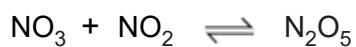
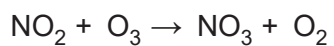


**A Level Chemistry B (Salters)**  
**H433/02** Scientific literacy in chemistry

**Question Set 14**

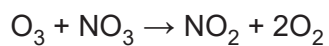
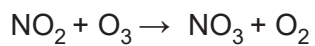
1

Dinitrogen pentoxide,  $\text{N}_2\text{O}_5$  is an oxide of nitrogen that is formed in the stratosphere by reactions such as those shown below.



The dinitrogen pentoxide acts as a 'sink' for  $\text{NO}_2$ , stopping it breaking down ozone.

(a) A student says that oxides of nitrogen catalyse the breakdown of ozone in the stratosphere by the reactions shown below.



Discuss the student's choice of reactions, giving the correct chemistry if necessary.

**[2]**

(b) (i) In the troposphere, dinitrogen pentoxide decomposes as shown below.



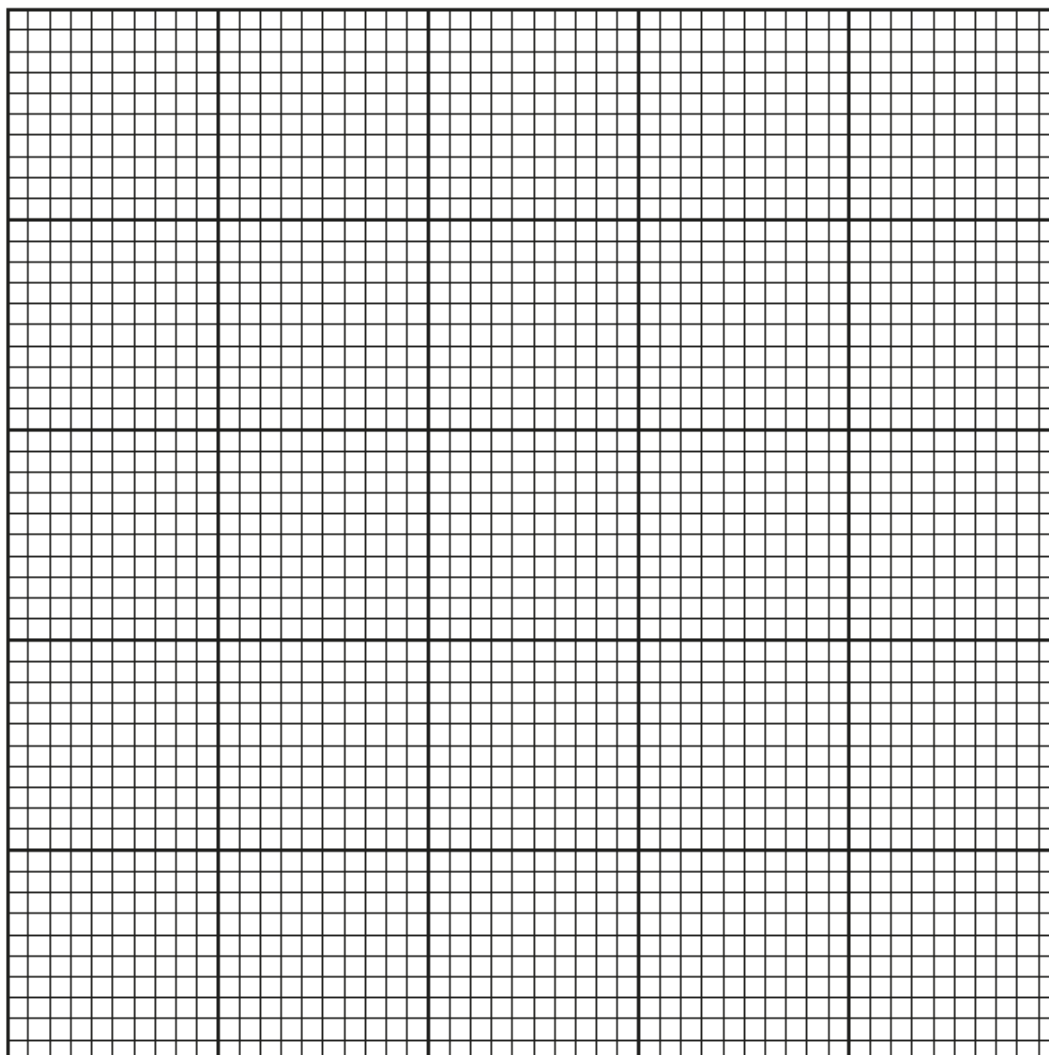
**Equation 4.1**

The table shows how the concentration of  $2\text{N}_2\text{O}_5$  varies with time at 315K.

