



**C9 Crude Oil and Fuel Exam Pack
and Mark scheme**

Name: _____

Class: _____

Date: _____

Time: **76 minutes**

Marks: **76 marks**

Comments:

1

Crude oil is a fossil fuel.

(a) To make crude oil more useful it is separated into fractions.

Use the correct word from the box to complete each sentence.

boiling	compound	decomposition	distillation
	filtration	mixture	molecule

(i) Crude oil is a of different substances. (1)

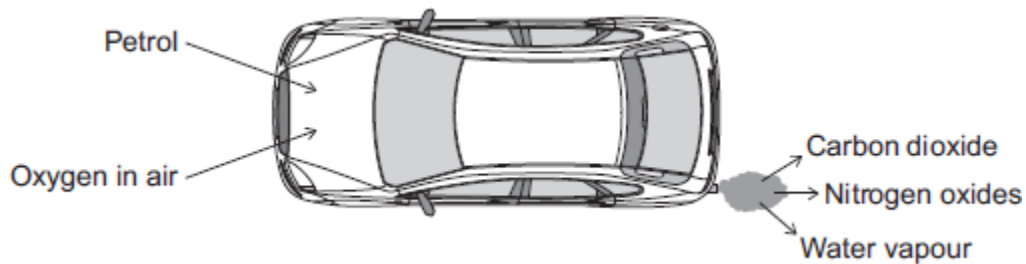
(ii) The substances in crude oil have different points. (1)

(iii) Crude oil is separated by fractional (1)

(b) Petrol is one of the fractions produced from crude oil.

Car engines use a mixture of petrol and air.

The diagram shows some of the gases produced.



(i) What type of reaction happens to petrol in a car engine?

Tick (✓) **one** box.

combustion

decomposition

neutralisation

(1)

(ii) Petrol contains octane (C₈H₁₈).

Complete the word equation for the reaction of octane with oxygen.

octane + → +

(2)

(iii) Cars use sulfur-free petrol as a fuel.

Describe why sulfur should be removed from petrol.

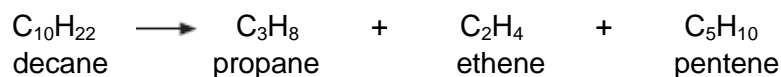
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(2)

(c) Some fractions from crude oil contain large hydrocarbon molecules.

These molecules can be cracked to produce smaller, more useful molecules.

An equation for cracking decane is:



(i) Why is propane useful?

Tick (✓) **one** box.

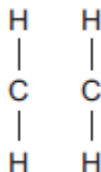
Propane is a polymer.

Propane is an alloy.

Propane is a fuel.

(1)

(ii) Draw bonds to complete the displayed structure of ethene.



(1)

(iii) What is the colour change when bromine water reacts with ethene?

Tick (✓) **one** box.

Orange to colourless

Orange to green

Orange to red

(1)

(iv) Complete the sentence.

Pentene is useful because many pentene molecules can join together to form

(1)

(Total 12 marks)

2

Barbecues are heated by burning charcoal or burning hydrocarbons.



(a) Use the Chemistry Data Sheet to help you to answer this question.

The chemical equation for charcoal burning is:



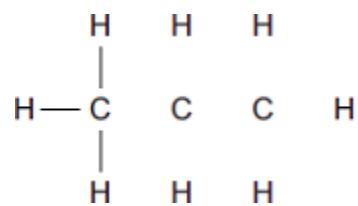
Complete the word equation for this reaction.

carbon + \longrightarrow carbon dioxide

(1)

(b) Propane is a hydrocarbon.

(i) Complete the displayed structure of propane. Draw in the missing bonds.



(1)

(ii) Write the chemical formula of propane.

(1)

(iii) Draw a ring around the correct answer to complete the sentence.

Propane burns in air to produce carbon dioxide and

hydrogen.
hydroxide.
water.

(1)

(c) The table shows information about six hydrocarbons.

Hydrocarbon	State at room temperature (20°C)	Boiling point in °C
Ethane (C ₂ H ₆)	gas	-89
Ethene (C ₂ H ₄)	gas	-104
Butane (C ₄ H ₁₀)	gas	-1
Butene (C ₄ H ₈)	gas	-6
Hexane (C ₆ H ₁₄)	liquid	+69
Hexene (C ₆ H ₁₂)	liquid	+64

Tick (✓) **two** correct statements about the six hydrocarbons.

