

## Solutions

---

Original marking guidance: M1 method, A1 accuracy, B1 explanation.

**2.1** S<sub>N</sub>1; slow heterolytic C–X cleavage forming a carbocation and halide ion.

**2.2**  $E_a = -R \times \text{gradient} = 49860 \text{ J mol}^{-1} = 49.9 \text{ kJ mol}^{-1}$ .

**2.3** Nucleophile participates in the S<sub>N</sub>2 rate-determining collision; it attacks after the slow ionisation in the simple S<sub>N</sub>1 sequence.

**3.1** Adding the steps cancels intermediate I and gives  $A + B \rightarrow C$ . Slow unimolecular A step gives rate proportional to  $[A]$ , and B reacts afterwards. Consistency supports this mechanism but other mechanisms may give the same law.

**3.2** Impurity blocks active sites, reducing available adsorption/reaction sites. Removing it restores rate but does not change the equilibrium constant at fixed temperature. Raising temperature changes  $K$  and yield according to the reaction enthalpy.