CHEMISTRY ONLINE
— TUITION —

Phone: +442081445350

www.chemistryonlinetuition.com

Email:asherrana@chemistryonlinetuition.com

CHEMISTRY

Physical Chemistry

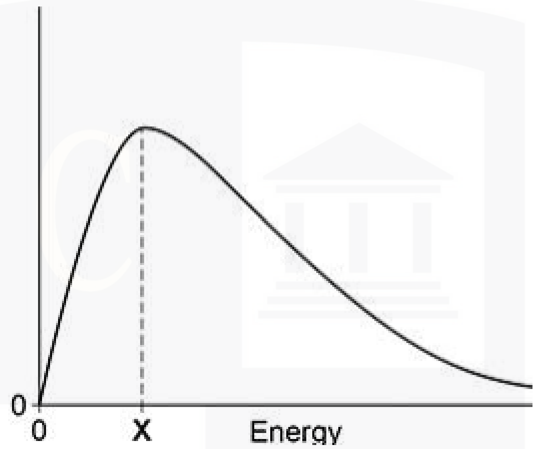
Level & Board	AQA (A-LEVEL)
TOPIC:	KINETICS
PAPER TYPE:	SOLUTION - 1
TOTAL QUESTIONS	10
TOTAL MARKS	28

Kinetics

1. (A)

(Total 1 mark)

2.



(a)
y-axis on the figure above shows number of molecules (with a particular energy)

(1)

(b)
The curve starts at the origin shows there are no molecules with no energy.

(1)

(c)
X indicates most probable energy.

(1)

3. (A)

(Total 1 mark)

4. (B)

(Total 1 mark)

5.
(a)
The student records the times to the nearest second and not to the nearest 0.01 s due to following possible reasons:

Precision Challenge: Human capability to accurately judge within hundredths of a second is limited due to reaction subtleties and perceptual constraints.
Endpoint Ambiguity: Reactions often exhibit gradual changes, making it difficult to precisely identify the exact moment the cross disappears or the solution becomes cloudy.
Reaction Time Variability: Wide-ranging reaction times imply inherent variability. Measuring to the hundredth of a second might not reliably represent this variability due to human limitations and reaction fluctuations.

(1)

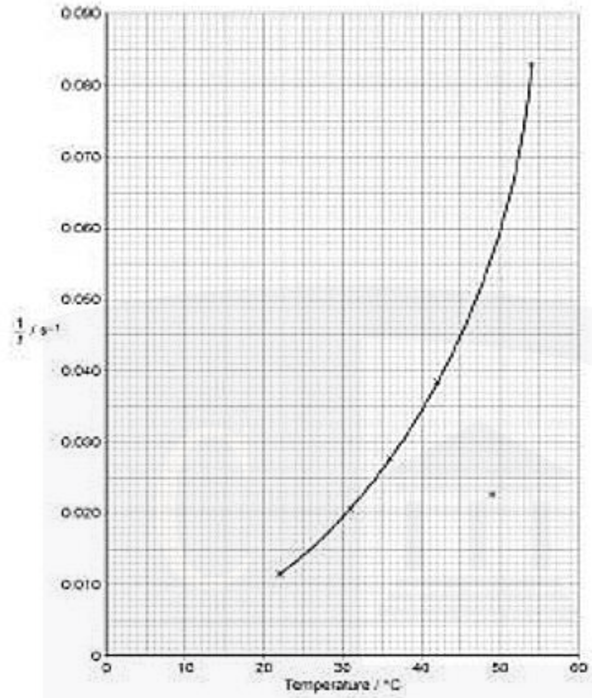
(b)

The formula to calculate $1/t$ is:
So $1/12 = 0.0833 s^{-1}$
Putting this value to table as:

Temperature / °C	22	31	36	42	49	54
Time t, for cross to disappear / s	87	48	36	26	44	12
1/t s^{-1}	0.0115	0.0208	0.0278	0.0385	0.0227	0.0833

(1)

(c)



(2)

(d)

=1/ best fit line at 40°C

=1/0.345

= 29 (s)

(1)

(e)

Small amounts of reactants are likely used in this experiment to limit the formation of sulfur dioxide (SO_2).

SO_2 is a toxic gas, and its production should be controlled in laboratory settings due to its harmful effects on health and the environment.

(1)

(f)

The student likely avoided conducting experiments at 1–10°C because at these temperatures, the reaction would be extremely slow, requiring an unreasonably long time to complete.

