Experiment 15: Strength of Intermolecular Forces

Liquid:	T_i (°C)	T_f (°C)	ΔT (°C)
Methanol	17.4	5.10	12.3
Ethanol	17.2	9.90	7.30
Propan-1-ol	17.8	13.6	4.20
Butan-1-ol	17.2	15.0	2.10

Q: Rank the alcohols from greatest to least in terms of their cooling effect.

But-1-ol, propan-1-ol, ethanol and methanol.

Q: Explain how the cooling effect relates to the rate of evaporation of the liquid.

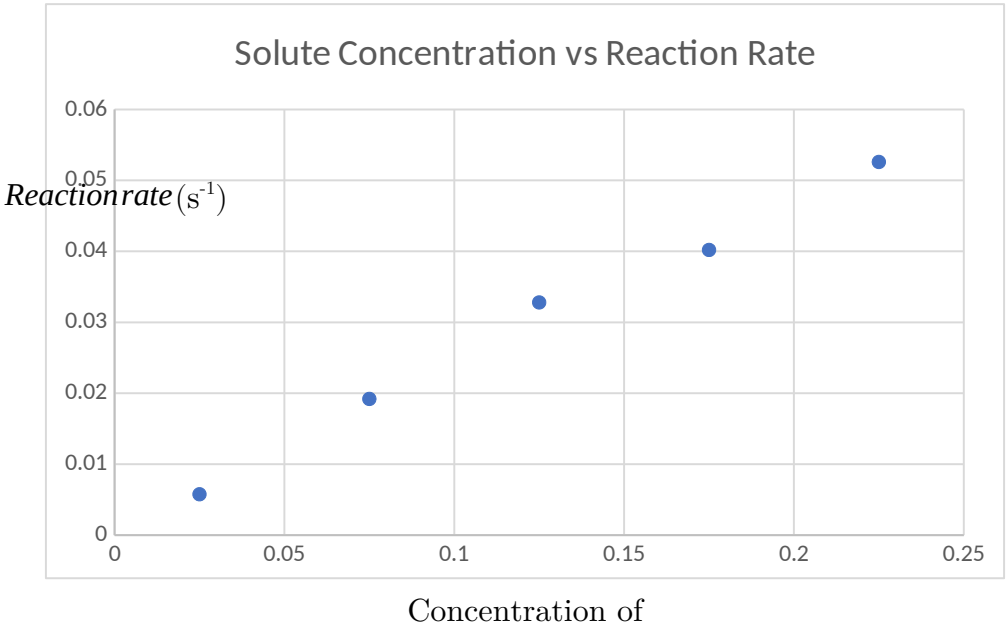
As a liquid evaporates, it absorbs energy from the surroundings, decreasing the temperature of the surroundings. The greater the intermolecular forces of the liquid, the greater the amount of energy required to overcome them and hence the lower the rate of evaporation and the lower the decrease in temperature.

Q: Explain how the cooling effect and rate of evaporation relate to the strength of intermolecular forces in the liquids. Support your answer with examples from this experiment.

The less electrons in the molecules of a substance, the weaker the intermolecular forces should be. Therefore, the methanol should evaporate more quickly than the other liquids since it has the weakest intermolecular forces due to having the least amount of electrons. The weak intermolecular forces mean that less energy is required to overcome the intermolecular forces and therefore the rate of evaporation increases and the greater the decrease in temperature.

Experiment 39: Reactant Concentration and Rate of Reaction

Volume of 0.25mol L^{-1} $Na_2S_2O_3$ (mL)	Volume of H_2O added (mL)	Total volume after adding and mixing 5mL HCl (mL)	Concentration of $Na_2S_2O_3$ on mixing (mol L_{-1})	Time for cross to disappear (s)	$\frac{1}{Time}$ (s^{-1})
45	0	50	0.225	19.00	0.0526
35	10	50	0.175	24.87	0.0402
25	20	50	0.125	30.50	0.0328
15	30	50	0.075	52.00	0.0192
5	40	50	0.025	173.62	0.00576



Q: What effect does the concentration of sodium thiosulfate have on the reaction rate?

