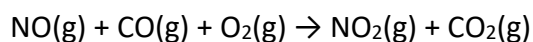


KINETICS AHL (HL only)

Please ensure that you have also completed the Core (SL & HL) questions

1. The following reaction occurs at high temperature:



(a) Given the data for four experiments below, deduce the order of reaction for each reactant, and write the rate expression. **Explain your reasoning.**

Experiment	[NO(g)] / mol dm ⁻³	[CO(g)] / mol dm ⁻³	[O ₂ (g)] / mol dm ⁻³	Initial rate / mol dm ⁻³ s ⁻¹
1	1.00 × 10 ⁻³	1.00 × 10 ⁻³	1.00 × 10 ⁻¹	4.40 × 10 ⁻⁴
2	2.00 × 10 ⁻³	1.00 × 10 ⁻³	1.00 × 10 ⁻¹	1.76 × 10 ⁻³
3	2.00 × 10 ⁻³	2.00 × 10 ⁻³	1.00 × 10 ⁻¹	1.76 × 10 ⁻³
4	4.00 × 10 ⁻³	1.00 × 10 ⁻³	2.00 × 10 ⁻¹	7.04 × 10 ⁻³

[4]

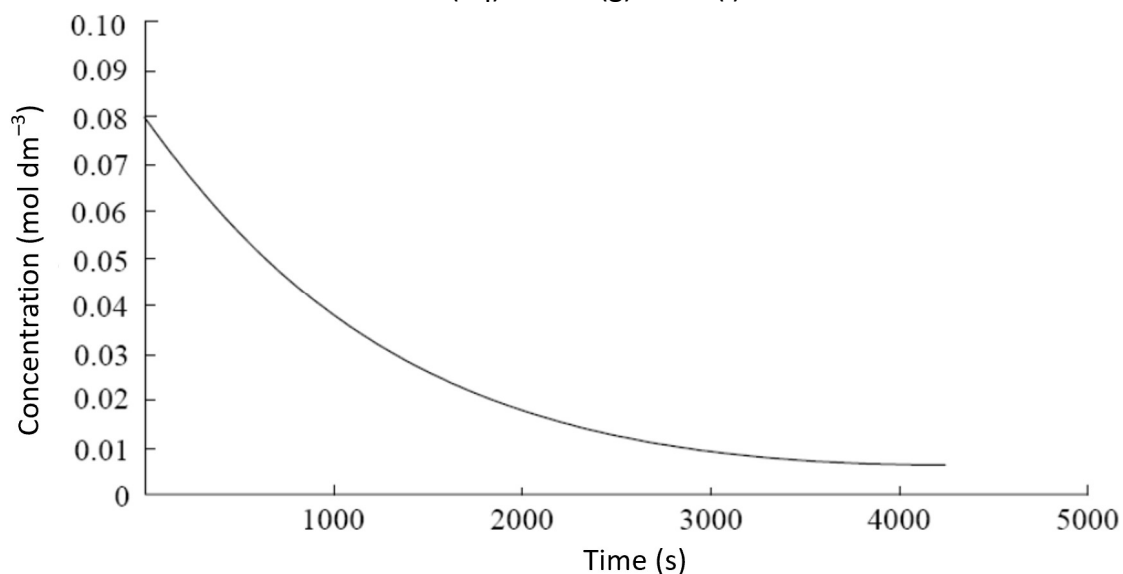
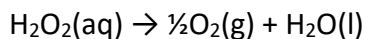
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(b) Calculate a value for the rate constant, stating its units.

[2]

<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

2. The decomposition of a sample of hydrogen peroxide, after addition of a catalyst, was followed over time:



(a) Using the graph (show your working) determine the half-life of the hydrogen peroxide.

[2]

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(b) Deduce the order of reaction with respect to H_2O_2 . Explain your reasoning.

[1]

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(c) Given that $t_{\frac{1}{2}} = \frac{\ln 2}{k}$, calculate a value for the rate constant for this reaction (units not required).

[1]

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(d) State how the rate constant will change with increasing temperature.

[1]

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(e) The decomposition reaction of hydrogen peroxide was conducted at different temperatures. Using section 1 of the data booklet, describe how the data from these experiments could be used to draw a graph to determine the activation energy.

[3]

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(f) Activation energy can also be found using two data points. Using section 1 and section 2 of the data booklet, calculate the activation energy for this reaction (in kJ mol^{-1}) if the rate constant was found to be $8.20 \times 10^{-4} \text{ s}^{-1}$ at 298K and $9.50 \times 10^{-4} \text{ s}^{-1}$ at 308K. Give your answer to three significant figures.

[4]

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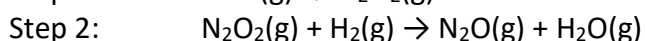
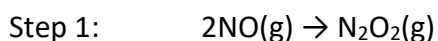
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3. The following is a proposed mechanism for the reaction of $\text{NO}(\text{g})$ with $\text{H}_2(\text{g})$.



(a) Identify the intermediate in the reaction.

[1]

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(b) Write an equation for the overall reaction between NO(g) and H₂(g)

[1]

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(c) Deduce a rate expression if **step 1** were the rate determining step. Explain your reasoning.

[2]

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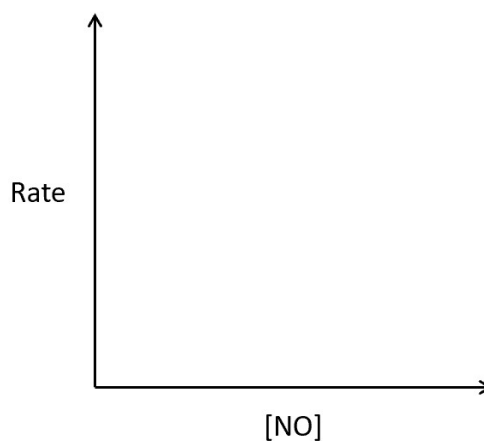
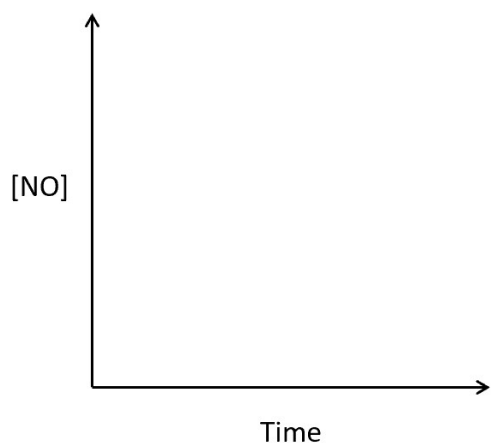
(d) Deduce a rate expression if **step 2** were the rate determining step. Explain your reasoning.

[3]

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(e) Assuming that the reaction is second order with respect to NO, sketch the two graphs below.

[2]



Total Marks 27 (41 minutes)