



# **GCSE Chemistry**

## **Cracking**

### **Question Paper**

**Time available: 63 minutes**

**Marks available: 63 marks**

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1.

This question is about fuels.

Octane ( $C_8H_{18}$ ) is a hydrocarbon in petrol.

(a) Cracking breaks down large hydrocarbon molecules into smaller hydrocarbon molecules.

Which hydrocarbon molecule can be cracked to produce octane,  $C_8H_{18}$ ?

Tick **one** box.

$C_4H_8$

$C_4H_{10}$

$C_8H_{16}$

$C_{12}H_{26}$

(1)

(b) What type of carbon compound is octane,  $C_8H_{18}$ ?

Tick **one** box.

Alcohol

Alkane

Carboxylic acid

Ester

(1)

(c) Oxygen is needed to burn fuels.

Name the source of the oxygen needed to burn fuels.

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(1)

(d) Particulates and sulfur dioxide are pollutants produced when some fuels burn.

Draw **one** line from each pollutant to the polluting effect.

Pollutant	Polluting effect
	Acid rain
Particulates	Global dimming
	Global warming
Sulfur dioxide	Landfill
	Sewage sludge

(2)

(e) Which **two** gases are produced when fuels burn in car engines?

Tick **two** boxes.

- Ammonia
- Carbon dioxide
- Carbon monoxide
- Nitrogen
- Oxygen

(f) Vehicles produce most of the atmospheric pollution in cities.

How could the atmospheric pollution in cities be reduced?

Tick **two** boxes.

Build more roads in cities

Build new car factories

Develop fuel efficient engines

Make car tax cheaper

Use electric cars

(2)

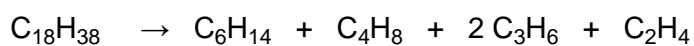
(Total 9 marks)

2.

This question is about organic compounds.

Hydrocarbons can be cracked to produce smaller molecules.

The equation shows the reaction for a hydrocarbon,  $C_{18}H_{38}$



(a) Which product of the reaction shown is an alkane?

Tick **one** box.

$C_2H_4$

$C_3H_6$

$C_4H_8$

$C_6H_{14}$

(1)

- (b) The table below shows the boiling point, flammability and viscosity of  $C_{18}H_{38}$  compared with the other hydrocarbons shown in the equation.

	<b>Boiling point</b>	<b>Flammability</b>	<b>Viscosity</b>
<b>A</b>	highest	lowest	highest
<b>B</b>	highest	lowest	lowest
<b>C</b>	lowest	highest	highest
<b>D</b>	lowest	highest	lowest

Which letter, **A**, **B**, **C** or **D**, shows how the properties of  $C_{18}H_{38}$  compare with the properties of  $C_2H_4$ ,  $C_3H_6$ ,  $C_4H_8$  and  $C_6H_{14}$ ?

Tick **one** box.

**A**

**B**

**C**

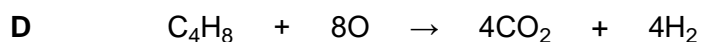
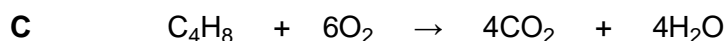
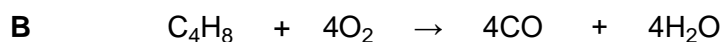
**D**

(1)

(c) The hydrocarbon C<sub>4</sub>H<sub>8</sub> was burnt in air.

Incomplete combustion occurred.

Which equation, **A**, **B**, **C** or **D**, correctly represents the incomplete combustion reaction?



Tick **one** box.