Statement	Tick (✓)
Ethane and butane boil at temperatures less than 20°C.	
Hexene and butene are alkanes.	
Butane and hexane are liquid at 0°C.	
Ethene and hexene each have a carbon-carbon double bond.	

(2)
(Total 6 marks)

3

This question is about oil reserves.

(a) Diesel is separated from crude oil by fractional distillation.

Describe the steps involved in the fractional distillation of crude oil.

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(3)

(b) Diesel is a mixture of lots of different *alkanes*.

What are *alkanes*?

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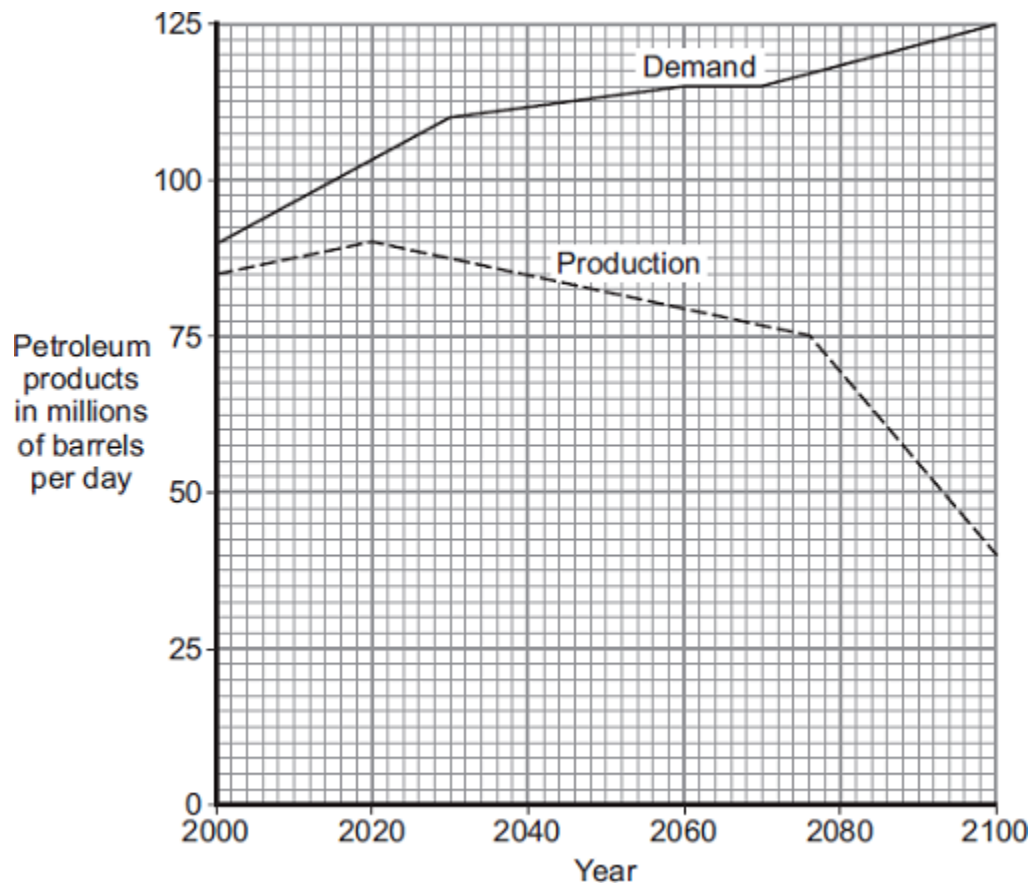
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(2)

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

Petroleum products, such as petrol, are produced from crude oil.

The graph shows the possible future production of petroleum products from crude oil and the expected demand for petroleum products.



Canada's oil sands hold about 20% of the world's known crude oil reserves.

The oil sands contain between 10 to 15% of crude oil. This crude oil is mainly bitumen.

In Canada the oil sands are found in the ground underneath a very large area of forest. The trees are removed. Then large diggers and trucks remove 30 metres depth of soil and rock to reach the oil sands. The oil sands are quarried. Boiling water is mixed with the quarried oil sands to separate the bitumen from the sand. Methane (natural gas) is burned to heat the water.

