

Name: _____

Organic Chemistry part 5 AQA Triple Chemistry

Class: _____

Date: _____

Time: **80 minutes**

Marks: **80 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)

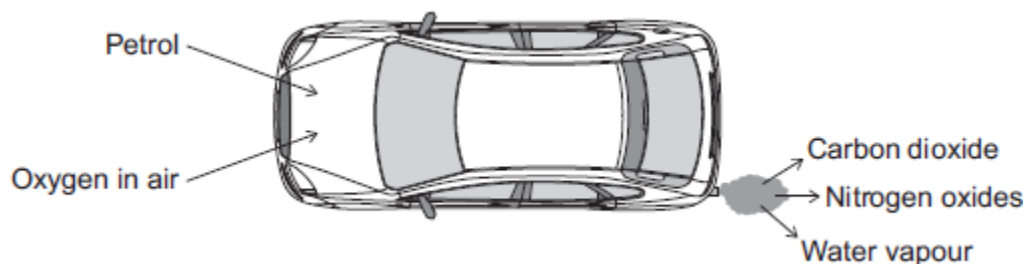
(iii) Crude oil is separated by fractional _____.

(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.

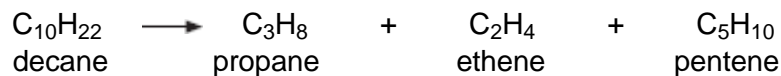
Describe why sulfur should be removed from petrol.

(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.

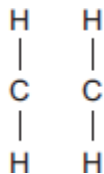
Propane is a polymer.

Propane is an alloy.

Propane is a fuel.

(1)

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



(1)

- (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.

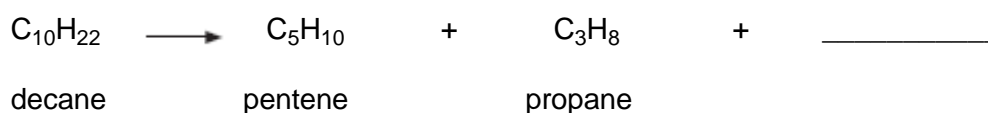
(3)

- (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.

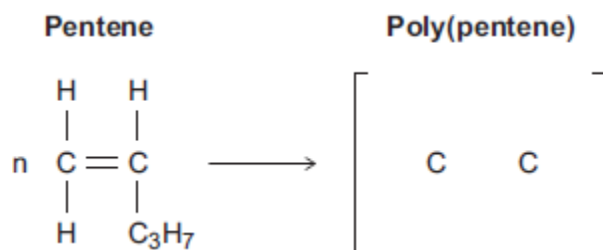
You do not need to give the name of this product.



(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.

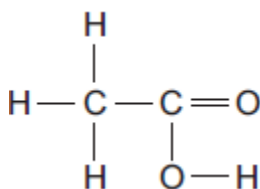
(1)

(Total 12 marks)

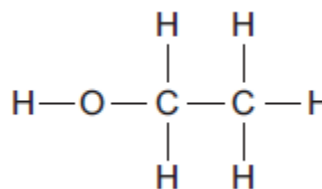
3.

The diagrams represent two compounds, **A** and **B**.

Compound A



Compound B



(a) (i) Compound **B** is an alcohol.

Name compound **B**.

(1)

(ii) Use the correct answer from the box to complete the sentence.

burned	decomposed	oxidised
--------	------------	----------

To form compound **A**,

compound **B** is _____

(1)

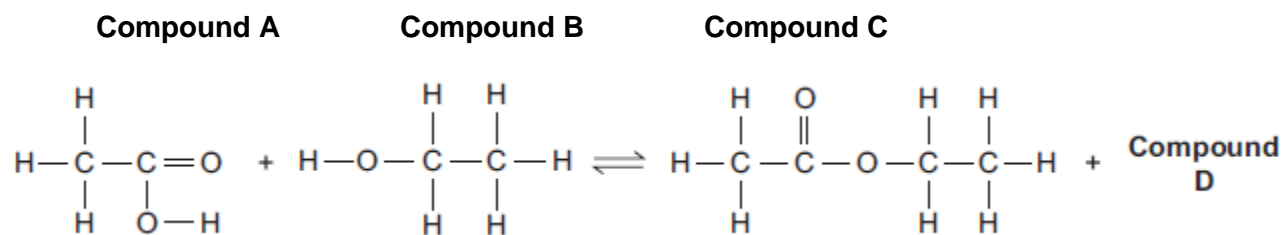
(iii) Compounds **A** and **B** are both colourless liquids.