Increasing concentration of reactants decreases the distance between the particles, increasing the rate of collisions that occur, hence increasing reaction rate.

Q: If the concentration of sodium thiosulfate is doubled, what happens to the rate of the reaction?

The rate of reaction would double.

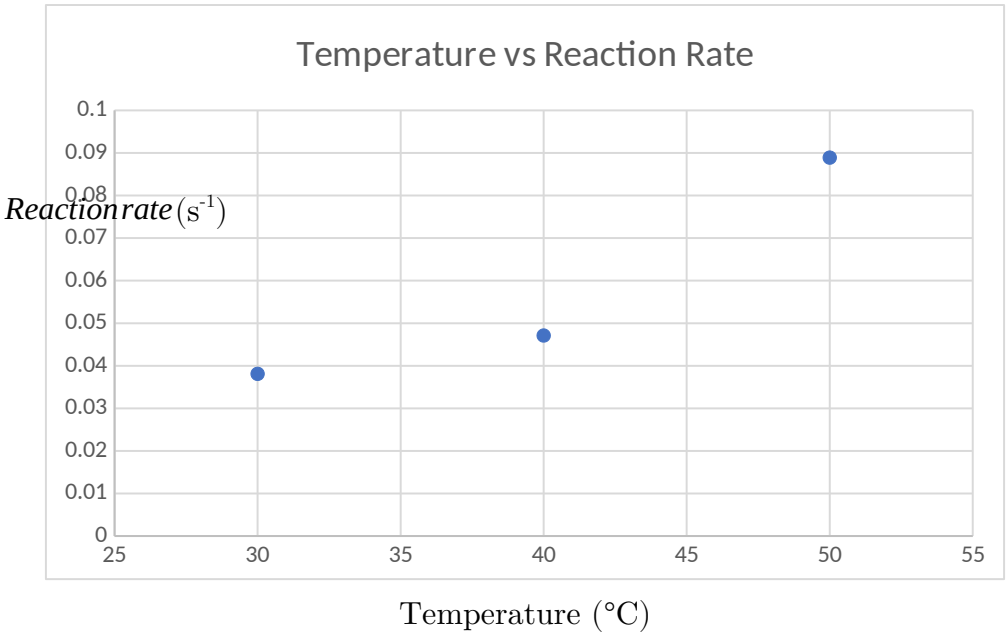
Q: Identify 2 random errors in this experiment. How could these errors be minimised?

[1] Reaction time of the person starting and stopping the stopwatch – do repeat trials with the same person timing it with the stopwatch.

[2] Thinking the cross is still there when the cross has actually disappeared – do repeat trials with the same person checking if the cross is still there.

Experiment 40: Temperature and Rate of Reaction

Temperature (°C)	Total volume of 0.25 mol L^{-1} (mL)	Volume of H_2O (mL)	Total volume after adding 5mL HCl (mL)	Concentration of Na_2SO_3 (mol L^{-1})	Time for cross to disappear (s)	$\frac{1}{Time}$ (s^{-1})
30	15	30	50	0.075	26.27	0.0381
40					21.25	0.0471
50					11.25	0.0889



Q: What effect does increasing temperature have on the reaction rate?

Increasing temperature increases the average kinetic energy of the particles, increasing the proportion of particles that have sufficient kinetic energy to meet the activation energy required for a successful collision, hence increasing reaction rate.

Increasing temperature increases the average kinetic energy of the particles, causing the particles to move faster and in doing so increase the rate of collisions that occur, hence increasing reaction rate.

Q: Suggest 2 factors that contribute to the change in reaction rate with temperature.

[1] Average kinetic energy of the particles.

[2] Random motion of the particles.

Q: Identify 2 random errors in this experiment. How could these errors be minimised?

[1] Wind/breezes through the window causing irregular changes in temperature – do repeat trials while ensuring windows are closed.

[2] Different person timing the stopwatch and looking at the cross – use the same person to time the stopwatch and look at the cross.

Catalysts provide an **alternate pathway with a lower activation energy**. This means that a greater proportion of particles will have **sufficient kinetic energy** to meet the **activation energy** required for a successful collision, hence increasing the **reaction rate**.