Lab: Oxalate-Permanganate Clock

$$2 KMnO_4 \quad + \quad 5 (COOH)_2 \quad + \quad 3 H_2SO_4 \quad \longrightarrow \quad 2MnSO_4 \quad + \quad K_2SO_4 + 10 CO_2 \quad + \quad 8H_2O$$

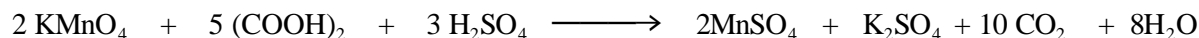**Procedure**

1. You will prepare mixtures in test tubes according to the following table. You will note that the volume in every tube is 16 cm^3. The sulphuric acid solution is **very** strong! **Be careful!** Use a stopper when mixing the tubes. Rinse it thoroughly after each use to avoid contamination. Hot water from the tap will provide the high temperature bath needed for tube #7; an ice bath at the front of the class will serve for tube #8. You may be asked to do another temperature, as assigned by the teacher. Just follow the procedures for tube #7 or 8.

2. Once each tube is mixed, add 2.0 cm^3 of 0.002 mol dm^{-3} potassium permanganate solution to the tube, noting the time at which the addition was made. Stopper the tube and invert it three times to mix it thoroughly, (must stir constantly).

3. At the bottom of the table below, record the time required for the **purple** color of the permanganate to completely disappear. Another color may form. This is not important; it's the disappearance of purple that matters.

Substance	Tube #1	Tube #2	Tube #3	Tube #4	Tube #5	Tube #6	Tube #7	Tube #8
oxalic acid 0.1 0 moldm^{-3}	4mL	8mL	2mL	4mL	4mL	4mL	4mL	4mL
sulphuric acid (3.60 moldm^{-3})	8mL	8mL	8mL	4mL	8mL	8mL	8mL	8mL
water	4mL	0	6mL	8mL	4mL	4mL	4mL	4mL
manganese (II) sulphate crystal	0	0	0	0	one	0	0	0
potassium sulphate crystal	0	0	0	0	0	one	0	0
temperature	room	room	room	room	room	room	50^{0}C	5 ^{0}C
My reaction time(s)								
Class Average(s)								

4. Suppose a second 2.0 cm^3 portion of potassium permanganate solution had been added to Tube #1 after the reaction. What do you expect would happen? (Justify your hypothesis.) Test your prediction experimentally. Explain the result.

5. Summarize the data collected from this series of reactions. Explain the various effects that were observed.

6. Sketch a graph of reaction time versus temperature for the data from tubes #1,7,8 and the one assigned by the teacher. Explain from a molecular point of view why the graph appears the way it does.