Organic Chemistry 1

Name: _____

Class: _____

Date: _____

Time: **46 minutes**

Marks: **46 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)

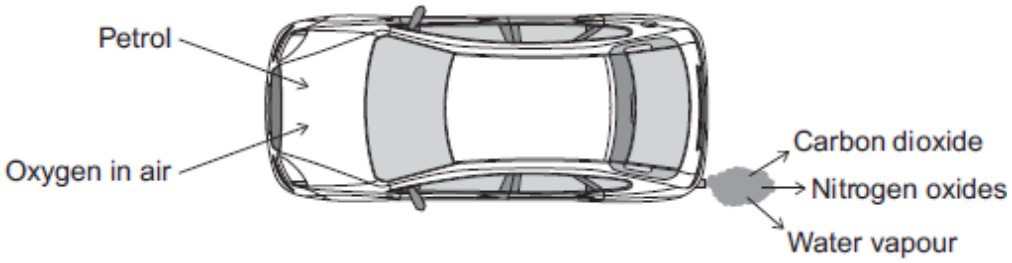
(iii) Crude oil is separated by fractional _____ .

(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 (C_8H_{18}).

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:

$C_{10}H_{22}$	⟶	C_3H_8	+	C_2H_4	+	C_5H_{10}
decane		propane		ethene		pentene

(i) Why is propane useful?

Tick (✓) **one** box.

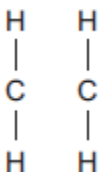
Propane is a polymer. ☐

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. 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.

_____

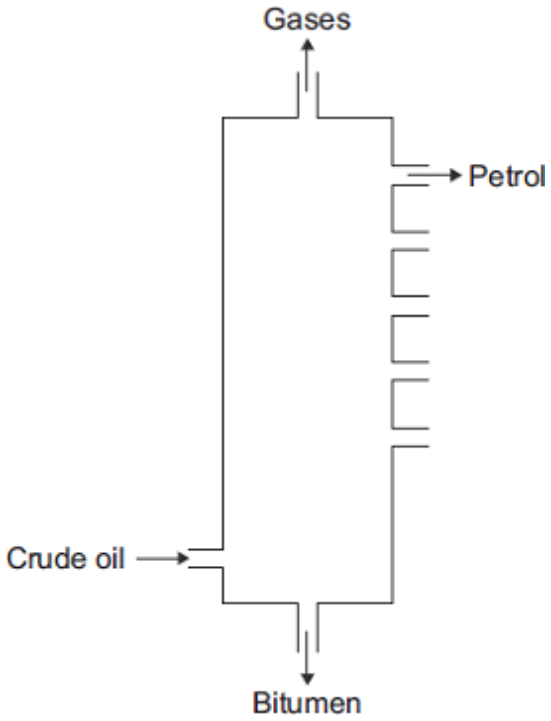
_____

_____

_____

(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.

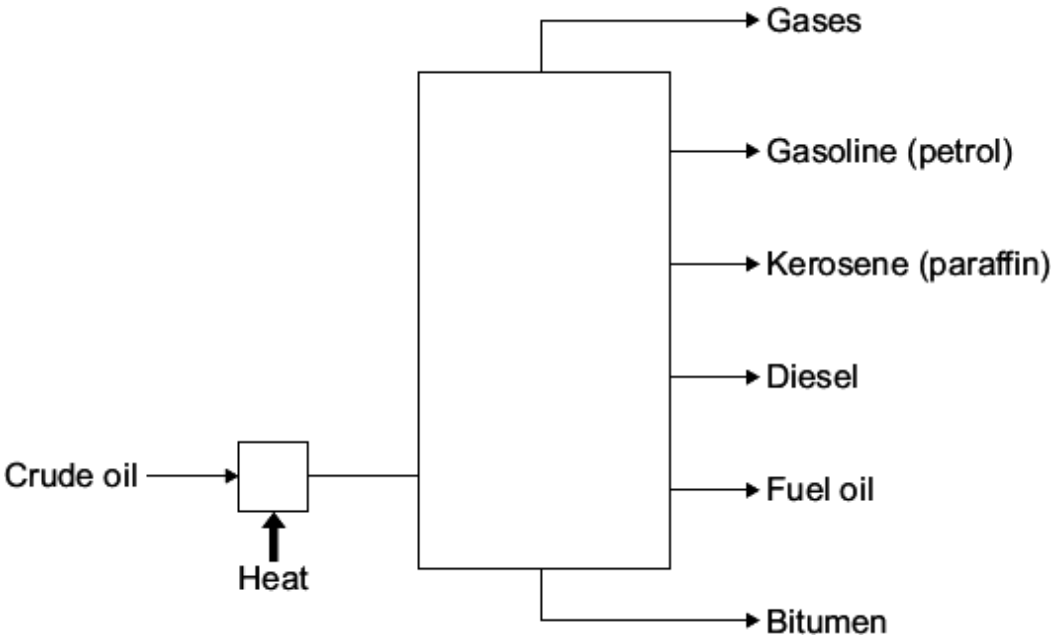
Use the diagram and your knowledge to answer this question.