A test tube contains a colourless liquid, which could be either compound **A** or compound **B**.

Describe a simple **chemical** test to show which compound, **A** or **B**, is in the test tube.

(2)

(b) Compounds **A** and **B** react to produce compound **C** and compound **D**.



(i) What is the formula of compound **D**?

(1)

(ii) Compound **C** is an ester.

Name compound **C**.

(1)

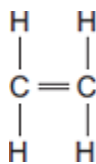
(iii) State **one** use of esters.

(1)

(Total 7 marks)

4.

A molecule of ethene (C_2H_4) is represented as:



- (a) A sample of ethene is shaken with bromine water.

Complete the sentence.

The bromine water turns from orange to _____.

(1)

- (b) Most ethene is produced by the process of cracking.

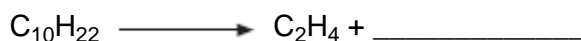
- (i) Complete the sentence.

Cracking is a type of thermal _____.

(1)

- (ii) Decane ($C_{10}H_{22}$) can be cracked to produce ethene (C_2H_4) and **one** other product.

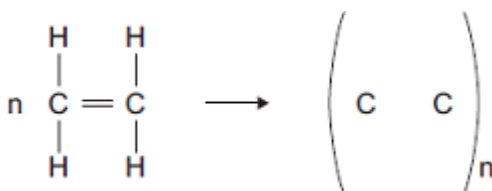
Complete the equation to show the formula of the other product.



(1)

- (c) Many molecules of ethene join together to produce poly(ethene).

- (i) Complete the structure of the polymer in the equation.



(2)

- (ii) Some carrier bags are made from poly(ethene). Some carrier bags are made from cornstarch.

Suggest **two** benefits of using cornstarch instead of poly(ethene) to make carrier bags.

(2)

(Total 7 marks)

5.

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.

(3)

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

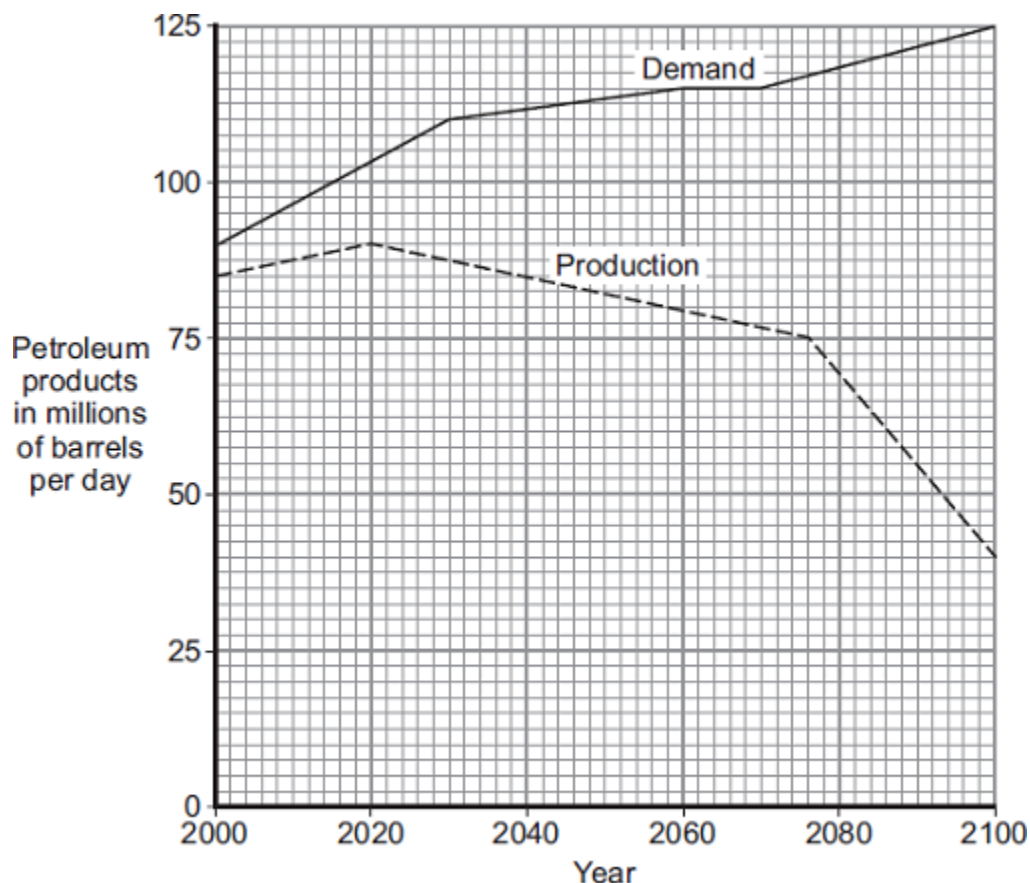
What are *alkanes*?