The mixture can be separated because bitumen floats on water and the sand sinks to the bottom of the water. The bitumen is cracked and the products are separated by fractional distillation.

Use the information given and your knowledge and understanding to suggest the advantages and disadvantages of extracting petroleum products from oil sands.

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(6)
(Total 11 marks)

4

Crude oil is a fossil fuel.

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

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(4)

(b) Fuel oil is one of the fractions from crude oil.

Power stations burn fuel oil to generate electricity. The waste gases from the combustion of fuel oil contain carbon dioxide, water vapour, sulfur dioxide and oxides of nitrogen.

The waste gases are passed through a suspension of limestone in water. Limestone is mainly calcium carbonate.

Suggest how the use of a suspension of limestone decreases one of the environmental impacts that the waste gases would cause.

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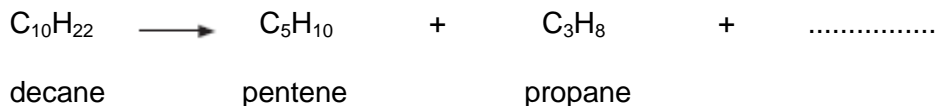
(3)

(c) Some fractions from crude oil contain large hydrocarbon molecules.

- (i) Hydrocarbon molecules, such as decane, can be cracked to produce smaller, more useful molecules.

Write the correct formula of the third product to complete the chemical equation.

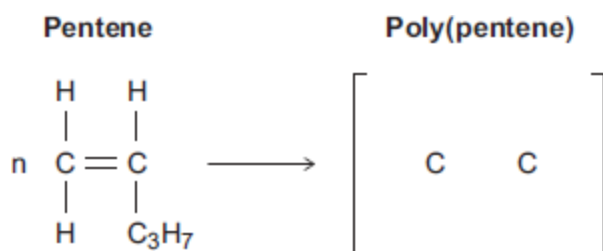
You do not need to give the name of this product.



(1)

- (ii) Pentene is used to produce poly(pentene).

Complete the equation and the displayed structure of poly(pentene).



(3)

- (iii) Some polymers are described as smart polymers.

Suggest **one** property of a smart polymer that is different to that of an ordinary polymer.

.....
.....

(1)

(Total 12 marks)

5

Alkanes are hydrocarbons found in crude oil.

- (a) (i) Complete the sentence.

Hydrocarbons contain the elements and only.

(1)

(ii) Ethane is an alkane with the formula C_2H_6

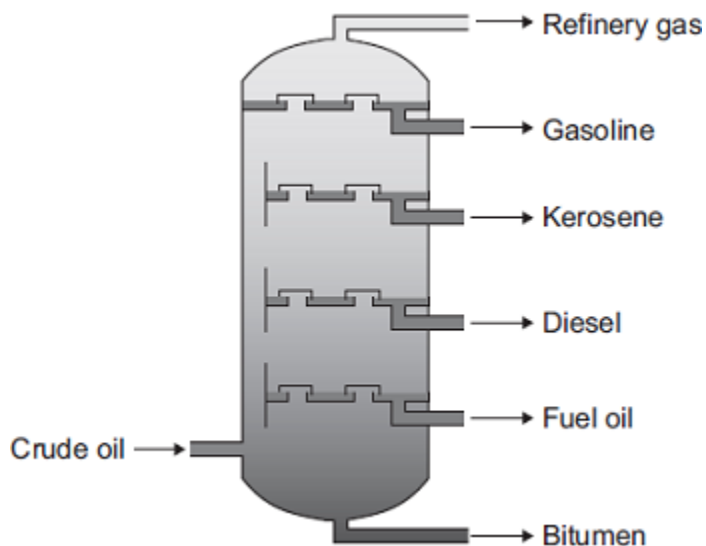
Draw a ring around the correct answer to complete the sentence.

Alkanes are hydrocarbons with the general formula

- C_nH_n
- C_nH_{2n}
- C_nH_{2n+2}

(1)

(b) Crude oil is separated into useful fractions by fractional distillation.



Describe and explain how crude oil is separated into fractions by fractional distillation.

Use the diagram to help you answer the question.

