Lab Activity: Rates of Reactions
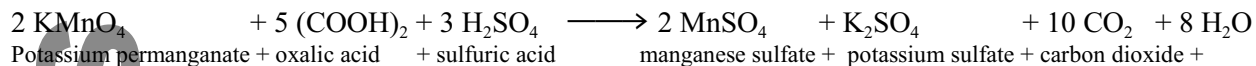
Potassium permanganate, KMnO₄, a purple solution, reacts with oxalic acid,(COOH)₂ , making a colorless product.

If only one factor (such as temperature, concentration, presence of a catalyst) is changed when compared to a control experiment, the effect of that factor may be assessed.

$2\ KMnO_4 \qquad + 5\ (COOH)_2 + 3\ H_2SO_4 \longrightarrow 2\ MnSO_4 \quad + K_2SO_4 \qquad + 10\ CO_2 \ + 8\ H_2O$
Potassium permanganate + oxalic acid   + sulfuric acid   manganese sulfate + potassium sulfate + carbon dioxide +

The manganese ion, Mn^{+2}, acts as a catalyst, it is added to the reaction in the form of manganese sulphate, $MnSO_4$, (containing the _____), but the reaction that is occurring is also producing manganese ions, Mn^{+2}. Therefore we can say that this reaction is **autocatalyzed.**

Autocatalyzed means that something is produced in the reaction which acts as a catalyst to increase the rate of the reaction.

Test tube 1 will act as a control, and you will compare the rate of the other three test tubes to the control, i.e. Test tube 1, and thereby compare the changed factor to explain the difference in rate of reaction.

SUBSTANCE ADDED	TUBE 1 (CONTROL)	TUBE 2	TUBE 3	TUBE 4
Potassium permanganate	1 ml	1 ml	1 ml	1 ml
Oxalic acid	3 ml	3 ml	3 ml	3 ml
Less concentrated (1M) sulphuric acid	5 ml	0	5 ml	5 ml
More concentrated (3M) sulphuric acid	0	5 ml	0	0
Temperature	room	room	Room	60 ºC
Manganese sulphate (catalyst)	0	0	1 crystal	0
Water	5 ml	5 ml	5 ml	5 ml
Time (s)				
Factor that changed				

Use the Data in the Table above to answer the following questions:

1.   What happened to the rate of the reaction when you increased the temperature? Use the kinetic molecular theory to explain what you observed.

2.   What happened to the rate of the reaction when you increased the concentration of one of the reactants? Use the kinetic molecular theory to explain what you observed.

3. What happened when you added the catalyst $MnSO_4$? Use the kinetic molecular theory to explain what you observed.

4. What would happen if you used a more concentrated (3M) sulphuric acid, and raised the temperature to 60 °C? Explain your predictions.

5. Hydrogen may be produced by reacting metals such as magnesium with acids such as hydrochloric acid.

a. Write a balanced chemical equation for the reaction of magnesium with hydrochloric acid.

b. Describe the test you would use to confirm the presence of hydrogen gas.

c. Explain what would happen to the rate of hydrogen production if the acid's concentration was increased?

d. Explain what would happen to the rate of hydrogen production if the magnesium was used in the form of powder instead of magnesium ribbon?

6. To light a wood fire, should you use larger or smaller pieces of wood, explain why?

7. Would ground beef or steak spoil faster? Explain using the kinetic molecular theory.