A-Level Chemistry: **w25 42**

| | |
|---|---|
| 2(a)(i) | homolytic fission |
| 2(a)(ii) |  |
| 2(a)(iii) | 115–120° |
| 2(b) | **M1:** $3.825 \times 10^{-3}$ / 0.003825 / 0.00383 / 0.0038 / $3.8 \times 10^{-3}$<br><br>**M2:** units = $mol^{-1}\ dm^{3}\ s^{-1}$ |
| 2(c) | not constant half-life because overall second order |
| 2(d) | 8.17 / 8.2 |
| 2(e) | • reactants are adsorbed onto the catalyst surface<br>• bonds within reactant molecules are weakened<br>• products are desorbed from catalyst surface<br><br>Any two [1], all three [2] |

A-Level Chemistry: **w25 43**

| | |
|---|---|
| 3(a) | heterogeneous **AND** $MnO_2$ is in a different state / phase to the reactants / $H_2O_2$ |
| 3(b)(i) | **M1:** (expt 2 and 3) $[I^-] \times 2$ initial rate $\times$ 2 so 1st order wrt $[I^-]$<br><br>**M2:** (expt 1 and 2) $[I^-] \times 2$, $[H_2O_2] \times 0.5$ initial rate $\times$ 1 so 1st order wrt $[H_2O_2]$<br>**OR** (expt 1 and 4) $[I^-] \times 4$ initial rate $\times$ 4 **AND** $[H^+] \times 4$ so zero order wrt $[H^+]$<br>**OR** (expt 1 and 3) $[I^-] \times 4$, $[H_2O_2] \times 0.5$ initial rate $\times$ 2 so 1st order wrt $[H_2O_2]$<br><br>**M3:** (expt 1 and 4) $[I^-]$ x 4 , $[H^+] \times 4$ initial rate $\times$ 4 so zero order wrt $[H^+]$<br>**OR** (expt 3 and 4) $[H_2O_2] \times 2$ initial rate $\times$ 2**AND** $[H^+]$ x 4 so zero order wrt $[H^+]$<br>**OR** (expt 3 and 4) $[H_2O_2] \times 2$, $[H^+] \times 4$ initial rate $\times$ 2 so 1st order wrt $[H_2O_2]$<br><br>**M4:** rate = $k\ [H_2O_2]\ [I^-]$ **OR** rate = $k\ [H_2O_2]\ [I^-]\ [H^+]^0$ |
| 3(b)(ii) | **M1:** $k = 2.42 \times 10^{-3} \div (0.045 \times 0.030) = 1.79$ min 2sf<br><br>**M2:** units = $dm^{3}\ mol^{-1}\ s^{-1}$ |
| 3(c)(i) | **M1:** calculation of one $t_{1/2}$ = 60 s ± 5 s<br><br>**M2:** two $t_{1/2}$ calculated that are constant |
| 3(c)(ii) | $k = \ln 2 \div 60 = 0.0116$ **OR** $k = 0.693 \div 60 = 0.0116$ min 2sf |
| 3(d) | increases $k$ and increases the rate of reaction |

| | |
|---|---|
| 4(a)(i) | the order of reaction with respect to $[H_2]$: 1<br>the order of reaction with respect to [NO]: 2<br>overall order of the reaction: 3 |
| 4(a)(ii) | rate $\times \frac{1}{4}$ |
| 4(a)(iii) | rate $\times$ 27 |
| 4(a)(iv) | a four-particle collision is unlikely |
| 4(a)(v) | step 1 $2NO \rightarrow N_2O_2$<br>step 2 $N_2O_2 + H_2 \rightarrow N_2O + H_2O$<br>step 3 $N_2O + H_2 \rightarrow N_2 + H_2O$ |
| 4(a)(vi) | intermediate formed (step 2) then used up later (step 3) |
| 4(b) | $k = 0.693 / 720 = 9.625 \times 10^{-4}$ min 2sf<br>**AND** units: $s^{-1}$ |
| 4(c)(i) | homogeneous<br>**AND** $Co^{3+}$ / catalyst / it is in the same phase / same state as the reactants |
| 4(c)(ii) | **M1:** (equation 1) $2Co^{3+} + 2I^- \rightarrow 2Co^{2+} + I_2$<br>**M2:** (equation 2) $2Co^{2+} + S_2O_8^{2-} \rightarrow 2Co^{3+} + 2SO_4^{2-}$ |
| 4(c)(iii) | repulsion of two negative / same charge ions slows the reaction / raises $E_A$ |