(1)

6. (B)

(Total 1 mark)

7. (D)

(Total 1 mark)

8.

(a)

A catalyst increases the rate of a reaction as it provides a different route / mechanism / pathway for the reaction with lower activation energy. Activation energy (E_a) is the minimum amount of energy that reactant molecules must overcome or acquire to initiate a chemical reaction. It represents the energy barrier that must be surpassed for the reactants to transform into products during a chemical reaction.

(2)

(b)

Increasing the concentration of hydrogen peroxide results in more molecules of H_2O_2 in the given volume or space. This higher concentration means a greater number of reactant particles are closer together within that space.
So, according to collision theory the frequency of successful collisions increases without invoking changes in activation energy. These more frequent successful collisions occur due to a higher number of collisions per unit time, enabling a greater probability of reactant particles having sufficient energy to overcome the activation energy barrier and leading to a faster rate of reaction.

(2)

9. (D)

(Total 1 mark)

10.

(a)

The use of a large excess of H_2O_2 and I^- means that the rate of reaction at a fixed temperature depends only on the concentration of $H^+(aq)$ because of :
The use of excess H_2O_2 and I^- ensures their concentrations remain effectively constant throughout the reaction.
So, only the concentration of H^+ changes, while the concentrations of H_2O_2 and I^- have a negligible effect on the rate of the reaction.
This shows that the reaction is independent of changes in H_2O_2 and I^- concentrations, indicating that their orders (a and b) are effectively zero in the rate equation.

(2)

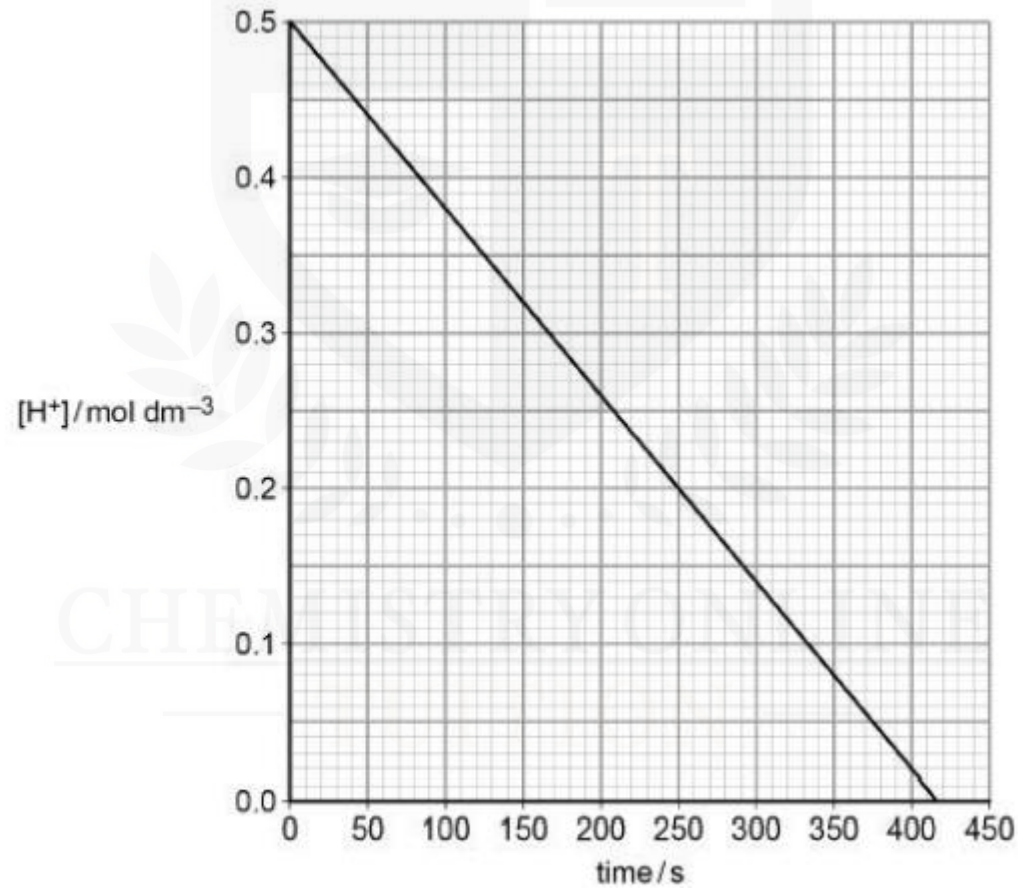
(b)

Samples of the reaction mixture are removed at timed intervals and titrated with alkali to determine the concentration of $H^+_{(aq)}$. To stop the reaction and prevent further chemical activity, quenching the reaction is necessary.

