QUICK CHECK — RATES OF REACTION (B)

A reacts with **B** in the presence of **C** to make **D**. **A + B → D**

A series of experiments was carried out to determine the rate equation for this reaction.

Experiment	initial [**A**] (mol dm^{-3})	initial [**B**] (mol dm^{-3})	initial [**C**] (mol dm^{-3})	initial rate (mol dm^{-3} s^{-1})
1	0.200	0.300	0.100	0.160
2	0.200	0.150	0.100	0.040
3	0.100	0.600	0.100	0.640
4	0.300	0.150	0.200	0.080

a Determine the order with respect to [**A**] **0** [**B**] **2** [**C**] **1**

b State the rate equation. **rate = k [B]^2 [C]**

c Determine the value of the rate constant.

rate = k [B]^2 [C]

$$k = \frac{\text{rate}}{[B]^2\,[C]} = \frac{0.160}{[0.300]^2\,[0.100]} = 17.8$$

d Determine the units of the rate constant.

$$k = \frac{(\text{mol dm}^{-3})\,\text{s}^{-1}}{(\text{mol dm}^{-3})^3} = \frac{\text{s}^{-1}}{(\text{mol dm}^{-3})^2} = \frac{\text{s}^{-1}}{\text{mol}^2\,\text{dm}^{-6}} = \text{mol}^{-2}\,\text{dm}^6\,\text{s}^{-1}$$

e State the role of **C** in this reaction. Explain your answer.

catalyst – appears in the rate equation but not the stoichiometric equation

f Why are the initial rates used in each case in these experiments?

rates change during the experiment – need to compare at the same stage and so must use the start