Time/s	$[\text{N}_2\text{O}_5]/\text{mol dm}^{-3}$
0	0.330
1000	0.210
2000	0.124
3000	0.078
4000	0.048

Use the data in the table to plot a graph to determine the half-life for the reaction.

Label the axes.



half-life = .....s **[4]**

- (ii) How does the graph show that the reaction in **equation 4.1** is first order with respect to  $\text{N}_2\text{O}_5$ ?

Draw construction lines on the graph to explain your answer.

[1]

- (c) The gradient of the graph at 1000 s is  $9.8 \times 10^{-5} \text{ mol dm}^{-3} \text{ s}^{-1}$ .

Work out the rate constant for the reaction in **equation 4.1** at 315 K.

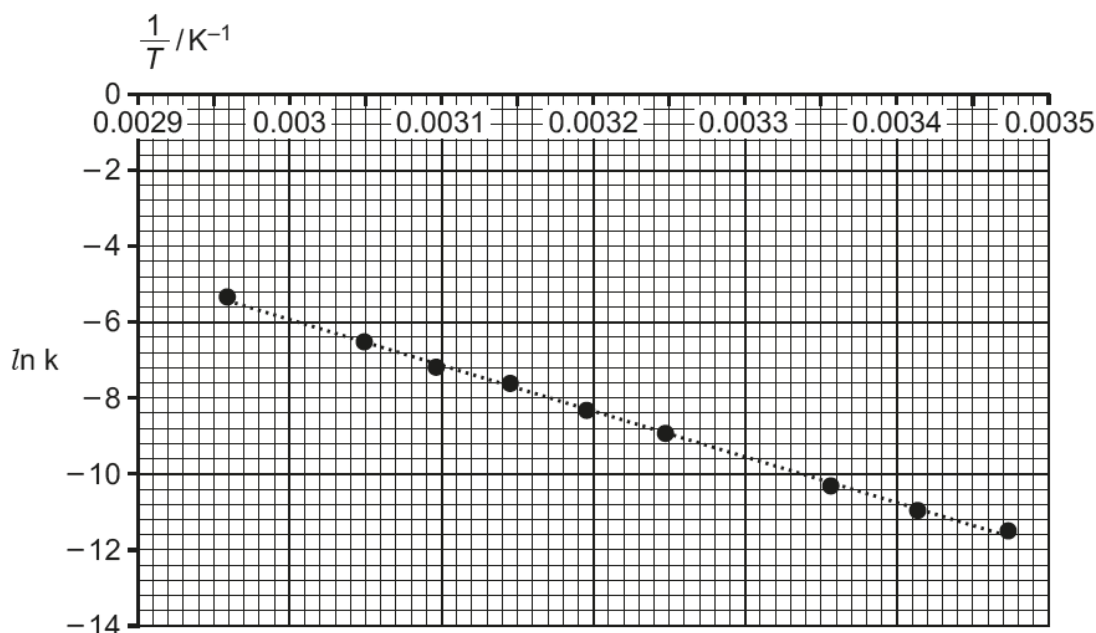
Give the units in your answer.

rate constant = ..... units .....

[2]

- (d) The reaction in equation 4.1 was repeated with a fixed concentration of  $\text{N}_2\text{O}_5$  at different temperatures.

A graph of  $\ln k$  against  $1/T$  for the reaction in **equation 4.1** is given below.



Use the graph to work out a value for the activation enthalpy (in  $\text{kJ mol}^{-1}$ ) for the reaction.

$E_a = \dots\dots\dots \text{kJ mol}^{-1}$  [3]

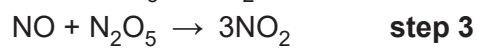
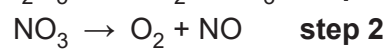
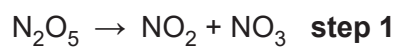
(e)



**Equation 4.1**

A student suggests the following mechanism for the reaction in **equation 4.1**.

The reaction is first order with respect to  $\text{N}_2\text{O}_5$ .



Show that this is a possible mechanism.

Consider which step(s) could be rate-determining.

**[3]**

**Total Marks for Question Set 14: 15**

## Resource Materials

Question Set No: 14

### General Information

Molar gas volume =  $24.0 \text{ dm}^3 \text{ mol}^{-1}$  at RTP

Avogadro constant,  $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

Specific heat capacity of water,  $c = 4.18 \text{ Jg}^{-1} \text{ K}^{-1}$

Planck constant,  $h = 6.63 \times 10^{-34} \text{ JHz}^{-1}$

Speed of light in a vacuum,  $c = 3.00 \times 10^8 \text{ m s}^{-1}$

Ionic product of water,  $K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$  at 298 K

1 tonne =  $10^6 \text{ g}$

Arrhenius equation:  $k = Ae^{-E_a/RT}$  or  $\ln k = -E_a/RT + \ln A$

Gas constant,  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

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