

## Candidate 2 evidence

### The effect of Temperature changes on Reaction Rate

#### Aim:

To investigate the effect of changing temperature on the rate of reaction of oxalic acid and acidified potassium permanganate.

#### underlying chemistry:

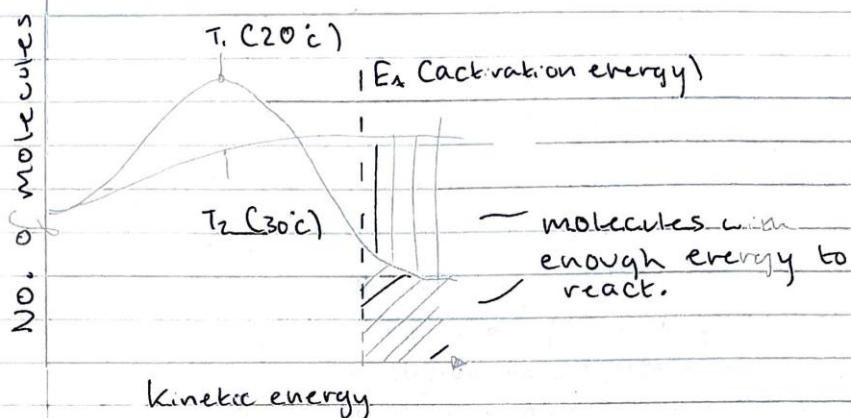
Collision theory is all about how reactions come about, it suggests that for a chemical reaction to be successful it needs the correct geometry and a sufficient kinetic energy (activation energy) so that an activated complex can form.

Temperature is a measure of the average kinetic energy of a particles in a substance. If the temperature is increased, the particles in the substance have more energy, become more excited, and so they move more quickly. Increasing the speed of the particles means that more successful reactions will take place as more particles are colliding. So this means that as you increase temperature you increase the average kinetic energy in a substance which increases the speed of particles, which increases the amount of collisions which in turn increases the rate of reaction.

Reaction Rate can be calculated using the equation below:

$$\text{Reaction Rate} = \frac{1}{t} \quad (\text{Time in seconds})$$

~~An potential~~ An energy distribution diagram can be used to show us the amount of molecules with enough energy to react.



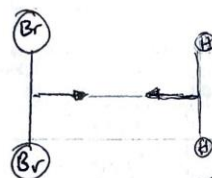
Line  $T_2 (30^\circ\text{C})$  shows us that there is an increase of the temperature and this causes a large increase of molecules with enough energy to react. When you have more molecules with enough energy you will get more successful collisions which increases rate of reaction.

This reaction we will be undergoing will be an exothermic reaction. This means energy is lost and the products have less energy than the reactants.

for a successful collision to occur, like mentioned previously, the collision geometry must be right as well so that the activated complex can be formed.



unsuccessful collision as no activated complex can be formed. This means the activated complex cannot form.



This is a potentially successful collision as an activated complex could potentially form.

procedure:

add sulphuric acid to potassium permanganate solution and water. Heat the mixture to a specific temperature. once at the correct temperature add oxalic acid to the mixture and record the time it takes for the mixture to go ~~colorless~~ colourless. When handling sulphuric acid and oxalic acid wear gloves to protect your hands from the chemicals corrosive properties.

Temperature (°C)	Time taken for solution to go colourless (s)			Average Time (s)	Relative Rate (s <sup>-1</sup> )
	1st	2nd	3rd		
25	177	300	163	213	0.005
35	79	72	39	<del>190</del> 63	0.02
45	27	24	32	28	0.04
55	9	10	10	9.7	0.1
65	9	6	9	8	0.13

Sample Calculation:

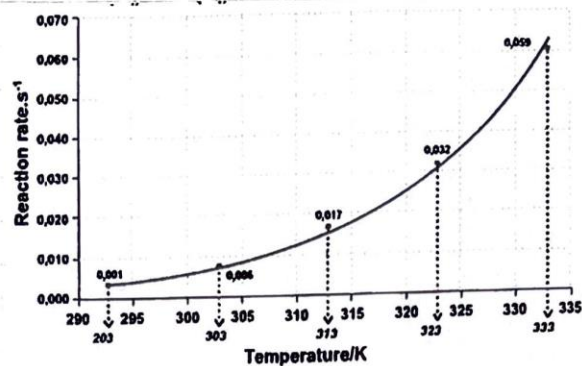
$$\text{Relative Rate} = \frac{1}{t}$$

$$\text{Relative rate} = \frac{1}{213}$$

$$= 0.005 \text{ s}^{-1}$$

Internet source:

