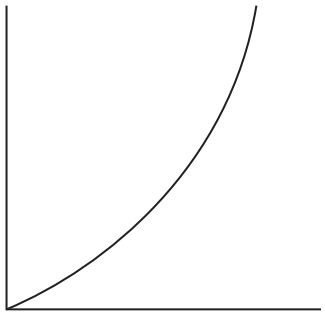
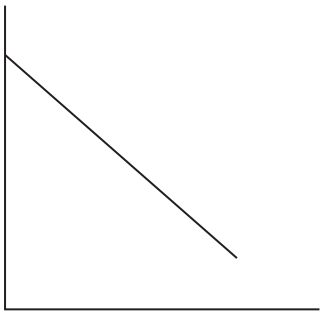
1 Four sketch graphs are shown below.

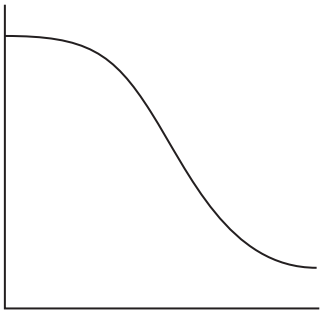
A



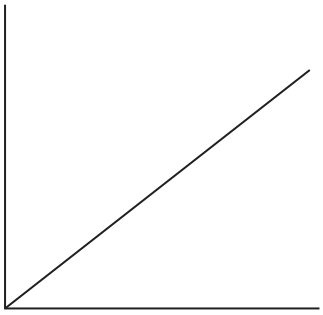
B



C



D



(a) Which could be a graph of the concentration of a reactant, on the vertical axis, against time for a **zero** order reaction?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) Which could be a graph of rate of reaction, on the vertical axis, against the concentration of a reactant for a **first** order reaction?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(c) Which could be a graph of rate of reaction, on the vertical axis, against the square of the concentration of a reactant for a **second** order reaction?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(d) Which could be a graph of the concentration of a reactant, on the vertical axis, against time for a reaction which is catalysed by a product?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question = 4 marks)

2 A halogenoalkane, RX, reacts with hydroxide ions, OH^-, to form an alcohol.

$$RX + OH^- \rightarrow ROH + X^-$$

The rate equation for the reaction is rate $k[RX]$. Which of these statements is **incorrect**?

☒ **A** Rate $\propto$ [RX].

☒ **B** RX is a primary halogenoalkane.

☒ **C** The reaction mechanism is S_N1.

☒ **D** A carbocation intermediate forms in the reaction.

(Total for Question 1 mark)

3 The rate equation for the reaction between hydrogen gas and nitrogen monoxide gas is

$$\text{rate} \quad k[NO]^2[H_2]$$

If the concentration of both reactants is doubled, the rate will increase by a factor of

☒ **A** 3

☒ **B** 4

☒ **C** 6

☒ **D** 8

(Total for Question 1 mark)

4 A reaction has the rate equation rate $k[X][Y]^2[Z]$. The concentrations of each reactant are shown in the table below.

Reactant	Concentration / mol dm^{-3}
X	0.040
Y	0.20
Z	0.12

(a) If the rate of reaction under these conditions has a value of 0.24 mol dm^{-3} s^{-1}, then the numerical value of k is

(1)

☒ **A** 0.00080

☒ **B** 0.533

☒ **C** 1.875

☒ **D** 1250

(b) The units for the rate constant, k, are

(1)

☒ **A** mol^{-3} dm^9 s^{-1}

☒ **B** mol^3 dm^9 s^{-1}

☒ **C** mol^{-3} dm^{-9} s^{-1}

☒ **D** mol^3 dm^{-9} s^{-1}

(Total for Question 2 marks)

5 The equation below shows the hydrolysis of a bromoalkane.

$$RBr + OH^- \rightarrow ROH + Br^-$$

For a particular bromoalkane, the rate equation is

$$\text{rate} \quad k[RBr]$$

The bromoalkane, RBr, is most likely to be

☒ **A** CH_3Br

☒ **B** CH_3CH_2Br

☒ **C** $(CH_3)_3CCH_2Br$

☒ **D** $(CH_3)_3CBr$

(Total for Question 1 mark)

6 Propanone reacts with iodine in acidic solution as shown in the equation below.

$$CH_3COCH_3(aq) + I_2(aq) \rightarrow CH_3COCH_2I(aq) + H^+(aq) + I^-(aq)$$

The rate equation for the reaction is

$$\text{Rate} = k[CH_3COCH_3(aq)][H^+(aq)]$$

(a) The most appropriate technique to investigate the rate of this reaction is

(1)

☒ **A** titrating samples of reaction mixture with acid.

☒ **B** measurement of optical activity.

☒ **C** measurement of the volume of gas given off.

☒ **D** colorimetry.

(b) Which statement about the reaction is **not** correct?

(1)

☒ **A** The overall order of reaction is second order.

☒ **B** The units of the rate constant are $dm^3\,mol^{-1}\,s^{-1}$.

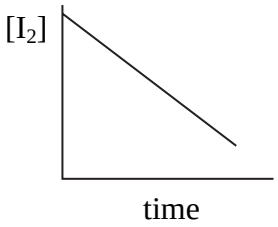
☒ **C** The rate constant increases with temperature.

