

45th Austrian Chemistry Olympiad

National Competition

Practical Tasks

May 31st, 2019

Solutions

Problem 8 83 bp ≜ 21 rp

Analysis of Wine

**Analysis of red wine 1 (RW1): Determining the color of red wine**

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| 8.1 Specify your results |
| A420 = 1.866 **1.5bp\*** | A520 =2.165 **1.5bp\*** | A620 = 0.506 **1.5bp\*** |
| FI = 4.536 **0.5 bp** | FT = 0.8640 **0.5 bp** |
| 8.2 Tick the boxes to give your assessment of the wine. |
| Wine color is **X** weak 🞎 good 🞎 very good **0.5bp**The wine seems to be 🞎 young **X** matured 🞎 strongly matured **0.5bp** |

\* Δ*A* = |*A*Student-*A*MasterValue|

if Δ*A < 0.005 → 1.5bp; if ΔA > 0.06 → 0bp; otherwise* $bp=1.5\*\left(1-\frac{∆A-0.005}{0.055}\right)$

**Analysis of red wine 2 (RW2): Determining reducing sugars**

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| 8.3 Specify your results. |
| Vbl = 15.2mL **15bp\*** | VZ = 12.7mL **15bp\*\*** | Sugar content 4.50 g /L **0.5bp** |

For this experiment, thiosulfate concentration was c(Na2S2O3) = 0.100mol/L

Δ*V* = |*V*Student-*V*MasterValue|

\* Δ*V < 0.20mL → 15bp; if ΔV > 0.75mL → 0bp; otherwise* $bp=15\*\left(1-\frac{∆V-0.20}{0.55}\right)$

\*\* Δ*V < 0.25mL → 15bp; if ΔV > 0.80mL → 0bp; otherwise* $bp=15\*\left(1-\frac{∆V-0.25}{0.55}\right)$

**Analysis of white wine 1 (WW1): Determining the content of free sulfurous acid**

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| 8.4 State your titration volumes und give the SO2 content of the wine in mg/L. |
| V1 = 3.91mL **10bp\*** | V2 = 0.62mL **12bp\*** | free SO2: 26.37 mg/L **2bp** |

For this experiment, iodate concentration was c(KIO3) = 0.417mmol/L

Δ*V* = |*V*Student-*V*MasterValue|

\* Δ*V < 0.05mL → 10bp; if ΔV > 0.80mL → 0bp; otherwise* $bp=10\*\left(1-\frac{∆V-0.05}{0.75}\right)$

\*\* Δ*V < 0.02mL → 12bp; if ΔV > 0.25mL → 0bp; otherwise* $bp=12\*\left(1-\frac{∆V-0.02}{0.23}\right)$

Analysis of white wine 2 (WW2): Determining the extract content

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| 8.5 Specify your results. |
| Ρwater = 0.99492 g/mL | $ρ\_{sample}$ = 1.00159 g/mL **10bp\*** |
| ρrel = 1.0067 **0.5bp** | Extract = 17.22 g/L **2.5bp** |

Δ*ρ*rel = |*ρ*Student-*ρ* MasterValue|(the Jury calculates ρrel from ρwater and ρwine. If the student calculates correctly themselves, they receive 0.5 bp)

\* Δ*ρ*rel *< 0.0015 → 10bp; if Δρ*rel *> 0.0070mL → 0bp; otherwise* $bp=10\*\left(1-\frac{∆\rho rel-0.0015}{0.00550}\right)$

**Analysis of white wine 3 (WW3): Determining titratable acid**

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| 8.6 Specify your titration volume and the content of tartaric acid in the wine in g/L. |
| V = 0.7mL **7bp\*** | Content tartaric acid: 5.18 g/L **1.5bp** |

Δ*V* = |*V*Student-*V*MasterValue|

\* Δ*V < 0.01mL → 7bp; if ΔV > 0.10mL → 0bp; otherwise* $bp=7\*\left(1-\frac{∆V-0.01}{0.09}\right)$