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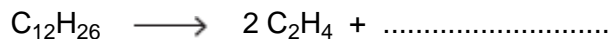
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(4)

(c) Dodecane ($C_{12}H_{26}$) from crude oil is cracked to produce ethene (C_2H_4).

(i) Complete the equation for this reaction.



(1)

(ii) Give **two** conditions needed for cracking.

1

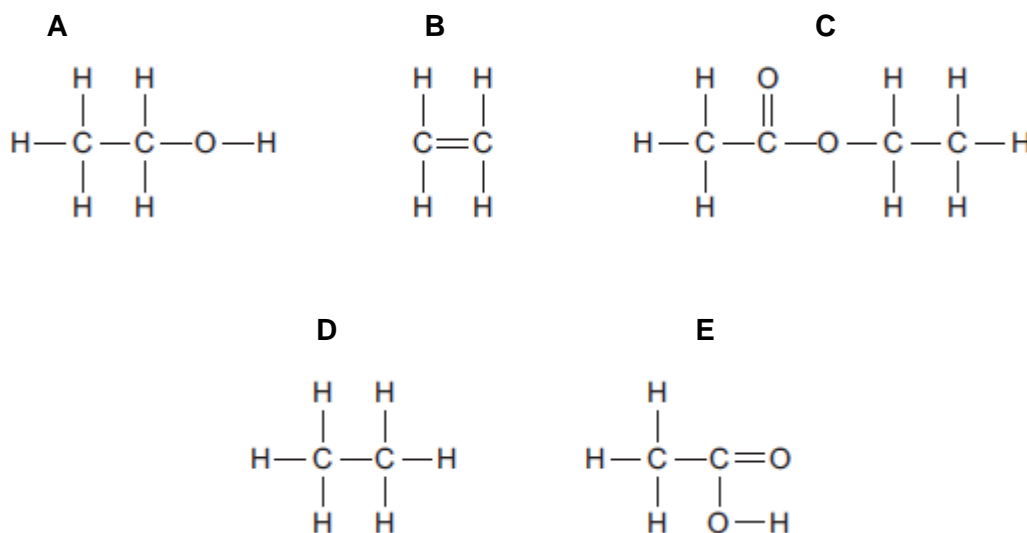
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(2)

(Total 9 marks)

6

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 C_nH_{2n}

(1)

(iii) has the empirical formula C_2H_6O

(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.

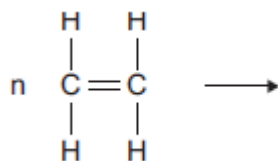
Test

Result

(2)

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

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



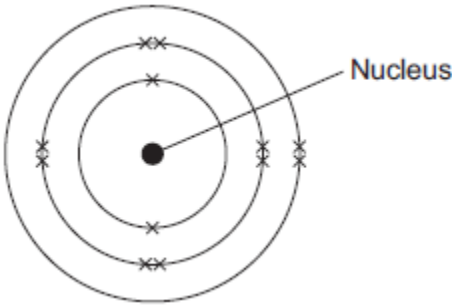
(3)

(Total 14 marks)

7

This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	neutrons	protons	shells
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The nucleus contains protons and

The particles with the smallest relative mass that move around the nucleus are called

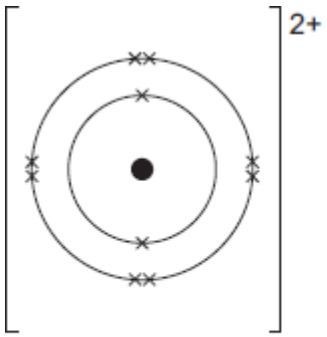
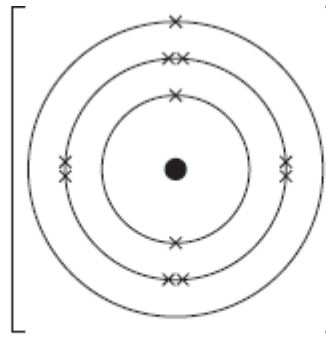
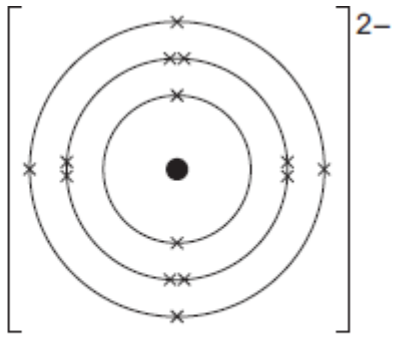
Atoms of magnesium are neutral because they contain the same number of electrons and

(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

Tick (✓) **one** box.