(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.

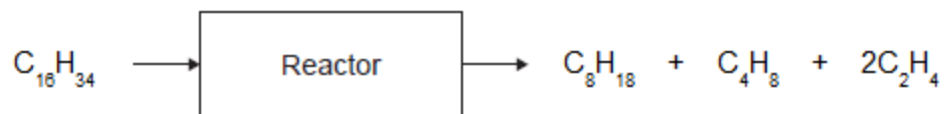
In Canada the oil sands are found in the ground underneath a very large area of forest. The trees are removed. Then large diggers and trucks remove 30 metres depth of soil and rock to reach the oil sands. The oil sands are quarried. Boiling water is mixed with the quarried oil sands to separate the bitumen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

6.

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 (C_4H_8) from the other hydrocarbons.

(1)

- (b) The second stage is to use butene (C_4H_8) to produce poly(butene).

- (i) Draw the displayed structure of a butene (C_4H_8) molecule.

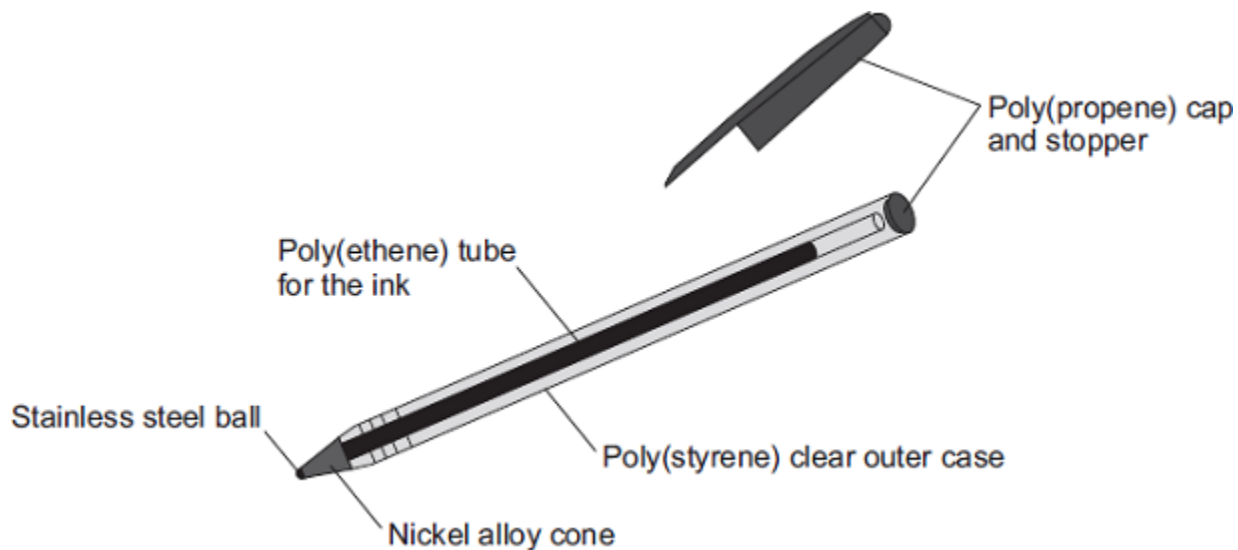
(1)

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

(2)
(Total 8 marks)

7.

The diagram shows a ballpoint pen.



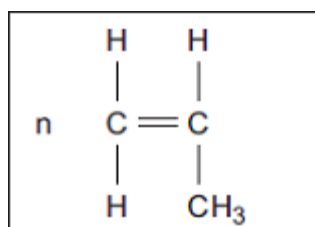
(a) Polymers are used to make the ballpoint pen.