This can be done by dilution, cooling the mixture, or adding a specific reagent that reacts with H_2O_2 or I^-. Dilution with water or cooling the reaction mixture can effectively halt the reaction by reducing the concentration of reactants or lowering the temperature. Additionally, adding a suitable reagent that reacts with H_2O_2 or I^-, other than an acid or alkali for the purpose of neutralization.

(2)

(c)

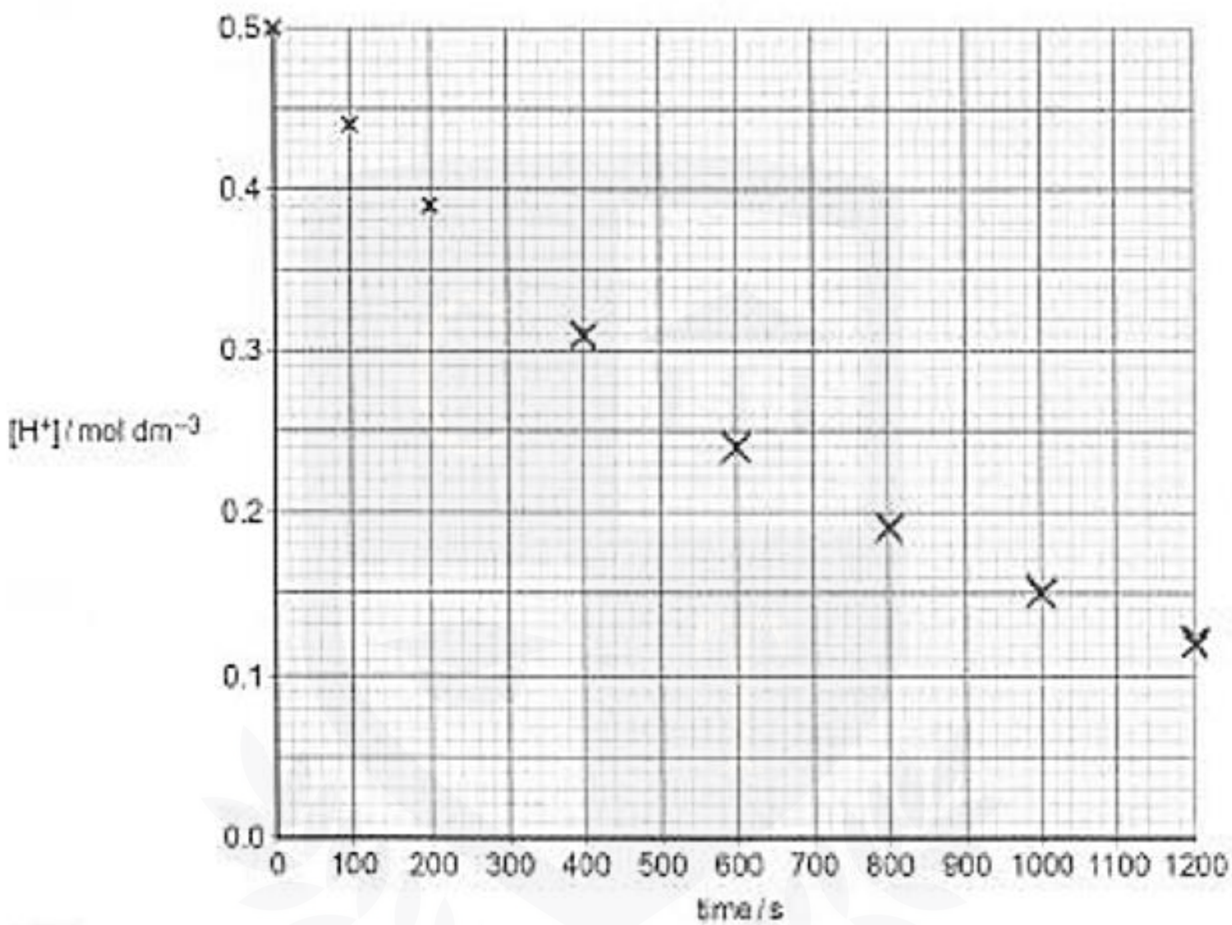


The graph shows that the order with respect to H^+ (aq) is zero because change/decrease in concentration is proportional to time. as $[H^+]$ changes/decreases has no effect on the rate.

