **0-3 bp** |

\*if → 29 bp; if *m*p > 2.23 g → 0 bp

otherwise: ; if no product but raw product obtained: 3 bp

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| 6.3 Give the melting point of your product: |
| 174-176°C **0-3 bp** |
| 6.4 Give the Rf values: |
| Rf-value educt: 0.35 Rf-value crude product: 0.64 Rf-value product: 0.64  **3 bp**  TLC-Grading:  2 lines, labeling **2 bp**  size of the spots & labeling, TLC-quality **5 bp** |
| 6.5 Briefly explain the reason for the different Rf values of educt and product. |
| educt is more polar than the product therefore,  retention factor is smaller for the educt **2 bp** |
| 6.6 Tick all correct ways of interpreting the thin layer chromatogramme. You will lose points for ticking wrong boxes. However, you cannot reach a negative number of points within 6.6. |
| |  |  | | --- | --- | |  | Two substance spots for RP indicate complete reaction. | |  | Two substance spots for RP indicate a high yield. | | X | Two substance spots for RP indicate contamination by a side product. | | X | Two substance spots for RP indicate contamination by the educt. | |  | Two substance spots for the RP and one substance spot for P indicate further reaction during work-up. | | X | Two substance spots for the RP and one substance spot for P indicate that the contamination has been removed during work-up. |   each correctly ticked box 1 bp, the wrong one - 1bp min 0 bp **max. 3 bp** |

Problem 7 51 bp ≙ 8 rp

Qualitative Analysis

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| Complete the table based on the results of your analyses. | | |
|  | formula | justification |
| 1 | Na2S2O3  **1 bp**  **3 bp** | Na+: exclusion **1 bp**  S2O32-: reactions with Ag+  **1 bp** |
| 2 | Fe(NO3)3  **2 bp** **2 bp** | Fe3+: typical own color,  precipitate with OH-, red color with NaSCN **1 bp**  NO3-: Kein precipitate with Ag+ und Ba2+ **1 bp** |
| 3 | NaSCN  **1 bp** **2 bp** | Na+: exclusion **1 bp**  SCN-: whit precipitate with Ag+, red color with Fe3+ **1 bp** |
| 4 | Pb(NO3)2  **3 bp** **2 bp** | Pb2+: yellow precipitate I-,  white precipitate with OH- (soluble in excess of OH-) **1 bp**  NO3-: no precipitate with Ag+ and Ba2+ **1 bp** |
| 5 | ZnI2  **3 bp** **3 bp** | Zn2+: white precipitate with S2-,  white precipitate with OH- (soluble in excess of OH-) **1 bp**  I-: yellow precipitate with Pb2+,  yellowish precipitate with Ag+ **1 bp** |
| 6 | Na3PO4  **1 bp** **4 bp** | Na+: exclusion **1 bp**  PO43-: alkaline pH-value gelber precipitate with Ag+ (soluble in HNO3), **1 bp** |
| 7 | HNO3  **2 bp** **2 bp** | H3O+: acidic pH value **1 bp**  NO3-: no precipitate with Ag+ and Ba2+ **1 bp** |
| 8 | NaHSO4  **1 bp** **3 bp** | Na+: exclusion **1 bp**  HSO4-: white precipitate with Ba2+,  acidic pH-value **1 bp** |

Aufgabe 8 54 bp ≙ 16 rp

Quantitative Analyse:   
Bestimmung von Eisen und Aluminium in einer Probe

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| 8.1 Report your titration volumes. | | |
| „VZn“ = 11 mL **0-12 bp**\* | „VFe“ = 15 mL **0-16 bp** | „VAl“ = 15 mL **0-22 bp** |

Zn: ;

Fe: ;

Al: ;

|  |  |  |
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| 8.2 Calculate the concentrations. | | |
| c(Zn2+) = 0.055M | c(Fe3+) = 0.0745M | c(Al3+) = 0.0724M |
| *c*(Zn2+):  *V*(EDTA) = 11 mL *c*(EDTA) = 0.05 mol/L  => *n*(EDTA) = *c* ⋅ *V* = 0.05 ⋅ 11 = 0.55 mmol  *n*(Zn2+) = *n*(EDTA) = 0.55 mmol => *c*(Zn2+) = **1 bp**  *c*(Fe3+):  *V*(EDTA) = 14.9 mL *c*(EDTA) = 0.05 mol/L  => *n*(EDTA) = *c* ⋅ *V* = 0.05 ⋅ 14.9 = 0.745 mmol  *n*(Fe3+) = *n*(EDTA) = 0.745 mmol => *c*(Fe3+) = **1 bp**  *c*(Al3+):  *V*(EDTA) = 14.1 mL *c*(Zn2+) = 0.055 mol/L  => *n*(Zn2+) = c ⋅ V = 0.055 ⋅ 14.1 = 0.7755 mmol  *n*Zn(EDTA) = *n*(Zn2+) = 0.7755 mmol  *n*ges(EDTA) = *c* ⋅ *V* = 0.05 ⋅ 30 = 1.50 mmol  *n*Al(EDTA) = *n*ges(EDTA) – *n*Zn(EDTA) = 1.50 – 0.7755 = 0.725 mmol  *n*(Al3+) = *n*Al(EDTA) = 0.725 mmol => *c*(Al3+) = **2 bp** | | |