Chemistry

Higher level

Paper 1B

Practice paper

Topic: Chemical Kinetics

Chemistry

Higher level

Paper 1B

Specimen paper

45 minutes

Instructions to candidates

- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for paper 1B is [25 marks].

Section B

1. The method of initial rates was used to investigate the kinetics of the reaction between nitrogen dioxide and carbon monoxide: $NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$. The following data was recorded at 298 K:

Experiment	**Initial [NO_2]** / mol dm^{-3}	**Initial [CO] / mol dm^{-3}**	**Initial Rate / mol dm^{-3}** s^{-1}
1	0.10	0.10	0.0021
2	0.20	0.10	0.0084
3	0.20	0.20	0.0084

(a) Deduce the order of reaction with respect to NO_2 and with respect to CO based on the initial rate data. Show your reasoning. **[3]**

....

....

....

....

....

....

(b) Formulate the experimental rate expression for this reaction. **[1]**

....

....

(c) Calculate the value of the rate constant, k, at 298 K, and clearly state its units. **[2]**

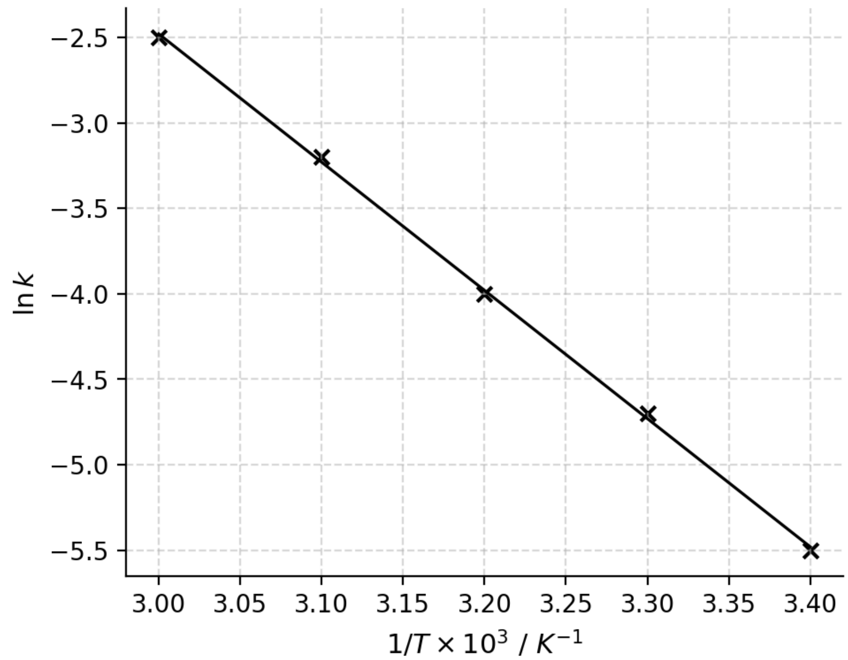
....

....

....

....

2. The rate constant for the decomposition of N_2O_5 is measured at several temperatures. A plot of ln k against 1/T is shown below.



(a) Determine the gradient of the line of best fit, being careful to note the axis scales. **[2]**

....

....

....

....

(b) Calculate the activation energy, E_a, for this reaction in kJ mol^{-1}. (R = 8.31 J K^{-1} mol^{-1}). **[3]**

....

....

....

....

....

....

3. Consider the gas phase reaction: $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$. The experimentally determined rate expression is Rate = $k[NO]^2[H_2]$.

(a) A proposed mechanism involves a fast equilibrium step followed by a slow rate-determining step:

Step 1: $2NO \rightleftharpoons N_2O_2$ (fast)

Step 2: $N_2O_2 + H_2 \rightarrow N_2O + H_2O$ (slow)

Show mathematically that this proposed mechanism is consistent with the experimental rate expression. **[3]**

....

....

....

....

....

....