



## EXAM PAPERS PRACTICE

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Level: CIE AS and A Level (9701)

Subject: Chemistry

Topic: CIE Chemistry

Type: Topic Question

2002



1583

Chemistry CIE AS & A Level  
To be used for all exam preparation for 2025+

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# CHEMISTRY

# AS and A

This to be used by all students studying CIE AS and A level Chemistry (9701) But students of other boards may find it useful

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**Question 1.**

- (a) Ammonia is a very important industrial chemical with many uses including the manufacture of other chemicals.

The first step in the production of nitric acid involves the reversible reaction of gaseous ammonia in air to form nitrogen(II) oxide gas and water vapour.

Construct an equation for this reaction. Include state symbols.

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(2 marks)

- (b) For this reaction, a fine mesh is powder-coated with a mixture of platinum and rhodium catalysts.

Deduce the type of catalysis involved in the formation of nitrogen(II) oxide. Explain your answer.

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(2 marks)

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- (c) Explain why the catalyst does not affect the yield of the products in the reaction described in (a).

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(1 mark)



**Question 2.**

- (a) The decomposition of 3% hydrogen peroxide solution into water and oxygen is a very slow chemical reaction.

Construct an equation for this reaction. Include state symbols.

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(2 marks)

- (b) The decomposition of 3% hydrogen peroxide solution can be catalysed by different chemicals including solid manganese dioxide and catalase solution.

Deduce the type of catalysis involved in the reaction using each catalyst. Explain your answer.

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(c) For the exothermic decomposition of hydrogen peroxide, manganese dioxide gives a greater increase in the rate of reaction than catalase solution.

On Fig. 2.1:

- Sketch a reaction pathway diagram for the reaction using each catalyst.
- Label the diagram to show the enthalpy change,  $\Delta H$ , and the activation energy,  $E_a$ , for each reaction.

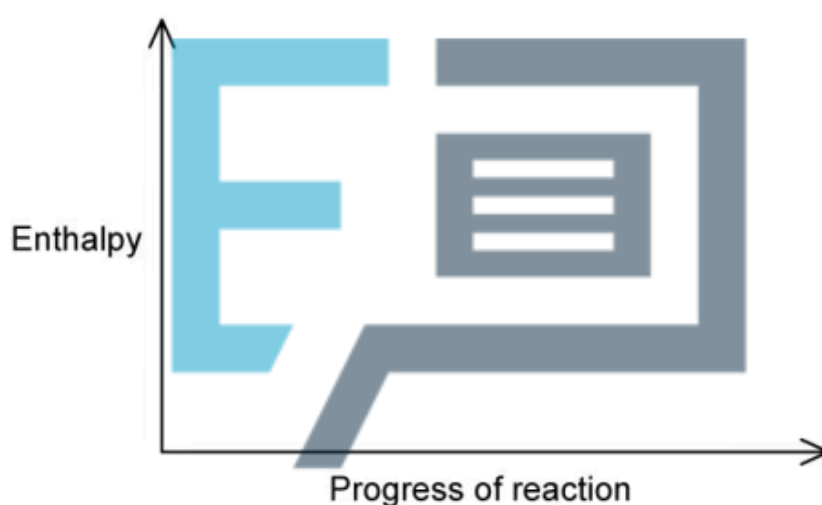


Fig. 2.1

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(4 marks)



(a) Gaseous **A** and **B** were added together to produce **C** as shown.

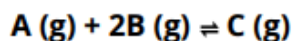


Fig. 3.1 shows the production of **C** over time.