**A**

**B**

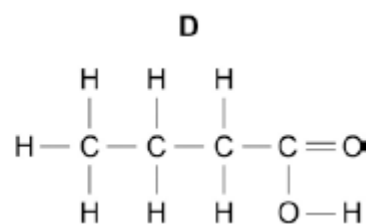
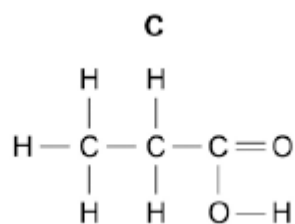
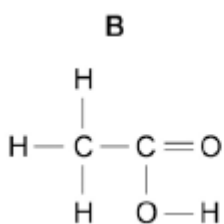
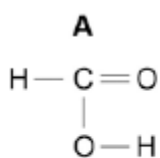
**C**

**D**

(1)

(d) Propanoic acid is a carboxylic acid.

Which structure, **A**, **B**, **C** or **D**, shows propanoic acid?



Tick **one** box.

**A**

**B**

**C**

**D**

(1)

(e) Propanoic acid is formed by the oxidation of which organic compound?

Tick **one** box.

Propane

Propene

Propanol

Polyester

(1)

(Total 5 marks)

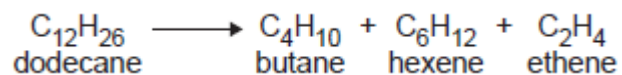
3.

This question is about hydrocarbons.

(a) Most of the hydrocarbons in crude oil are alkanes.

(i) Large alkane molecules can be cracked to produce more useful molecules.

The equation shows the cracking of dodecane.



Give **two** conditions used to crack large alkane molecules.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(ii) The products hexene and ethene are alkenes.

Complete the sentence.

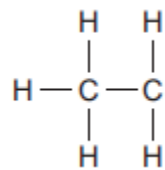
When alkenes react with bromine water the colour changes

from orange to \_\_\_\_\_ .

(1)

(iii) Butane (C<sub>4</sub>H<sub>10</sub>) is an alkane.

Complete the displayed structure of butane.

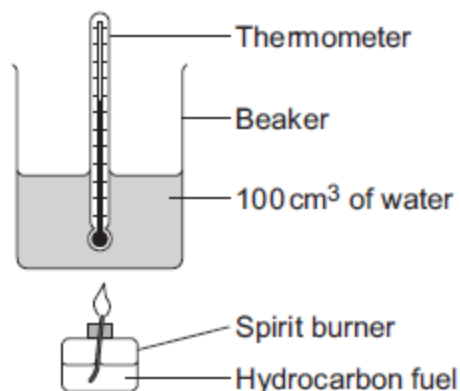


(1)



- (b) A group of students investigated the energy released by the combustion of four hydrocarbon fuels.

The diagram below shows the apparatus used.



Each hydrocarbon fuel was burned for two minutes.

**Table 1** shows the students' results.

**Table 1**

Name and formula of hydrocarbon fuel	After two minutes				Relative amount of smoke in the flame
	Mass of fuel used in g	Temperature increase of water in °C	Energy released by fuel in kJ	Energy released by 1.0 g of fuel in kJ	
Hexane, C <sub>6</sub> H <sub>14</sub>	0.81	40	16.80	20.74	very little smoke
Octane, C <sub>8</sub> H <sub>18</sub>	1.10	54	22.68	20.62	some smoke
Decane, C <sub>10</sub> H <sub>22</sub>	1.20	58	24.36		smoky
Dodecane, C <sub>12</sub> H <sub>26</sub>	1.41	67	28.14	19.96	very smoky

- (i) Calculate the energy released by 1.0 g of decane in kJ.

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Energy released = \_\_\_\_\_ kJ

(2)

- (ii) Suggest **one** improvement to the apparatus, or the use of the apparatus, that would make the temperature increase of the water for each fuel more accurate.

Give a reason why this is an improvement.

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(2)

- (iii) The students noticed that the bottom of the beaker became covered in a black substance when burning these fuels.

Name this black substance.

Suggest why it is produced.

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(2)

- (iv) A student concluded that hexane is the best of the four fuels.

Give **two** reasons why the results in **Table 2** support this conclusion.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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(2)

- (c) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Most car engines use petrol as a fuel.

- Petrol is produced from the fractional distillation of crude oil.
- Crude oil is a mixture of hydrocarbons.
- Sulfur is an impurity in crude oil.