		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(1)

- (b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.



- (i) State **two** observations that could be made during the reaction.

1

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2

.....

(2)

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

Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

In your method you should name the apparatus you will use.

You do **not** need to mention safety.

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(6)
(Total 12 marks)

Mark schemes

1	(a)	(i)	mixture (of different substances)	1
		(ii)	boiling (points)	1
		(iii)	distillation	1
	(b)	(i)	combustion	1
		(ii)	(reactant)	
			oxygen	
			<i>allow correct formulae</i>	1
			(products)	
			<i>products in any order</i>	
			carbon dioxide	
			<i>allow carbon or carbon monoxide</i>	
			and	
		water		
		<i>allow water vapour or steam or hydrogen oxide</i>	1	
	(iii)	(burning sulfur) produces sulfur dioxide / SO_2		
		<i>allow it / sulfur reacts with oxygen ignore sulfur oxide</i>	1	
		causes acid rain	1	
(c)	(i)	propane is a fuel	1	
	(ii)	double bond drawn between carbon atoms		
		<i>do not allow any other bonds or symbols</i>	1	
	(iii)	orange to colourless	1	
	(iv)	poly(pentene)		
		<i>allow polymer(s)</i>	1	
			[12]	

- 2** (a) oxygen
must be name
*do **not** accept oxide or dioxide* 1
- (b) (i) 2 x C–C
and
5 x C–H
all single (line) bonds 1
- (ii) C₃ H₈
must be formula
*do **not** accept lower case h* 1
- (iii) water 1
- (c) ethane and butane boil at temperatures less than 20°C 1
ethene and hexene each have a carbon-carbon double bond 1
- [6]**
- 3** (a) heat to vaporise (the crude oil)
*do **not** accept cracking / burning* 1
vapours condense 1
at different temperatures
allow they have different boiling points 1
- (b) (alkanes) are hydrocarbons **or** are compounds of hydrogen and carbon only 1
alkanes are saturated **or** have only (carbon-carbon) single bonds
accept have no (carbon-carbon) double bonds
*accept general formula is C_nH_{2n+2} for **2** marks* 1

- (c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a basic description of at least one advantage or one disadvantage of extracting petroleum products from oil sands.

Level 2 (3-4 marks)

There is a clear description of an advantage and a disadvantage of extracting petroleum products from oil sands.

Level 3 (5-6 marks)

There is a detailed description of both advantages and disadvantages of extracting petroleum products from oil sands.

Examples of the chemistry/environmental/economic/social points made in the response

Advantages:

- the oil sands are needed because crude oil is running out
- this crude oil is needed because demand is increasing
- the oil sands contain a large amount of crude oil
- the oil sands could improve Canada's economy
- the oil sands provide employment for a lot of people
- the trees / forest are used for wood products / fuel

Disadvantages:

- destruction of environment / habitats
- fewer trees / forests to absorb carbon dioxide
- specified pollution, for example, visual, noise, atmospheric (including dust), water (including river or drinking) with cause, e.g. gases / particulates from burning diesel
- large amounts of methane (natural gas) are used to provide energy
- energy / fuel needed for cracking and fractional distillation
- burning fuel releases carbon dioxide
- crude oil / natural gas contains locked up carbon
- crude oil is non-renewable

6

[11]

4

(a) any **four** from:

- (crude oil is) heated
- to evaporate / vaporise / boil (the substances / hydrocarbons)
- the column is hotter at the bottom or is cooler at the top
- (vapours / fractions) condense
- at their boiling points or at different levels.