(i) Name the monomer used to make poly(ethene).

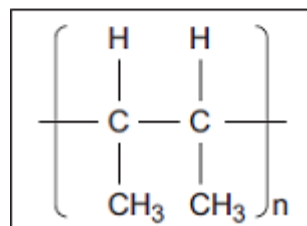
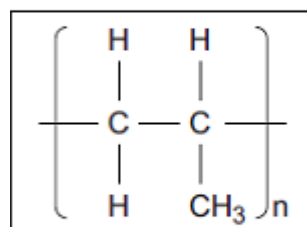
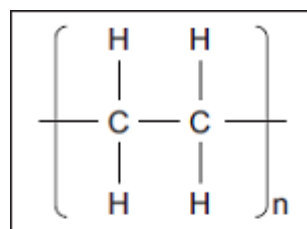
(1)

(ii) Draw **one** line from the monomer propene to its polymer poly(propene).

Monomer

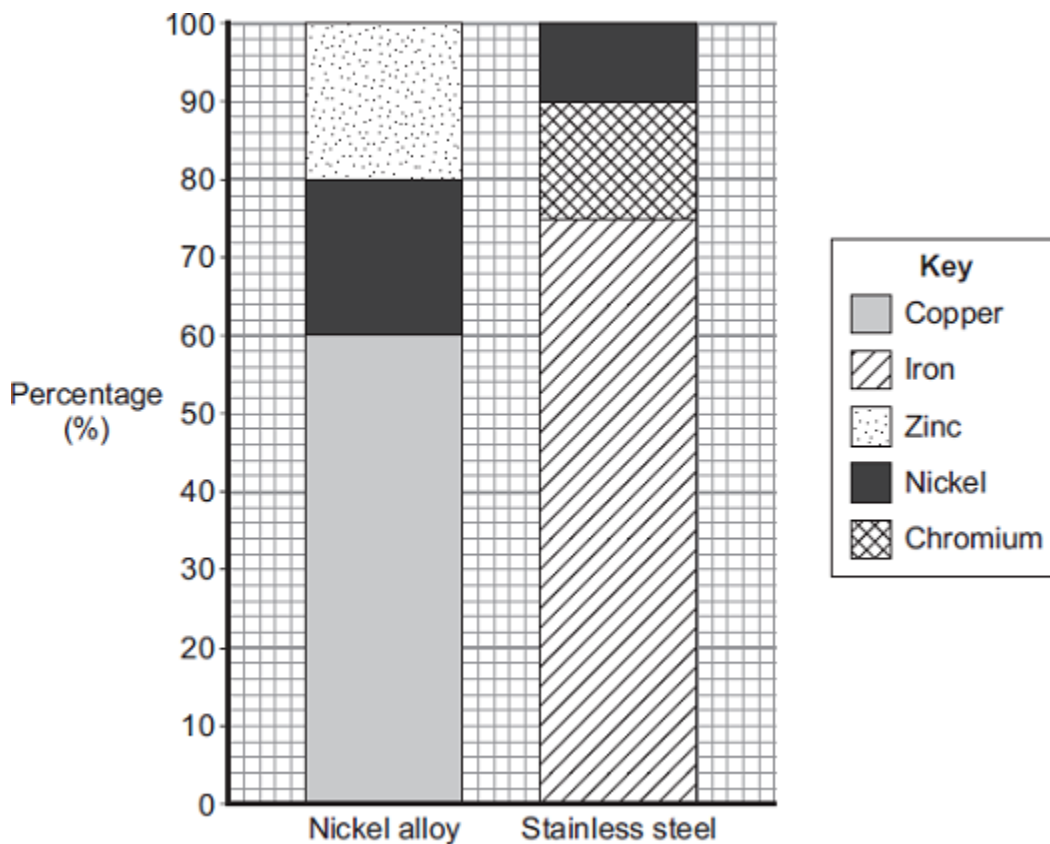


Polymer



(1)

(b) Two alloys are used to make the ballpoint pen.



Use the bar chart to answer these questions.

(i) Which metal is in both of these alloys?

(1)

(ii) What is the percentage of iron in the stainless steel?