☒ **D** The rate increases four times when the concentration of propanone and iodine are both doubled**.**

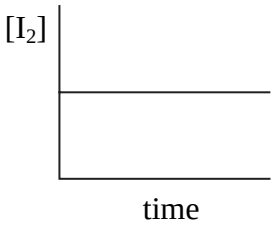
(c) The reaction is carried out using a large excess of both propanone and acid.
Which of the graphs below shows the change of iodine concentration with time?

(1)

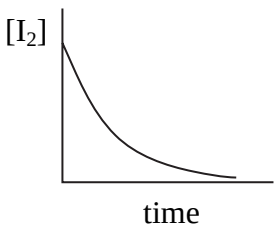
☒ **A**



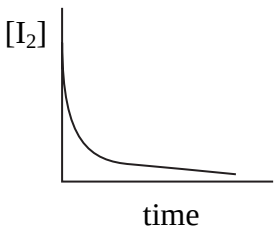
☒ **B**



☒ **C**



☒ **D**



(Total for Question = 3 marks)

7 Methods for investigating reaction rates include

A colorimetry

B collecting and measuring the volume of a gas

C quenching, followed by titration with acid

D quenching, followed by titration with iodine solution.

Which method would be most suitable to investigate the rate of the following reactions?

(a) $H_2O_2(aq) + 2I^-(aq) + 2H^+(aq) \rightarrow 2H_2O(l) + I_2(aq)$

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) $C_4H_9Br(l) + OH^-(aq) \rightarrow C_4H_9OH(l) + Br^-(aq)$

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question = 2 marks)

8 For a given initial reactant pressure, the half-life for a first order gaseous reaction was found to be 30 minutes.

If the experiment were repeated at half the initial reactant pressure, the half-life would be

☒ **A** 15 minutes.

☒ **B** 30 minutes.

☒ **C** 45 minutes.

☒ **D** 60 minutes.

(Total for Question = 1 mark)

9 To determine the activation energy (E_a) for a reaction, the variation of reaction rate with temperature is investigated.

The rate constant, k, for the reaction is related to the absolute temperature, T, by the expression

$$\ln k = -\frac{E_a}{R} \times \left(\frac{1}{T}\right) + \text{constant}$$

where R is the gas constant.

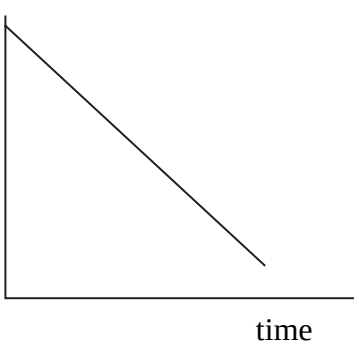
The activation energy for the reaction could be obtained by plotting a graph of

	vertical axis	**horizontal axis**
☒ **A**	k	T
☒ **B**	k	$\frac{1}{T}$
☒ **C**	$\ln k$	T
☒ **D**	$\ln k$	$\frac{1}{T}$

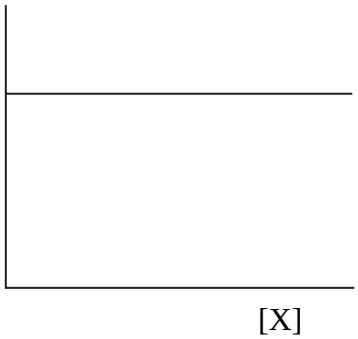
(Total for Question = 1 mark)

10 Which of the following graphs shows that a reaction is first order with respect to reactant **X**?

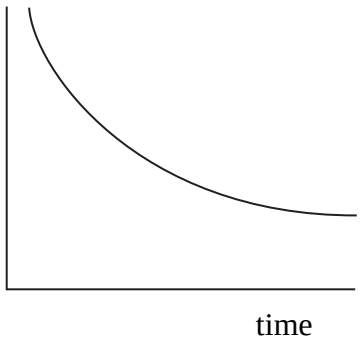
☒ **A**



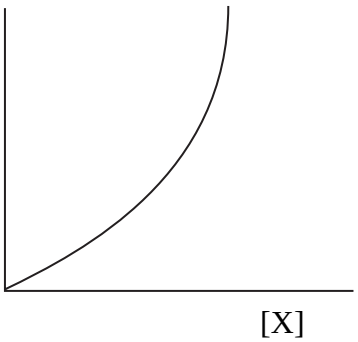
☒ **B**



☒ **C**



☒ **D**



(Total for Question = 1 mark)

11 Which of the following changes will lead to the greatest increase in the **rate** of the following endothermic reaction?

$$N_2(g) + O_2(g) \rightarrow 2NO(g) \quad \Delta H \text{ +ve}$$

		Temperature	Initial concentration of N_2 and O_2
☒	**A**	decrease by 15%	decrease by 15%
☒	**B**	increase by 15%	stay the same
☒	**C**	decrease by 15%	increase by 15%
☒	**D**	increase by 15%	increase by 15%

(Total for Question = 1 mark)