Car engines could be developed to burn hydrogen as a fuel.

- Hydrogen is produced from natural gas.
- Natural gas is mainly methane.

**Table 2** shows information about petrol and hydrogen.

	<b>Petrol</b>	<b>Hydrogen</b>
State of fuel at room temperature	Liquid	Gas
Word equation for combustion of the fuel	petrol + oxygen $\rightarrow$ carbon dioxide + water	hydrogen + oxygen $\rightarrow$ water
Energy released from combustion of 1 g of the fuel	47 kJ	142 kJ

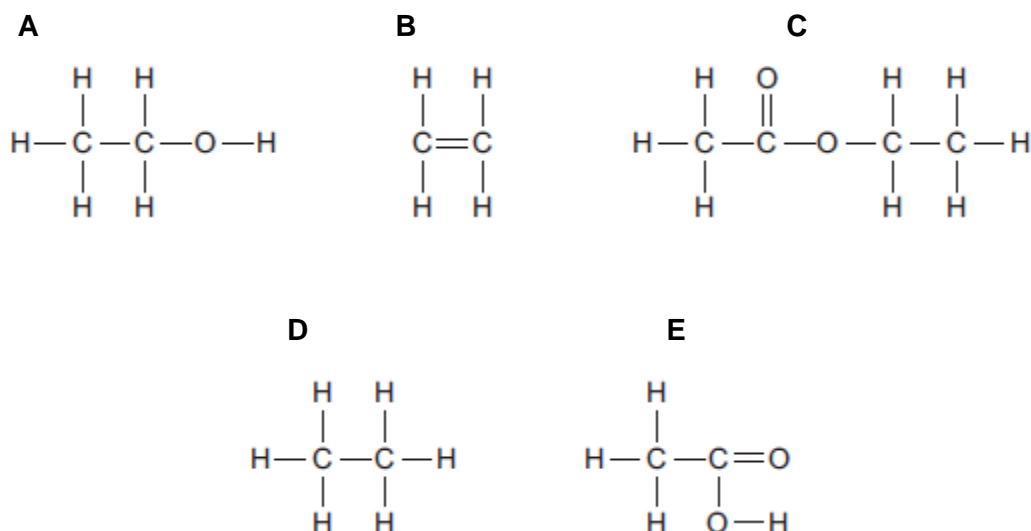
Describe the **advantages** and **disadvantages** of using hydrogen instead of petrol in car engines.

Use the information given and your knowledge and understanding to answer this question.

(6)  
(Total 18 marks)

**4.**

The figure below shows the displayed structures of five organic compounds, **A**, **B**, **C**, **D** and **E**.



(a) Choose which organic compound, **A**, **B**, **C**, **D** or **E**, matches the descriptions.

You may choose each compound once, more than once or not at all.

Write the letter of the compound that:

(i) is a saturated hydrocarbon

(1)

(ii) comes from a homologous series with the general formula  $\text{C}_n\text{H}_{2n}$

(1)

(iii) has the empirical formula  $\text{C}_2\text{H}_6\text{O}$

(1)

(iv) reacts with calcium carbonate to produce carbon dioxide

(1)

(v) reacts with compound **A** to produce compound **C**.

(1)

(b) Compound **B** ( $C_2H_4$ ) and  $C_8H_{18}$  are produced by cracking  $C_{14}H_{30}$



(i) Give **two** conditions for cracking.

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(2)

(ii) Explain why  $C_8H_{18}$  has a lower boiling point than  $C_{14}H_{30}$

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(2)

(c) Compound **B** is a colourless gas.

Give a chemical test and its result to show that compound **B** is unsaturated.

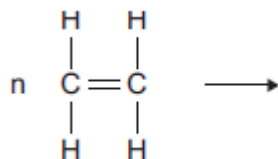
Test \_\_\_\_\_  
\_\_\_\_\_

Result \_\_\_\_\_  
\_\_\_\_\_

(2)

(d) Compound **B** is ethene.