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| 8.7 *Bromothymol blue is a useful indicator, because …. (tick correct answers).* |
| □ the color change is well visible (yellow – green - blue).□ it is non-toxic and hence does not spoil the wine sample.**X** its p*K*a is 7.1. **0.5bp**□ its p*K*a is 9.3. |

Problem 9 15 bp ≜ 4 rp

A little Photometry

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| *9.1 Specify the absorbtion maximum λmax and the corresponding absorbance of your hydrazone. Write at least 10 pairs of values into the table.* |
| Photometer A: λmax: 377.5 nm (respective absorbance: 1.52)Photometer B: λmax: 384 nm (respective absorbance: 1.25)Photometer C: λmax: 377 nm (respective absorbance: 1.57) (3.5 + 1.5 bp)

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| Measurement | Lambda | A |
| 1. | 350 | 1 |
| 2. | 400 | 1.25 |
| 3. | 450 | 0.4 |
| 4. | 500 | 0.06 |
| 5. | 360 | 1.28 |
| 6. | 370 | 1.46 |
| 7. | 380 | 1.5 |
| 8. | 390 | 1.44 |
| 9. | 375 | 1.51 |
| 10. | 385 | 1.45 |
| 11. | 377 | 1.52 |
| 12. | 378 | 1.52 |
| 13. | 376 | 1.52 |
| 14. | 379 | 1.52 |

5 bp for 10 measured values **10 bp** |

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| *9.2 Draw the absorption spectrum and label abscissa and ordinate.* |
| Abszissa: wavelength [nm] Ordinate: Absorbance **2+3bp** |

Problem 10 56.5 bp ≜ 15 rp

Synthesis: Derivatization of carbonyl compounds to achieve semicarbazones

**Synthesis of the raw product:**

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| 10.1 Show your raw product as well as the mass you measured in the weighing room to a lab supervisor for affirmation..  |
| Assessment of yield **0-10 bp\***\*If $0.2665 g \leq m\_{RP} \leq 0.295 g$ → 10 bp; if $m\_{RP}$ > 0.295 g → 0 bp otherwise: $bp= 10 ⋅\left(\frac{m\_{RP}}{0.2665}\right)$ ; |

**Reprocessing and purification:**

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| 10.2 Show product as well as the mass you measured in the weighing room to a lab supervisor for affirmation.  |
| Assessment of yield **25 bp\***\*If $0.222\leq m\_{P}\leq 0.295 $ → 25 bp; if $m\_{P}$ > 1→ 0 bp otherwise: $bp= 25 ⋅\left(\frac{m\_{P}}{0.222}\right)$ ;Apperance of the product: **0-3 bp**  |

Evaluation and control of purity:

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| 10.3 Determine yield in g and % of theory. |
| theor. yield.: *m* = $0.2∙\frac{177.20}{120.15}=0.295g$ own yield in $\%=\frac{m\_{p}}{0.295}∙100=…\%$ **2 bp** |
| 10.4 Determine the melting point and choose your unknown carbonyl compound from the list. Show your experiment for determining the melting point to a laboratory supervisor directly on the Kofler bench. |
| Melting point: \_\_\_\_\_\_\_\_\_\_\_ (208-210)  **0-3 bp**Correct assignment of carbonyl compound **1 bp** |

**Analysis**

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| 10.5 Specify the following Rf values: |
| Rf-value of educt: 0.84 Rf-value of raw product: 0.35 Rf-value product: 0.35 **3 bp**Assessment of TLC: Two lines, labelling **2 bp**Size of spots, marking the spots on the plate **5 bp**  |

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| 10.6 Tick the correct statement(s) |
| The **Educt E** has □ lower □ higher Rf value, than the **Product P** , because …□ **E** forms stronger H-bonds with silica gel. □ **E** forms intramolecular H-bonds. **X** **P** forms stronger H-bonds with silica gel. □ **P** has higher molar mass.□ **P** is less polar.**X** **E** is less polar.**X** Silica gel is also polar.**X** Silica gel forms stronger interactions with **P**.0.5 bp per correctly ticked box,– 0.5bp per incorrectly ticked box. min 0 bp **max. 2.5 bp** |