So, constant rate / rate = k

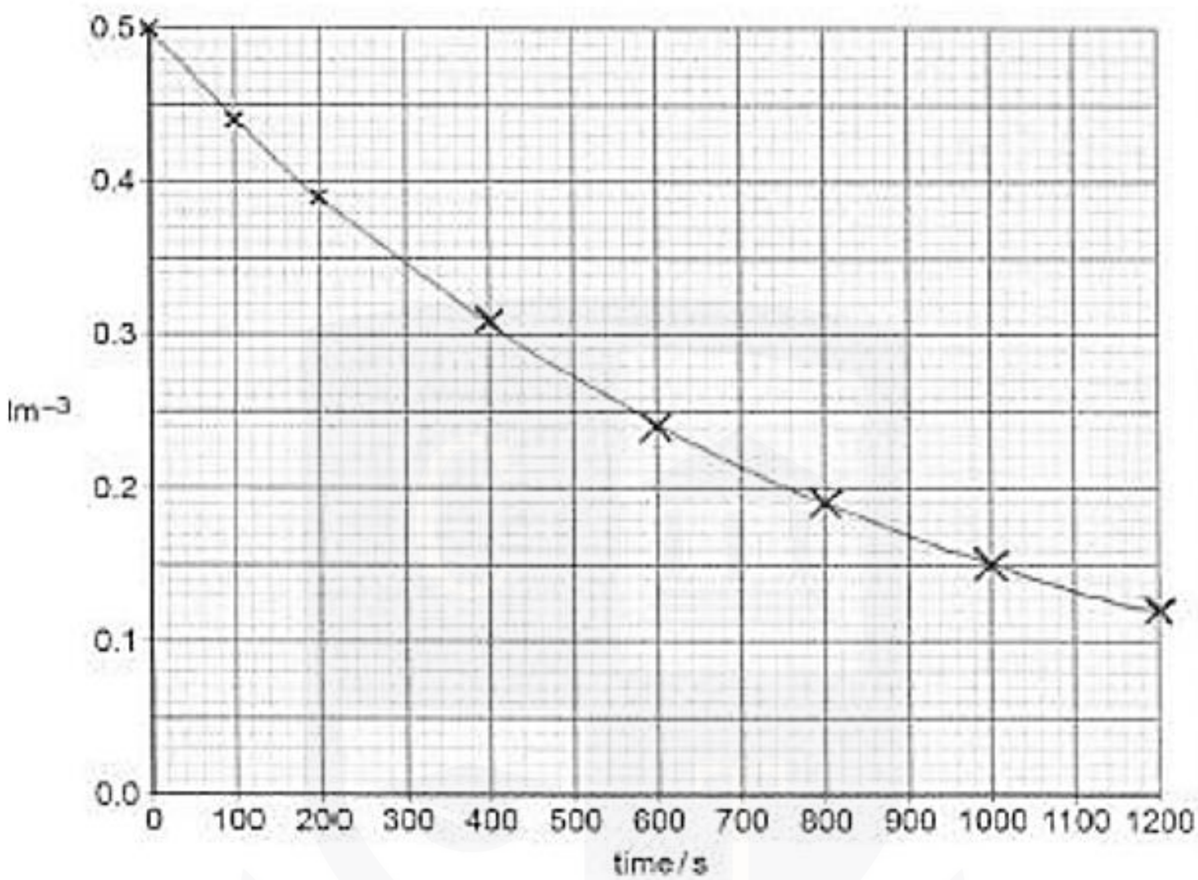
(2)

(d)


0.5
0.4
0.3
0.2
0.1
0.0
[H⁺] / mol dm⁻³
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
time / s

(1)

(e)


0.5
0.4
0.3
0.2
0.1
0.0
Im⁻³
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
time / s

(1)

DR. ASHAR RANA

M.B.B.S / MS. CHEMISTRY

CHEMISTRY ONLINE
TUITION
Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

- Founder & CEO of Chemistry Online Tuition Ltd.
- Completed Medicine (M.B.B.S) in 2007
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, Math's and Biology Tutor

CONTACT INFORMATION FOR **CHEMISTRY ONLINE TUITION**

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com

Address: 210-Old Brompton Road, London SW5 OBS, UK