Complete the equation to show the formation of poly(ethene) from ethene.



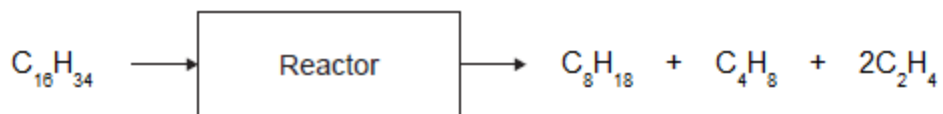
(3)

(Total 14 marks)

5.

Poly(butene) is a polymer made from crude oil in two stages.

- (a) The first stage in making poly(butene) is to break down large hydrocarbon molecules from crude oil into smaller hydrocarbon molecules, as shown in the figure below.



- (i) The products contain two types of hydrocarbon with different general formulae.

Name the two types of hydrocarbon.

\_\_\_\_\_

(1)

- (ii) Describe the conditions in the reactor.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

- (iii) Suggest why air must **not** enter the reactor.

\_\_\_\_\_  
\_\_\_\_\_

(1)

- (iv) Suggest a method that can be used to separate butene ( $\text{C}_4\text{H}_8$ ) from the other hydrocarbons.

\_\_\_\_\_

(1)

- (b) The second stage is to use butene ( $\text{C}_4\text{H}_8$ ) to produce poly(butene).

- (i) Draw the displayed structure of a butene ( $\text{C}_4\text{H}_8$ ) molecule.

(1)

(ii) Describe how molecules of butene ( $C_4H_8$ ) form poly(butene).

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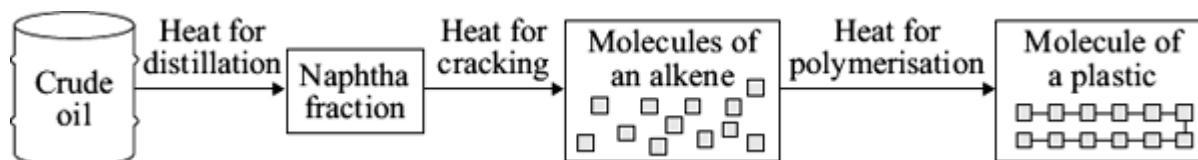
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(2)

(Total 8 marks)

6.

To make a plastic, such as poly(ethene), from crude oil involves many processes.



(a) Describe how crude oil is separated into fractions.

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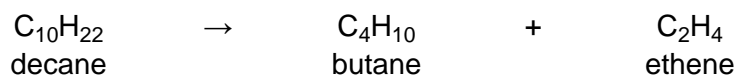
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(2)

(b) Ethene is produced by cracking the hydrocarbons in the naphtha fraction.

(i) Balance the symbol equation for this reaction.



(1)

(ii) Describe how cracking is carried out.

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(2)

(c) Alkanes, such as butane (C<sub>4</sub>H<sub>10</sub>), do **not** form polymers.

Alkenes, such as ethene (C<sub>2</sub>H<sub>4</sub>), do form polymers.

Explain these statements.

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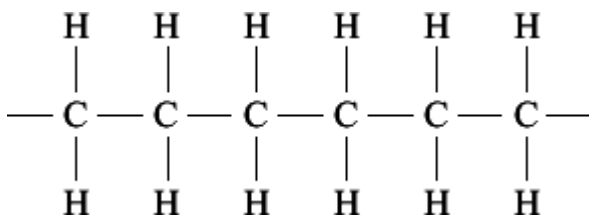
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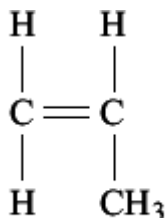
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(2)

(d) Ethene molecules form the polymer poly(ethene). One molecule in poly(ethene) will contain thousands of carbon atoms. The diagram represents part of a poly(ethene) molecule.



Propene molecules form the polymer poly(propene).



**Propene molecule**

Draw a diagram to represent part of a poly(propene) molecule.

(2)

(Total 9 marks)