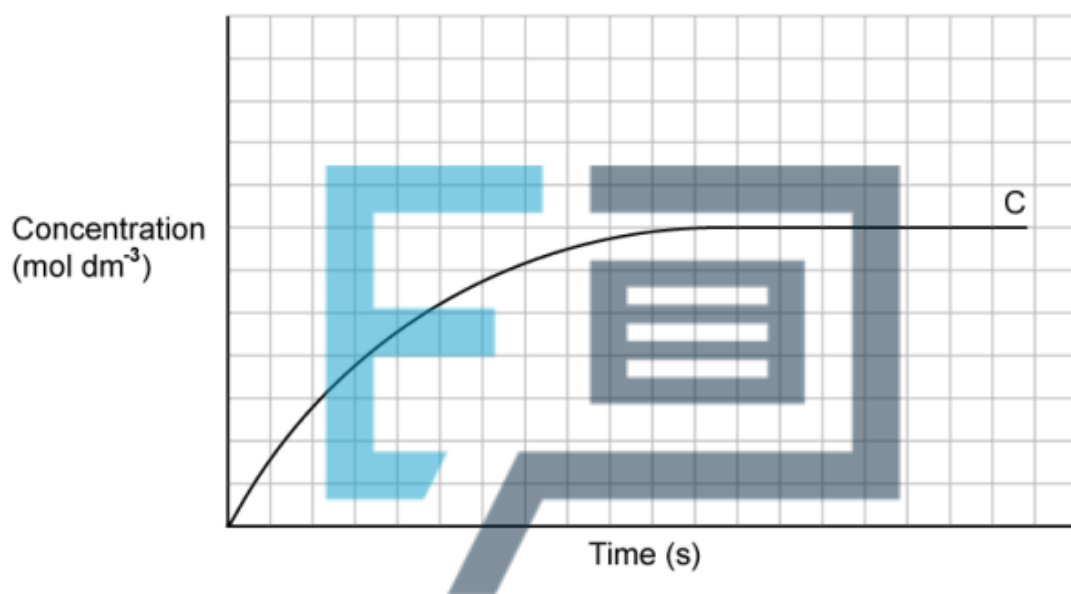


Fig. 3.1

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i) On Fig. 3.1, sketch a line to show what happens to the concentrations of **A** and **B** during the progress of the reaction.

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[2]

ii) On Fig. 3.1, label the point at which an equilibrium is first established.

[1]

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(3 marks)



(b) Explain how the addition of a catalyst affects the rate and yield of the reaction in (a).

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(3 marks)

(c) A catalyst was added to speed up the rate of reaction in part (a).

- i) Sketch a Maxwell-Boltzmann distribution on the axes in **Fig. 3.1** to show the distribution of molecular energies at a constant temperature with **and** without a catalyst.
- Use  $E_a$  to label the activation energy without a catalyst
  - Use  $E_c$  to label the activation energy with a catalyst.

[3]

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Fig. 3.1



ii) Explain what your distribution shows.

[3]

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(6 marks)