marks can be taken from a diagram

max 3 marks for reference to cracking

allow fractional distillation allow vapours (enter the column)

allow temperature gradient or (vapours) cool as they rise

allow description e.g. vapour turns to liquid)

allow they have different boiling points

4

(b) acid rain is caused by
allow consequences of acid rain 1

sulfur dioxide or oxides of nitrogen
second marking point is dependent on first marking point 1

they react with / are neutralised by calcium carbonate or limestone

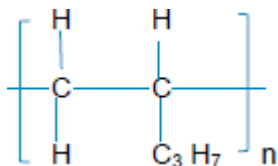
OR

global warming is caused by
carbon dioxide

carbon dioxide will react or dissolve in suspension of limestone
allow greenhouse effect is caused by or allow consequences of global warming 1

(c) (i) C_2H_4
must be formula
ignore any name 1

(ii) a single bond between carbon atoms



would score 3 marks 1

other four bonds linking hydrogen atoms and C_3H_7 group plus two trailing /
connecting bonds 1

n at the bottom right hand corner of the bracket 1

(iii) has a shape memory
or
(a smart polymer) can return to original shape (when conditions change) 1

[12]

5 (a) (i) hydrogen / H and carbon / C
answers can be in either order
if letters given, must be capital H 1

(ii) C_nH_{2n+2} 1

(b) (most) crude oil vaporises / evaporates **or** crude oil enters as a vapour 1

(vapour) cools as it rises up the tower / column **or** tower / column cooler at the top **or** negative temperature gradient 1

the fractions have different boiling / condensation points / ranges

accept the larger the molecules, the higher the boiling point / condensation point

1

so they will condense at different levels in the tower

allow will collect at different levels if condensation mentioned

allow will condense to give different fractions

if no other mark is gained allow 1 mark for mention of heating

1

(c) (i) C_8H_{18}

if one answer is given C_8H_{18} is the only acceptable answer

credit any correct combination of alkanes and alkenes, eg C_5H_{12} and C_3H_6

1

(ii) hot / high temperature

accept any temperature in the range 300 – 900 °C

'heat' is insufficient

1

catalyst

*accept a named catalyst – alumina **or** zeolites **or** aluminosilicates **or** broken pot*

ignore other named catalysts

allow (mixing with) steam as an alternative to second marking point

ignore pressure

1

[9]

6

(a) (i) D

1

(ii) B

1

(iii) A

1

(iv) E

1

(v) E

1

(b) (i) high temperature
ignore hot / heat
allow temperature quoted (range 300-900 °C) 1

catalyst **or** steam 1

(ii) C₈H₁₈ smaller molecule
It = C₈H₁₈ 1

therefore there are weaker intermolecular forces
allow intermolecular bonds
*do **not** accept breaking covalent bonds / bonds*

or

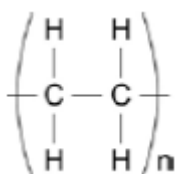
weaker intermolecular forces in C₈H₁₈ (1)
allow intermolecular bonds

so less energy to break (1) 1

(c) add bromine water 1

turns (from orange / yellow / red / brown) to colourless **or** decolourises
do not accept discoloured
ignore clear incorrect test = 0 marks 1

(d)



single C – C bond 1

four carbon-hydrogen bonds in place and two trailing bonds 1

structure in brackets and n at bottom right 1

[14]

7

- (a) (i) neutrons
this order only 1
- electrons 1
- protons 1
- (ii) box on the left ticked 1
- (b) (i) effervescence / bubbling / fizzing / bubbles of gas
*do **not** accept just gas alone* 1
- magnesium gets smaller / disappears
allow magnesium dissolves
*allow gets hotter **or** steam produced*
ignore references to magnesium moving and floating / sinking and
incorrectly named gases. 1

- (ii) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There are simple statements of some of the steps in a procedure for obtaining magnesium chloride.

Level 2 (3–4 marks)

There is a description of a laboratory procedure for obtaining magnesium chloride from dilute hydrochloric acid and magnesium.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **or** a method of obtaining magnesium chloride crystals.

Level 3 (5–6 marks)

There is a well organised description of a laboratory procedure for obtaining magnesium chloride that can be followed by another person.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **and** a method of obtaining magnesium chloride crystals.

examples of the points made in the response:

- hydrochloric acid in beaker (or similar)
- add small pieces of magnesium ribbon
- until magnesium is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess magnesium
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper).

*Student may choose to use a named indicator until it turns a neutral colour, record the number of pieces of magnesium added then repeat without the indicator.