



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+

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



Question 1.

(a) State **two** reasons why alkanes are unreactive.

(2 marks)

(b) Methane reacts with chlorine to produce chloromethane, CH_3Cl . The reaction is initiated by the formation of chlorine radicals.

- i) State what is meant by a radical. [1]
- ii) State the condition required to form chlorine free radicals from Cl_2 . [1]

EXAM PAPERS PRACTICE (2 marks)

(c) State the type of bond fission involved in the reaction in part **(b)**.

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(1 mark)

(d) Chloromethane will be formed via several steps.

- i) Write the equations for the **two** propagation steps. [2]
- ii) Write an equation to show how ethane can be formed in this reaction. [1]



(3 marks)

Question 2.

(a) Alkanes can undergo both complete and incomplete combustion.

State the difference between complete and incomplete combustion of a hydrocarbon fuel, such as octane. Include the balanced symbol equation for each in your answer.



(4 marks)

(b) Octane is found in petrol.

Carbon monoxide is a colourless, odourless and poisonous gas which is emitted in the exhaust fumes of motor vehicles that use a petrol internal combustion engine.

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i) State why carbon monoxide can cause dizziness, fainting, loss of consciousness and death in humans.

[1]

ii) State another pollutant that is also released in cars' exhaust fumes. Explain the effect of this pollutant in the atmosphere.

[2]

(1 mark)



(c) Octane can be cracked to form pentane and one other product.

i) Give the balanced symbol equation for this reaction.

[1]

ii) Describe how catalytic cracking is carried out.

[2]

(2 marks)

(d) Describe and give the result of a chemical test that would distinguish between the two products.

(3 marks)

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(a) A reaction scheme involving cyclohexane is shown in Fig. 1.1.

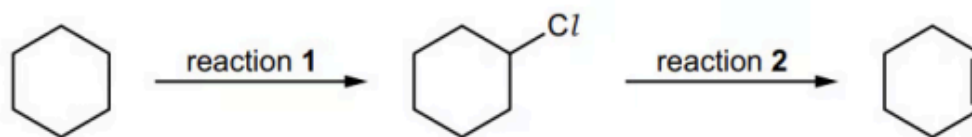


Fig. 1.1.

Reaction 1 involves a free radical substitution mechanism.

State the essential condition required for reaction 1 to occur.

(1 mark)

(b) Complete Table 1.1 to give details of the mechanism in reaction 1. Include curly arrows to show the movement of electrons occurring in the termination step.

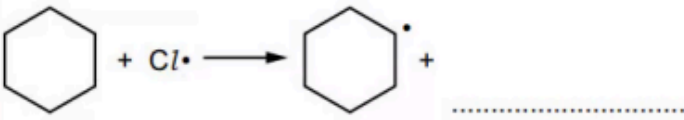


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Table 1.1

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name of step	equation
.....	$\text{Cl}_2 \longrightarrow 2\text{Cl}\cdot$
propagation	
.....	
termination	

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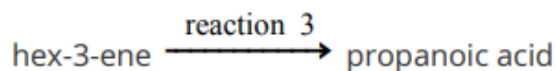
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(5 marks)

(c) Deduce the type of reaction that occurs in reaction 2.

(1 mark)

(d) Hex-3-ene is an isomer of cyclohexane. Hex-3-ene can be converted into propanoic acid.





Deduce the reagents and conditions for reaction 3.

(2 marks)

Question 4.

(a) Crude oil contains a mixture of hydrocarbons which are separated using fractional distillation.

Further processes can then be carried out, including cracking.

- i) What is meant by the term 'cracking'. [1]
- ii) Explain why cracking is carried out. [1]

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(2 marks)

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(b) i) State **two** conditions required for the cracking of alkanes. [2]

- ii) Construct a balanced equation for the formation of heptane, C_7H_{16} and two other products, by cracking tetradecane, $C_{14}H_{30}$. [1]

(3 marks)



(c) Another alkane, C_8H_{18} is used in gasoline. It undergoes combustion to produce a mixture of products including carbon monoxide, oxides of nitrogen and unburnt hydrocarbons.

i) Explain why carbon monoxide is dangerous if inhaled.

[2]

ii) Describe the environmental effect of oxides of nitrogen and unburnt hydrocarbons.

[2]

(4 marks)

(d) Catalytic converters are found in the exhaust system of cars.

Use equations to show how a catalytic converter reduces the levels of carbon monoxide and oxides of nitrogen released into the atmosphere.

(2 marks)



Question 5.

- (a) Alkanes are generally unreactive and do not react with acids, bases, or with oxidising or reducing agents. However, they will react with halogens under suitable conditions, to form halogenoalkanes.

Methane reacts with chlorine in this way to form chloromethane.

- i) Deduce the type of mechanism that occurs in this reaction.

[1]

- ii) Two test tubes are set up, each containing a small amount of methane and pale green chlorine gas. One test tube is left in the dark, whereas the other is placed in direct sunlight.

Explain the observations that would be observed in each test tube and give an equation for the reaction that has occurred if applicable.

[4]

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(5 marks)



(b) The reaction described in part (a) consists of three steps. The first step is the initiation step in which the Cl-Cl bond is broken to form two chlorine free radicals.

i) Explain the type of bond breaking that occurs in the initiation step.

[2]

ii) Define the term *free radical*.

[1]

iii) Explain why the C-H bond in the alkane does not break in the initiation step instead of the Cl-Cl bond.

[1]

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(4 marks)

(c) Name each step of the reaction between methane and chlorine as described in part (a). Include relevant equations for each step.

(3 marks)

Question 6.

(a) This question is about free radical substitution.

1,2-dibromoethane reacts with bromine in UV light to produce a mixture of further substituted haloalkanes.

i) Write an equation for the initiation step.

[1]

ii) Explain why this is an example of homolytic fission.

[1]

(2 marks)

(b) Write **two** equations showing the propagation of this chain reaction to produce 1,1,2-tribromoethane.

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(2 marks)

(c) Traces of 1,2,3,4-tetrabromobutane are found in the reaction mixture.

i) Write an equation to show how this product is formed.

[1]

ii) Write a balanced symbol equation to show the overall reaction between 1,1,2-tribromoethane with bromine in UV light to form hexabromoethane.

[1]

(2 marks)

- (d) Using the information from this question and your own knowledge, suggest the limitations of free radical substitution.

(2 marks)



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