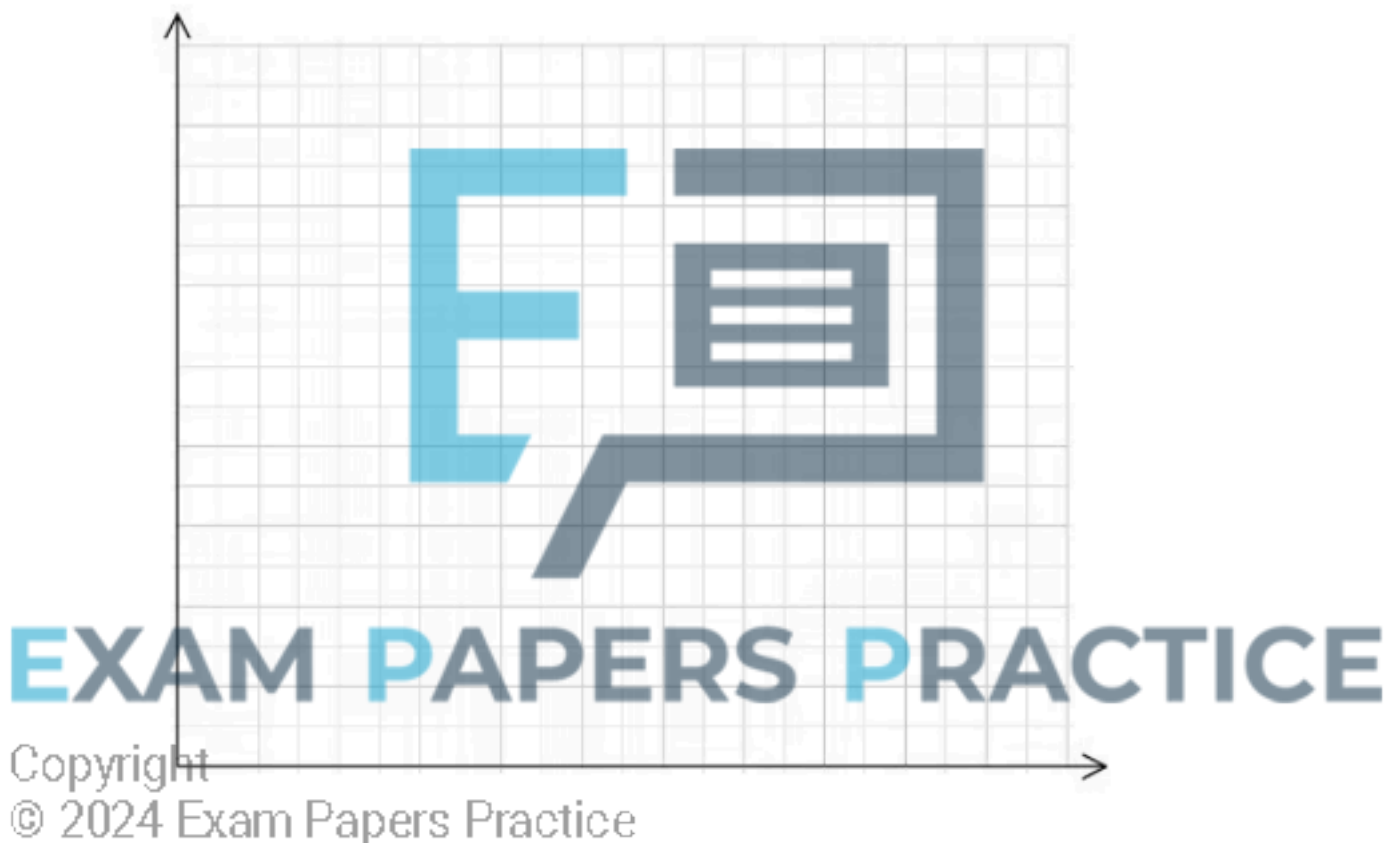
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**Question 4.**

- (a) Reaction rates can be affected by a range of factors including changes in pressure and temperature.

**Fig 1.1**



On Fig 1.1:

- i) Sketch one Maxwell-Boltzmann distribution labelled  $T_1$  and a second Maxwell-Boltzmann distribution at a higher temperature labelled  $T_2$ .

[2]

- ii) State how the mean energy of the molecules would be at  $T_2$  compared to  $T_1$ .

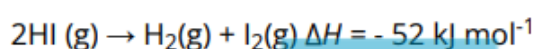
[2]





(4 marks)

- (b) Hydrogen iodide can be used in the manufacturing of pharmaceuticals and can be broken down back into its elements in standard form, iodine and hydrogen.



The activation energy when uncatalysed is  $+183 \text{ kJ mol}^{-1}$  and when catalysed with gold it is  $+105 \text{ kJ mol}^{-1}$ .

- Sketch a reaction profile for the reaction, including the curves for the activation energies for both the catalysed and uncatalysed reactions.
- Calculate the activation energy for the *reverse reaction* in both the uncatalysed and catalysed reactions.
- Explain why increasing the concentration of hydrogen iodide gas results in a faster reaction rate.

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(6 marks)



(c) Catalysts are often used in industrial processes and can be used in a variety of forms.

- i) Explain why it is likely that the solid gold catalyst was used in powder form to catalyse the reaction mentioned in part (c). [1]
- ii) Gold is a heterogeneous catalyst used in the formation of hydrogen iodide. State the difference between a homogenous and heterogenous catalyst. [1]
- iii) State how, if at all, the area under the curve of a Maxwell-Boltzmann distribution curve, changes as a catalyst is introduced without changing the temperature or the total number of molecules. [1]

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(d) The Contact process is an important industrial process, contributing to the production of sulfuric acid. In the Contact process, solid vanadium (V) oxide, a heterogeneous catalyst, is used to make sulfur trioxide from sulfur dioxide and oxygen. This process is reversible.

i) Write a balanced symbol equation for this reaction. Include state symbols in your answer.

[1]

ii) Explain why the use of the catalyst in the Contact process, reduces energy demand and benefits the environment.

[2]

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(3 marks)

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