$$H_2(g) + Cl_2(g) \rightarrow 2\ HCl(g)$$

6. The table below gives data for a reaction rate study of the reaction represented above.

| Experiment | Initial $[H_2]$ (mol $L^{-1}$) | Initial $[Cl_2]$ (mol $L^{-1}$) | Initial Rate of Formation of HCl (mol $L^{-1}$ $s^{-1}$) |
|---|---|---|---|
| 1 | 0.00100 | 0.000500 | $1.82 \times 10^{-12}$ |
| 2 | 0.00200 | 0.000500 | $3.64 \times 10^{-12}$ |
| 3 | 0.00200 | 0.000250 | $1.82 \times 10^{-12}$ |

(a) Determine the order of the reaction with respect to $H_2$ and justify your answer.

(b) Determine the order of the reaction with respect to $Cl_2$ and justify your answer.

(c) Write the overall rate law for the reaction.

(d) Write the units of the rate constant.

(e) Predict the initial rate of the reaction if the initial concentration of $H_2$ is 0.00300 mol $L^{-1}$ and the initial concentration of $Cl_2$ is 0.000500 mol $L^{-1}$.

The gas-phase decomposition of nitrous oxide has the following two-step mechanism.

Step 1: $N_2O \rightarrow N_2 + O$

Step 2: $O + N_2O \rightarrow N_2 + O_2$

(f) Write the balanced equation for the overall reaction.

(g) Is the oxygen atom, O, a catalyst for the reaction or is it an intermediate? Explain.

(h) Identify the slower step in the mechanism if the rate law for the reaction was determined to be *rate* = $k[N_2O]$. Justify your answer.

**STOP**

**END OF EXAM**