16.1 Rate Expression & Reaction Mechanism
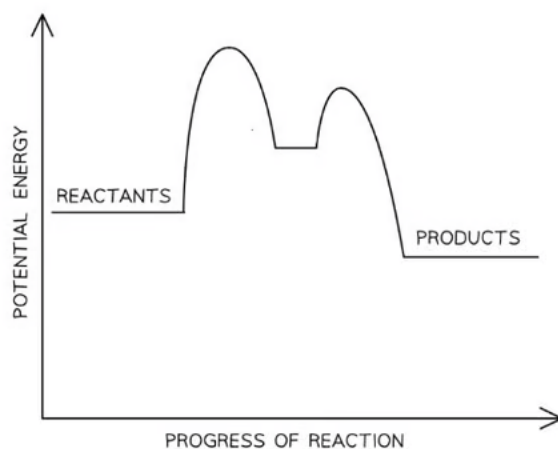
Question Paper

Course	DP IB Chemistry
Section	16. Chemical Kinetics (HL only)
Topic	16.1 Rate Expression & Reaction Mechanism
Difficulty	Hard

Time allowed: 10

Score: /5

Percentage: /100

Question 1

The potential energy level profile for the hydrolysis of a tertiary halogenoalkane is shown.

Which of the following conclusions can be deduced from the potential energy level profile?

   I. The reaction proceeds via an S_N1 mechanism
  II. The reactants are more stable than the products
 III. The rate-determining step is the first step of the reaction mechanism

  A. I and II only

  B. I and III only

  C. II and III only

  D. I, II and III

[1 mark]

Question 2

The rate information below was obtained for the following fourth order reaction at a constant temperature:
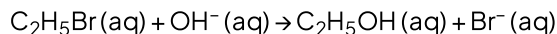
$$5Br^- (aq) + BrO_3^- (aq) + 6H^+ (aq) \rightarrow 3Br_2 (aq) + 3H_2O (l)$$
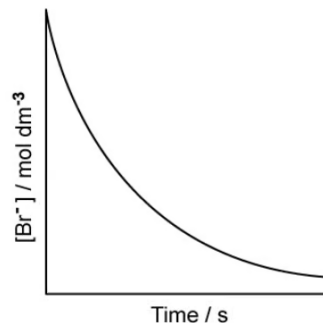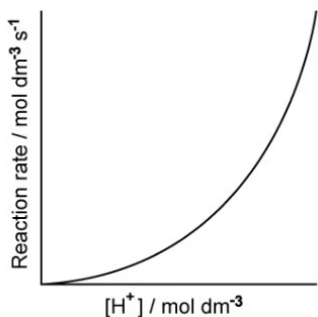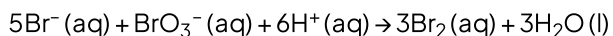
Which rate expression is consistent with the data?

A. Rate = k $[Br^-]$ $[BrO_3^-]$ $[H^+]$

B. Rate = k $[Br^-]^2$ $[H^+]^2$

C. Rate = k $[Br^-]$ $[BrO_3^-]$ $[H^+]^2$

D. Rate = k $[Br^-]^2$ $[BrO_3^-]$ $[H^+]$

[1 mark]

Question 3

The rate information below was obtained for the following reaction at a constant temperature:

$$C_2H_5Br\,(aq) + OH^-\,(aq) \rightarrow C_2H_5OH\,(aq) + Br^-\,(aq)$$

| $[C_2H_5Br]$ / mol dm^{-3}	$[OH^-]$ / mol dm^{-3}	Rate / mol dm^{-3} s^{-1}
2.0×10^{-3}	1.0×10^{-2}	4.0×10^{-4}
4.0×10^{-3}	1.0×10^{-2}	8.0×10^{-4}
8.0×10^{-3}	2.0×10^{-2}	3.2×10^{-3}

What is the correct equation to calculate the value of the rate constant, k?

A. $\dfrac{\text{rate}}{[C_2H_5Br]\,[OH^-]}$

B. $\dfrac{[C_2H_5Br]\,[OH^-]}{\text{rate}}$

C. $\dfrac{\text{rate}}{[C_2H_5Br]\,[OH^-]^2}$

D. $\dfrac{\text{rate}}{[C_2H_5Br]^2\,[OH^-]^2}$

[1 mark]

Question 4

The mechanism for the following reaction between nitrogen(II) oxide and carbon monoxide is shown.

$$NO_2\,(g) + CO\,(g) \rightarrow NO\,(g) + CO_2\,(g)$$
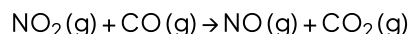
Step 1: $NO_2 + NO_2 \rightleftharpoons N_2O_4$ fast step

Step 2: $N_2O_4 + 2CO \rightarrow 2NO + 2CO_2$ slow step

Which rate expression is consistent with the mechanism?

A. Rate $= k\,[NO_2]\,[CO]^2$

B. Rate $= k\,[N_2O_4]\,[CO]^2$

C. Rate $= k\,[NO_2]^2\,[CO]^2$

D. Rate $= k\,[N_2O_4]\,[CO]$

[1 mark]

Question 5

The rate information below was obtained for the following reaction of aqueous solutions of F and G, in the presence of a homogeneous catalyst, H,

$$2F + 3G \rightarrow J + 2K$$
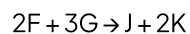
When the concentrations of F and G are doubled, the rate of reaction increases by a factor of four.

When the concentrations of F and H are doubled, the rate of reaction increases by a factor of eight.

Which rate expression is consistent with the data?

A. Rate = $k\,[F]^2\,[G]^3$

B. Rate = $k\,[F]^2\,[H]$

C. Rate = $k\,[F]\,[G]\,[H]$

D. Rate = $k\,[F]^2\,[H]^2$

[1 mark]