Kinetics Activity Handout Form

**Name**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Date:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Note: You are strongly encouraged to use a spreadsheet program (excel), or other mathematical program (matlab, Mathcad, mathematica, R etc.) to complete this assignment. The blackboard site has links to a video introducing excel, along with excel spread sheets that contain the data for question 3.**

**1)** (4 pts) This form accompanies the online kinetics activity. Please use it to answer the following questions:

*Step-1*

**a)** Attach the printout of your kinetic trace and fill in the following data table:

 Volume of dye solution

 Concentration of bleach solution

 Volume of bleach solution

 **b)** What are the initial concentrations of [Dye] and [Bleach] for your experiment?

*Step-2*

 **c)** What is the value of the pseudo rate constant for your experiment?

*Step-3*

 **d)** Design an experiment to determine the order of the reaction with respect to [bleach]. Attach a printout of your kinetic trace from your experiment. Give the order with respect to [bleach] and explain how you determined this from the experiment.

  *Step-4*

**e)** What is the proportionality constant, ε l, in Beer’s law, abs = ε l [dye]? Include units in your answer. (Abs is unitless and [dye] is in mol/L or M.)

**f)** Calculate the rate constant (k) for the reaction of Yellow 6 with bleach to 2 significant figures, assuming the concentration of [dye] and [bleach] are in M. Write the rate law for the reaction (including both the numerical value of k, and the order of the reaction with respect to [dye] and [bleach]).

**3)** (4 pts total) The following shows results from experiments similar to those of the online tutorial, but with different dyes and bleach. The reaction has 1:1 stoichiometry.

 dye + bleach 🡪 colorless products

The initial solutions have the following concentrations

 Blue dye: 3.20 x 10-5 M Red dye: 5.60 x 10-5 M Bleach: 0.150 M

The absorbance was measured at various dye concentrations and the results are summarized below. (Note: This data also available in the file: <http://collective.chem.cmu.edu/kinetics/documents/dyeData.xlsx> )

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| [blue dye] | abs |  | [red dye] | abs |
| 0 | 0 |  | 0 | 0 |
| 3.20E-06 | 0.08 |  | 5.60E-06 | 0.085 |
| 6.40E-06 | 0.16 |  | 1.12E-05 | 0.17 |
| 9.60E-06 | 0.24 |  | 1.68E-05 | 0.255 |
| 1.28E-05 | 0.32 |  | 2.24E-05 | 0.34 |
| 1.60E-05 | 0.4 |  | 2.80E-05 | 0.425 |
| 1.92E-05 | 0.48 |  | 3.36E-05 | 0.51 |
| 2.24E-05 | 0.56 |  | 3.92E-05 | 0.595 |
| 2.56E-05 | 0.64 |  | 4.48E-05 | 0.68 |
| 2.88E-05 | 0.72 |  | 5.04E-05 | 0.765 |
| 3.20E-05 | 0.8 |  | 5.60E-05 | 0.85 |



Experiments were then performed by mixing the following volumes of dye and bleach solutions and monitoring absorbance versus time.



Experiment 1: blue dye: 9.50 mL bleach: 0.500 mL

Experiment 2: blue dye: 9.00 mL bleach: 1.00 mL

Experiment 3: red dye: 9.50 mL bleach: 0.500 mL

Experiment 4: red dye: 9.00 mL bleach: 1.00 mL

The results of the experiments are available in the dyeData.xls excel file accompanying this homework, and are plotted to the right.

**a)** (2 pts) Determine the rate law of the reaction (including the rate constant, and order with respect to [dye] and [bleach]):

 blue dye + bleach 🡪 colorless products

Please describe your approach, including any calculations or plots used for the analysis.

**b)** (2 pts) Determine the rate law of the reaction (including the rate constant, and order with respect to [dye] and [bleach]):

 red dye + bleach 🡪 colorless products

Please describe your approach, including any calculations or plots used for the analysis.