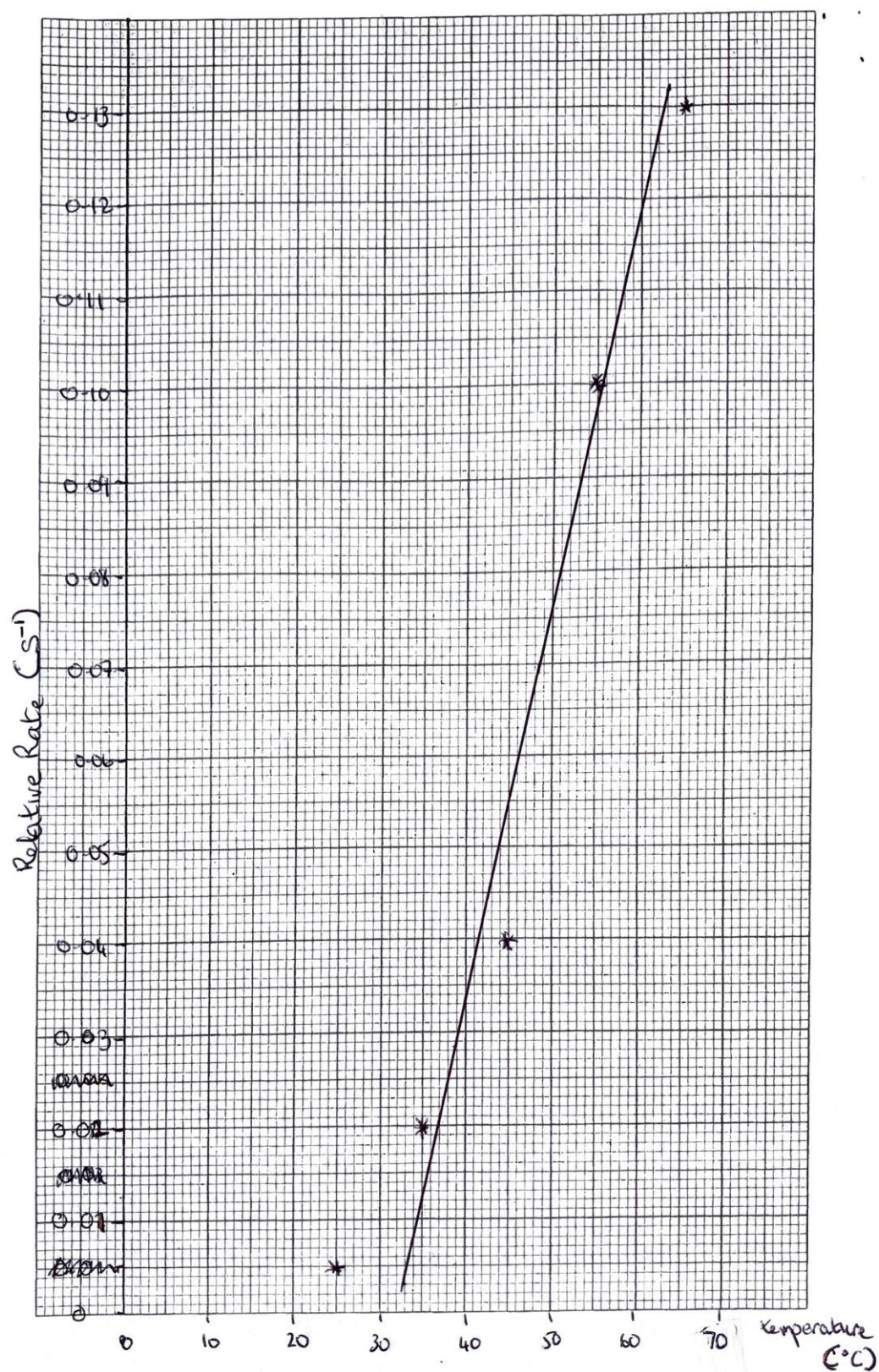
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<http://chemstasis.blogspot.com/2016/05/01-arch-vc.html?view=sidebar>  
(February 2014)





### Analysis:

Although the second source's temperature is measured in Kelvins and my graph is measured in degrees. They both show the same trend of as you increase temperature, relative rate also increases.

### Conclusion:

To conclude, as you increase temperature, you increase the rate of reaction between oxalic acid and acidified potassium permanganate. This is proven by both my table of raw data, my graph and my second source.

### Evaluation:

Our experiment is reliable as we repeated the experiment at ~~the~~ a good range of temperatures three times. From this we then created an average which we used to create a more accurate set of results.

In our experimental procedure, we did not use pipettes but instead we used measuring cylinders. Next time using a pipette will help improve the accuracy of our results by reducing the errors and ~~uncertainties~~ uncertainties involved.

In our experiment the use of B grade glass also added to the errors and uncertainties in our results, next time to improve accuracy, A grade glass will be used instead.

Next time, finding a second source that has its temperature in degrees instead of kelvins would make my results more comparable and therefore reliable. Also Z could've changed my temperature from degrees to kelvins. This would bring about the same result as the solution mentioned above.