Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Rate Equations

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Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1.

Iodide ions are oxidised to iodine by hydrogen peroxide in acidic conditions.

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow I_2(aq) + 2H_2O(l)$$

The rate equation for this reaction can be written as

$$rate = k\,[H_2O_2]^a\,[I^-]^b\,[H^+]^c$$

In an experiment to determine the order with respect to $H^+(aq)$, a reaction mixture is made containing $H^+(aq)$ with a concentration of 0.500 mol dm^{-3}

A large excess of both H_2O_2 and I^- is used in this reaction mixture so that the rate equation can be simplified to

$$rate = k_1\,[H^+]^c$$

(a) Explain why 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 $H^+(aq)$.

_____

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_____

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_____

(2)

(b) Samples of the reaction mixture are removed at timed intervals and titrated with alkali to determine the concentration of $H^+(aq)$.

State and explain what must be done to each sample before it is titrated with alkali.

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(2)

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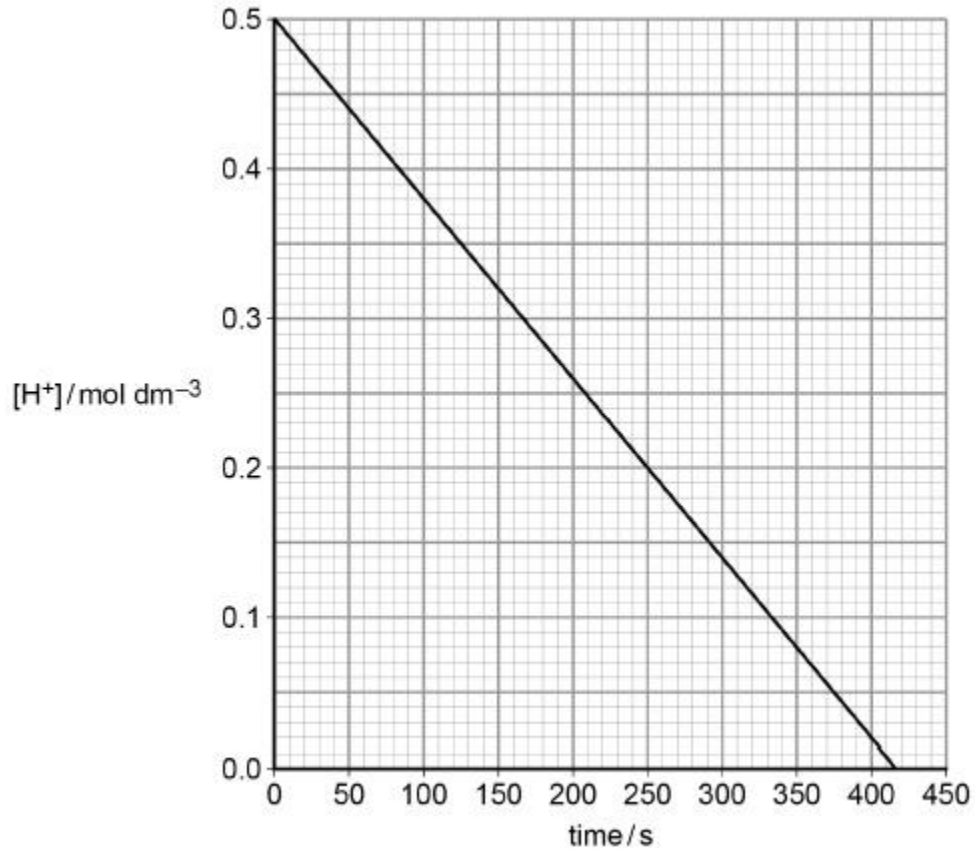
(c) A graph of the results is shown in **Figure 1**.

Figure 1



Explain how the graph shows that the order with respect to $H^+(aq)$ is zero.

_____

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_____

(2)

(d) Use the graph in **Figure 1** to calculate the value of k_1

Give the units of k_1

k_1 _____

Units _____

(3)

(e) A second reaction mixture is made at the same temperature. The initial concentrations of $H^+(aq)$ and $I^-(aq)$ in this mixture are both 0.500 mol dm^{-3}

There is a large excess of H_2O_2

In this reaction mixture, the rate depends only on the concentration of $I^-(aq)$.

