

Solutions

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

2.1 Zero order; rate remains unchanged at fixed other conditions.

2.2 $k = r/[A]^2 = 0.0120/(0.200)^2 = 0.300 \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$.

2.3 40 s; first order under the stated fixed conditions, because successive half-lives are constant.

3.1 First pair: doubling A quadruples rate, order 2. Last pair: tripling B triples rate, order 1. $r = k[A]^2[B]$, overall order 3. $k = 0.0020/(0.10^2 \times 0.10) = 2.0 \text{ dm}^6 \text{ mol}^{-2} \text{ s}^{-1}$.

3.2 The chord gives an interval average; a tangent at 60 s gives instantaneous concentration gradient, and the positive disappearance rate is the negative of that gradient. Reciprocal time compares rates only when the same small conversion/endpoint and relevant conditions are controlled.