**Kinetics Rubric**

| | **Level 4** | **Level 3** | **Level 2** | **Level 1** | **Level 0** |
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| **Q1. Report the initial data from your datasheet with the correct number of significant figures (1 point)**<br><br>Using the values the first two tables in your Data Sheet, fill in the Table 1 below with the **correct number of significant figures.** | The table is complete, and the data is reported with the correct number of significant figures **(1 point)**. | All the data is included and there is one error in the significant figures **(0.75 points)**. | All the data is included, there are two errors in the significant figures **(0.5 points)**. | All the data is included, there are two errors in the significant figures **(0.5 points)**. | The table is not filled or there are more than three errors in significant figures **(0 points)**. |
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| **Q2. Find *n*, the apparent reaction order with respect to CV (2 points)**<br><br>Fill in the correlation ($R^2$) and slope for each order and each trial. Report four decimal places for $R^2$. Report the slope values as given by Excel. Please | The table is complete, and the data is reported correctly.<br><br>$R^2$ are reported to 4 decimal places as instructed.<br><br>The units for the slopes are included.<br>(**2 points**) | All the data is included but the $R^2$ is not reported with 4 decimal places (and a slope sign is not reported correctly (**1.5 points**)<br><br>**OR**<br><br>One of the slope units if not | All the data is included but the $R^2$ is not reported with 4 decimal places and a slope sign is not reported correctly<br><br>**AND**<br><br>One of the slope units is not reported | All the data is included but the $R^2$ is not reported with 4 decimal places and a slope sign is not reported correctly<br><br>**AND**<br><br>Two of the slope units are not reported correctly (**0.5 points**) | Three slope units are reported incorrectly<br><br>**AND**<br><br>The R2 is not reported with 4 decimal places and the slope signs are incorrect (**0 points**) |

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| indicate the units for the slopes. | | reported correctly (**1.5 points**) | correctly (**1 point**)<br><br>**OR**<br><br>Two slope units are reported incorrectly (**1 point**) | **OR**<br><br>Three slope units are reported incorrectly (**0.5 points**) | |
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| **Q3. Determine the values of $k_1$, the apparent rate constant at $T_1$. (2 points)** | The table is complete, and the data is reported correctly:<br><br>- The units for the slope are correct<br><br>-The values for the $k_1$ are reported correctly<br><br>-The *n* is reported correctly<br>(**2 points**) | There is one error from the items in Level 4 **(1.5 point)**. | There are two errors in the items from Level 4 (**1 point**) | There are three errors in the items from Level 4 (**0.5 points**) | There are more than three errors in Level 4 **(0 points)**. |
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| **Q4. Determine the values of log($k_1$) and log([$OH^-$]) (1 point)** | The table is complete, and data is reported correctly **(1 point)**. | All the data is included and there is one error in data **(0.75 points)**. | All the data is included, there are two errors in the significant figures **(0.5 points)**. | All the data is included, there are three errors in the significant figures **(0.25 points)**. | The table is not filled or there are more than three errors in significant figures **(0 points)**. |
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| **Q5a). Plot the graph**<br><br>Using an Excel app, plot log($k_1$) as a function of log([$OH^-$]) for the values obtained at $T_1$ (Table 4) (**5 points**) | The graph is copied directly into the report, not as a separate file (**1 point**). The following formatting requirements are met:<br>**A title for the graph**: should be brief but comprehensive. *Log($k_1$) vs log(OH-)* is not accepted as a title (**1 points**)<br>**Titles for the axes:** present, relevant, contain units (**1 points**) | There are up to 2 errors in 0.5-point items' formatting or 1 error in 1-point item from Level 4 (**4 points**).<br><br>**OR**<br><br>The graph is included separately (**4 points**) | The graph is included in the report.<br><br>There are up to 2 errors in 1 -point items' formatting or 1 error in 1-point item and two 0.5-point items from Level 4 (**3 points**).<br><br>**OR**<br><br>The graph is included separately and There are up to 2 errors in 0.5-point items' formatting or 1 | The graph is included in the report.<br><br>There are up to 3 errors in 1 -point items' formatting or 2 error in 1-point item and 2 errors in two 0.5-point items from Level 4 (**2 points**).<br><br>**OR**<br><br>The graph is included separately and There are up to 2 errors in 1 -point items' formatting or 1 error in 1-point item and two 0.5-point items from Level 4 | There are multiple formatting errors (e.g., more than 3 errors in 1-point items from Level 4 or more than 2 errors in 0.5-point items and 2 errors in 1-point items (**0 points**) |