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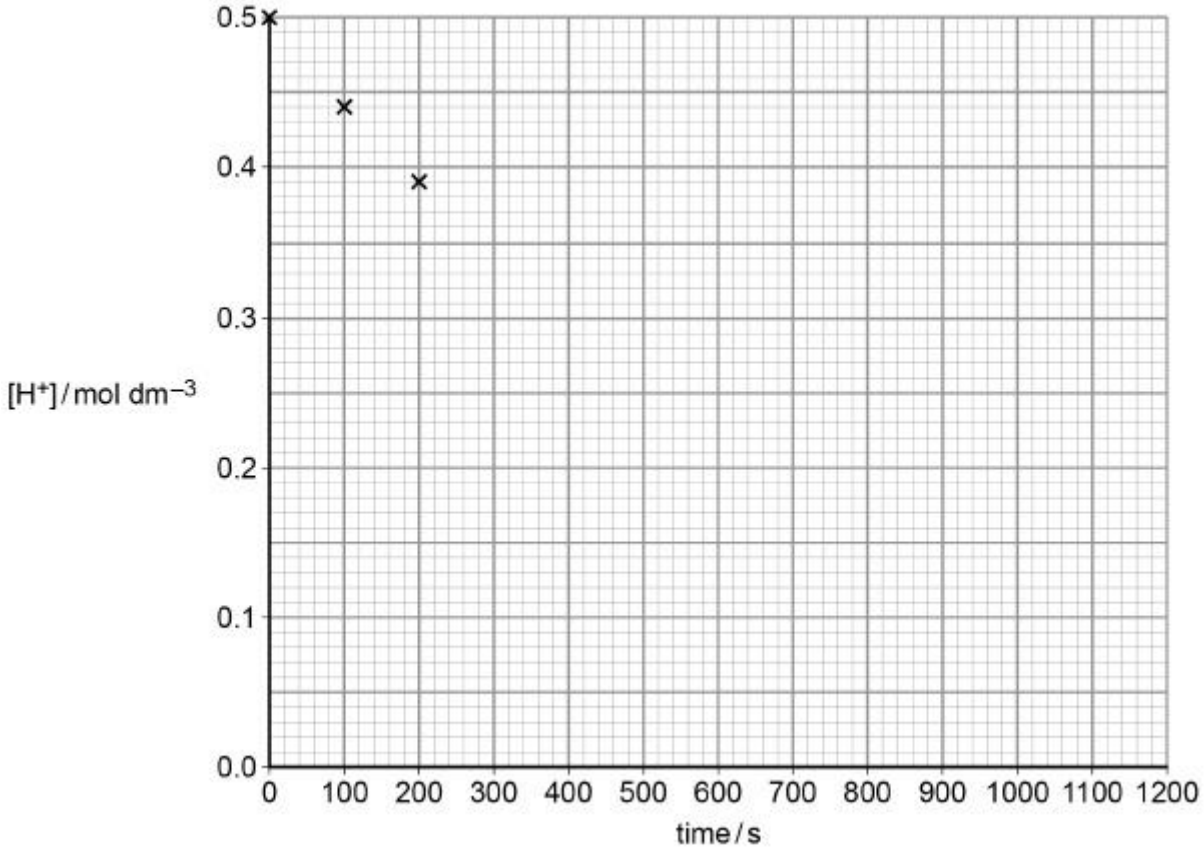
The results are shown in the table.

Time / s	0	100	200	400	600	800	1000	1200
$[H^+]$ / mol dm^{-3}	0.50	0.44	0.39	0.31	0.24	0.19	0.15	0.12

Plot these results on the grid in **Figure 2**. The first three points have been plotted.

Figure 2



(1)

(f) Draw a line of best fit on the grid in **Figure 2**.

(1)

(g) Calculate the rate of reaction when $[H^+] = 0.35$ mol dm^{-3}
Show your working using a suitable construction on the graph in **Figure 2**.

Rate _____ mol dm^{-3} s^{-1}

(2)

(h) A general equation for a reaction is shown.

$$\mathbf{A}(aq) + \mathbf{B}(aq) + \mathbf{C}(aq) \rightarrow \mathbf{D}(aq) + \mathbf{E}(aq)$$

In aqueous solution, **A**, **B**, **C** and **D** are all colourless but **E** is dark blue.

A reagent (**X**) is available that reacts rapidly with **E**. This means that, if a small amount of **X** is included in the initial reaction mixture, it will react with any **E** produced until all of the **X** has been used up.

Explain, giving brief experimental details, how you could use a series of experiments to

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determine the order of this reaction with respect to **A**. In each experiment you should obtain a measure of the initial rate of reaction.

(6)

(Total 19 marks)

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