_____ %

(1)

(iii) The alloy stainless steel is used instead of pure iron for the ball of the pen.

Give **two** reasons why.

(2)

- (c) Tick (✓) **one** advantage and tick (✓) **one** disadvantage of **recycling** this type of ballpoint pen.

	Advantage Tick (✓)	Disadvantage Tick (✓)
Can be refilled and reused		
Conserves resources of crude oil and ores		
High cost of separating materials		
Polymers and alloys are not expensive		

(2)
(Total 8 marks)

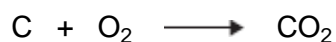
8.

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:



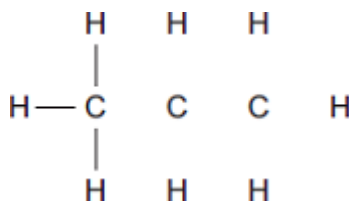
Complete the word equation for this reaction.



(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)

9.

Crude oil is a mixture of many different chemical compounds.

(a) Fuels, such as petrol (gasoline), can be produced from crude oil.

(i) Fuels react with oxygen to release energy.

Name the type of reaction that releases energy from a fuel.

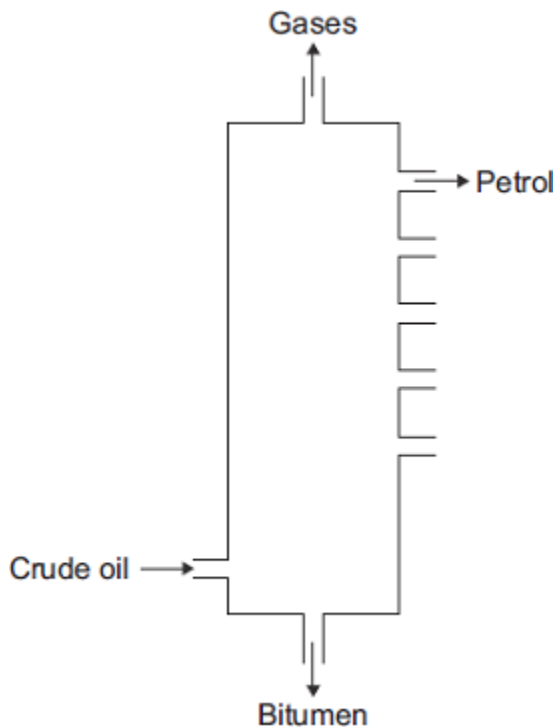
(1)

(ii) Fuels react with oxygen to produce carbon dioxide.
The reaction of a fuel with oxygen can produce a different oxide of carbon.

Name this different oxide of carbon and explain why it is produced.

(2)

(b) Most of the compounds in crude oil are hydrocarbons.
Hydrocarbons with the smallest molecules are very volatile.



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

Describe and explain how **petrol** is separated from the mixture of hydrocarbons in crude oil.

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) 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

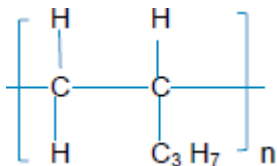
(c) (i) C_2H_4

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]

3.

- (a) (i) ethanol

1

- (ii) oxidised

1

- (iii) **Test**

add any named carbonate or hydrogen carbonate

the first mark is for the test; the second is for the result

if the test is incorrect award 0 marks.

1

Result

A will effervesce (carbon dioxide) **or B** will not effervesce.

if the result is incorrect, award the first mark only

1

or

candidates do not have to name a gas but penalise an incorrect gas.

Test

add a named (magnesium, aluminium, zinc, iron or tin) metal
give credit to any test that will work.

Result

A will effervesce (hydrogen), **B** will not
allow a test that would identify B.

or

Test

add an acid-base indicator

Result

credit any acid colour for that indicator eg for universal indicator allow red, yellow or orange

give credit for the neutral colour for **B**

or

Test

add an alcohol (+ acid catalyst)

Result

sweet or fruity smell of esters.

(b) (i) H₂O

1

(ii) ethyl ethanoate

1

(iii) any **one** from:

- flavourings
- perfumes
- solvents
- plasticisers

allow any correct use of esters

1

[7]

4.