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| | **Trendline and tick marks:** present, trendline is a dotted line, not a solid line (**0.5 points**)<br>**Equation and correlation ($R^2$):** present in the graph window (**1 points**)<br>**Gridline** is removed and the graph is well centered and occupies most of the window (**0.5 points**) | | error in 1-point item from Level 4 (**3 points**) | | |
| **Q5b) Determination of *m*, the reaction order with respect to $OH^-$ and k, the overall rate constant. (2 points)**<br><br>Refer to equation 16 in your lab manual and to your graph equation to determine ***m*** (the order of the reaction with respect to $OH^-$) and **k** | All the values are calculated correctly.<br><br>k is converted from a corresponding logarithm and the calculations are shown. | There is one error from Level 4 items (**1.5 points**) | There are two errors from Level 4 items (**1 point**) | There are three error from Level 4 items (**0.5 points**) | There are more than three error from Level 4 items (**0 points**) |

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| (the overall rate constant). You should round ***m*** to the nearest integer. Report your values in Table 4 and indicate the units for the reaction rate constant **k**. **Please show your calculations for k** | The units for the k are reported correctly (with accordance to the overall reaction order)<br><br>The reaction order with respect to OH- (m) is reported correctly (**2 points**) | | | | |
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| **Q6a) The law equation (2 points)**.<br><br>Write the general rate law (equation 2 from the lab manual) for the CV hydrolysis with NaOH reaction at temperature $T_1$. Replace the constants k, *m* and *n* by the values you have determined from your experiment and indicate at which temperature this equation is valid **(2 points)**. | Rate law equation written correctly with all the coefficients, constant and temperature reported (either in °C or K) (**2 points**) | One missing/incorrect term from the rate law or temperature or other small error<br><br>(**1.5 points**) | 2 missing/ incorrect terms in the rate law equation or using the rate law expression only for [CV] (**1 points**) | 3 missing terms from the rate law equation or one missing/incorrect term combined with using the rate law expression only for [CV] (**0.5 points**) | More than 3 items missing in the rate law equation or rate law equation is completely wrong (**0 points**) |

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| **Q6b) The overall reaction order (1 point)** | The overall reaction order is correct and an explanation or a calculation is present to show how to find it. (**1 point**) | | The overall reaction order is correct, but a calculation or explanation is not present (**0.5 points**) | | The overall reaction order is incorrect (**0 points**) |
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| **Q7. Recommendations for the water treatment (2 points)**<br><br>Based on your results and observations, what would you recommend for the water waste treatment with regards to NaOH concentration? Please justify your recommendation. | Both the recommendation and justification are provided and are clear and valid.<br>(**2 points**) | Both the recommendation and justification are provided, but are somewhat unclear or not completely valid (**1.5 points**) | Both the recommendation and justification are provided, but one of the two is completely invalid. (**1 point**)<br><br>**OR**<br><br>Only the recommendation is provided and no justification (**1 point**) | Only recommendation is provided, and it is not completely valid or clear (**0.5 points**) | Both the recommendation and justification are completely invalid or unclear. (**0 points**) |
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| **Q8.** Why are you being asked to report the temperature for all your measurements and calculations? (**2 points**) | The answer is provided, and it is clear and valid (**2 points**) | | The answer is provided but it is not completely clear or valid (**1 point**) | | The answer is provided but it is completely invalid or |

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| | | | | | unclear (**0 points**) |
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| Data Sheet (**3 points**) | Data sheet is complete, no information is missing. The TA signature is present. The data sheet is submitted on time **(3 points)**. | Data sheet is mostly complete, but some data is missing (up to 10-20%). The TA signature is present. The data sheet is submitted on time **(2 points)**. | Data sheet is partially complete, up to 30% of data is missing. The TA signature is present. The data sheet is submitted on time **(1 point)**. | Data sheet is partially complete, up to 50% of data is missing. The TA signature is present. The data sheet is submitted on time **(0.5 points)**. | Data sheet is incomplete (more than 50% of data is missing), or it is not submitted or submitted after the last deadline, or it is not signed by the TA **(0 points)**. |
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| **Personalized procedure** (**2 points**) | The procedure is complete or mostly complete and personalized. The TA signature is present. **(2 points)** | | The procedure is missing up to 50% of the steps.<br>The TA signature is present. **(1 point)** | | The procedure is copied directly from the manual, or the procedure is not submitted, or submitted past the last deadline, or it is not signed by the TA **(0 points)**. |

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| Total # points: | **25 points** |