**BETHEL HIGH SCHOOL**

**CHEMISTRY PRACTICAL TAS**

---

**Experiment 8**

**Determining the activation energy of a reaction**

---

**Introduction**

The equation for the reduction of peroxodisulphate (VI) ions by iodide ions is:

\[ \text{S}_2\text{O}_8^{2-}(aq) + 2 \text{I}^- (aq) \rightarrow 2 \text{SO}_4^{2-}(aq) + \text{I}_2(aq) \]

A small, known amount of thiosulphate ions is added to the reaction mixture, which also contains some starch indicator. The thiosulphate reacts with the iodine formed in the above reaction as in the following equation:

\[ 2 \text{S}_2\text{O}_3^{2-}(aq) + \text{I}_2(aq) \rightarrow \text{S}_4\text{O}_6^{2-}(aq) + 2 \text{I}^- (aq) \]

At the instant that all the thiosulphate has reacted, free iodine is produced in the solution and its presence is shown by the appearance of the blue-black colour of the iodine-starch complex, i.e. the thiosulphate ions act as a ‘monitor’ indicating the point at which a certain amount of iodine has been formed. For this reason the reaction is often referred to as an iodine ‘clock’ reaction. In general, for a ‘clock’ reaction:

\[ \text{rate of reaction} \propto \frac{1}{t} \]

where \( t \) is the time taken to reach a specified stage.

You carry out the experiment at five different temperature between about 40 °C and 60 °C. You then find the activation energy for the reaction by plotting a graph of log (1/t) against 1/T (T is the absolute temperature).

---

**Procedure**

1. Half-fill the beaker with water and heat it to between 59 °C and 61 °C. This will be used as a water-bath.
2. Using a burette, measure out 10 cm³ of potassium peroxodisulphate (VI) solution into the first boiling-tube. Clamp this in the water-bath and place a thermometer in the solution in the boiling-tube.
3. Using burettes, measure out 5 cm³ each of the potassium iodide and sodium thiosulphate solutions and 2.5 cm³ of starch solution into the second boiling-tube. Place another thermometer in this solution and stand it in the water-bath.
4. When the temperatures of the two solutions are equal and constant (to within ± 1 °C), pour the contents of the second boiling-tube the first, shake to mix, and start the clock.
5. When the blue colour of the starch-iodine complex appears, stop the clock and write down the time in a copy of Results Table.
6. Repeat the experiment at temperatures close to 55 °C, 50 °C, 45 °C, 40 °C. (The temperatures you use may differ from those by a few degrees but must, of course, be recorded carefully.)

---

<table>
<thead>
<tr>
<th>Temperature / °C</th>
<th>Temperature, T/K</th>
<th>Time, t/s</th>
<th>log₁₀ (1/t)</th>
<th>1/T, K⁻¹</th>
</tr>
</thead>
</table>

---

**Calculations**

1. Plot a graph of \( \log_{10} (1/t) \) (vertical axis) against \( 1/T \) (horizontal axis).
2. Use your graph to calculate a value for the activation energy.
3. Explain why the reaction rate can be affected by temperature.

---

Tas_8