(a) colourless

ignore clear

1

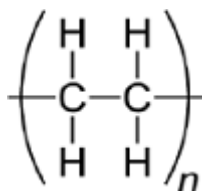
(b) (i) decomposition

1

(ii) C_8H_{18}

1

(c) (i)



two single trailing bonds extending from the carbons (through the brackets) 1 mark

five single bonds (1 C-C bond and 4 C-H bonds) 1 mark

2

(ii) any **two** from:

- (polymers made from) cornstarch are biodegradable
- less space needed in landfill sites
- polymers from cornstarch come from a renewable source.

allow converse for poly(ethene)

2

[7]

5.

(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]

6.

- (a) (i) alkanes **and** alkenes
any order
*allow saturated **and** unsaturated (hydrocarbons)*

1

- (ii) high temperature
allow temperatures from 300 – 900 °C
allow vapours
*ignore heat / hot **or** pressure*

1

catalyst **or** steam
allow zeolite / aluminium oxide
ignore names of other catalysts

1

(iii) oxygen could react / *burn* with the hydrocarbons
allow oxygen could cause an explosion

1

(iv) (*fractional*) distillation

1

(b) (i) displayed structure of butene drawn

1

(ii) many monomers **or** many butene molecules

1

form chains or very large molecules

*if no other mark awarded allow double bond breaks / opens up or
double bond forms a single bond for 1 mark*

1

[8]

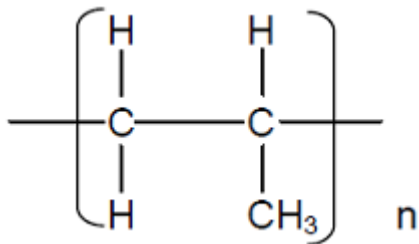
7.

(a) (i) ethene

allow C₂H₄

1

(ii)



*accept line drawn from word 'Monomer' or from the monomer box
to the correct 'Polymer'*

allow the correct 'Polymer' indicated by a tick, circled etc.

1

(b) (i) nickel

accept Ni

1

(ii) 75(%)

1

(iii) (stainless steel) is hard /strong / durable

it = stainless steel

accept (pure) iron is soft

1

(stainless steel) resistant to corrosion **or** unreactive

accept (pure) iron rusts / corrodes / reacts

*do **not** allow corrosive*

1

(c) **Advantage** : Conserves resources of crude oil and ores
do not allow more than one tick in the advantage column

1

Disadvantage : High cost of separating materials
do not allow more than one tick in the disadvantage column

1

[8]

8.

(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]

9.

(a) (i) exothermic
accept combustion
allow burning or oxidation or
redox

1

(ii) carbon monoxide / CO (is produced)
allow monoxide (is produced) ignore carbon oxide

1

because there is incomplete / partial combustion (of the fuel)
accept because there is insufficient oxygen / air (to burn the fuel)

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#).

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a statement that crude oil is heated **or** that substances are cooled. However there is little detail and any description may be confused or inaccurate.

Level 2 (3-4 marks)

There is some description of heating / evaporating crude oil **and either** fractions have different boiling points **or** there is an indication of a temperature difference in the column.

Level 3 (5-6 marks)

There is a reasonable explanation of how petrol is or fractions are separated from crude oil using evaporating **and** condensing.

If cracking is given as a preliminary or subsequent process to fractional distillation then ignore.

However, if cracking / catalyst is given as part of the process, maximum is **level 2**.

Examples of chemistry points made in the response could include:

- Some / most of the hydrocarbons (or petrol) evaporate / form vapours or gases
- When some of / a fraction of the hydrocarbons (or petrol) cool to their boiling point they condense
- Hydrocarbons (or petrol) that have (relatively) low boiling points and are collected near the top of the fractionating column or hydrocarbons with (relatively) high boiling points are collected near the bottom of the fractionating column
- The process is fractional distillation
- Heat the crude oil / mixture of hydrocarbons or crude oil / mixture is heated to about 350°C
- Some of the hydrocarbons remain as liquids
- Liquids flow to the bottom of the fractionating column
- Vapours / gases rise up the fractionating column
- Vapours / gases cool as they rise up the fractionating column
- The condensed fraction (or petrol) separates from the vapours / gases and flows out through a pipe
- Some of the hydrocarbons remain as vapours / gases
- Some vapours / gases rise out of the top of the fractionating column
- There is a temperature gradient in the fractionating column or the fractionating column is cool at the top and hot at the bottom

6

[9]