(6)

(Total 9 marks)

3. Crude oil is used to produce many useful materials.

(a) The diagram shows some of the fractions produced from crude oil by fractional distillation.



Use the diagram to help you to explain how crude oil is separated into fractions.

You should use the words evaporated and condensed in your answer.

(3)

(b) The table shows some information about four of the fractions from crude oil that are used as fuels.

Fraction	Boiling point in °C	Number of carbon atoms found in the molecules
Gasoline (petrol)	20 - 200	5 - 10
Kerosene (paraffin)	180 - 260	10 - 16
Diesel	260 - 340	14 - 20
Fuel oil	370 - 600	20 - 70

Use the information in the table to help you to answer these questions.

(i) How can you tell that each of the fractions is a mixture?

_____

_____

(1)

(ii) How does the number of carbon atoms in a molecule affect its boiling point?

_____

_____

(1)

(c) Fuels are substances that release energy.

(i) Name the reaction that releases energy from a fuel such as gasoline (petrol).

_____

(1)

(ii) Describe how fuel oil is broken down into smaller, more useful molecules such as gasoline (petrol).

_____

_____

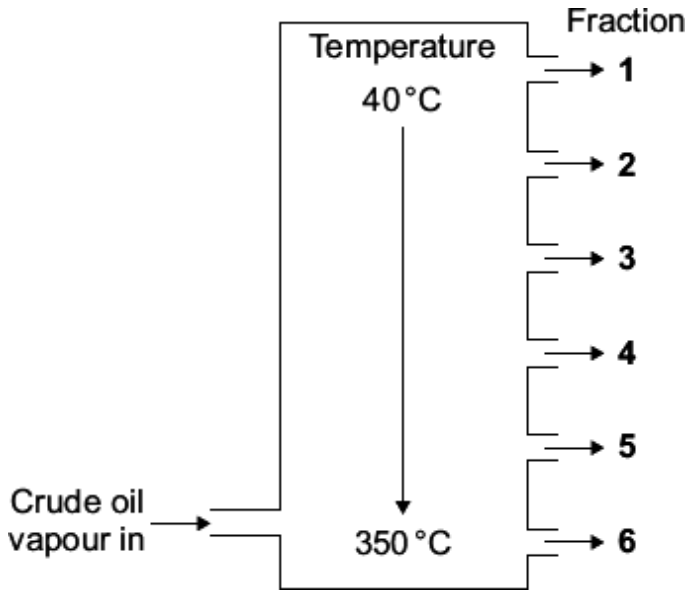
_____

_____

(2)

(Total 8 marks)

4. Crude oil is a mixture of hydrocarbons.
Crude oil can be separated into fractions.



(a) (i) Complete the sentence.

The process used to separate the crude oil into fractions is called

fractional _____ .

(1)

(ii) Why do the fractions separate at different temperatures?

_____

_____

(1)

(b) Tick (✓) **two** properties of fraction **6**.

Property	Tick (✓)
contains hydrocarbons	
has a small number of carbon atoms in each molecule	
is easy to ignite	
has a high boiling point	

(2)

(c) Fraction **1** contains hydrocarbons called alkanes.
The general formula of an alkane is: C_nH_{2n+2}

What is the formula of the alkane that has 5 carbon atoms in each molecule?

Draw a ring around the correct answer.

C_5H_9 **C_5H_{10}** **C_5H_{11}** **C_5H_{12}**

(1)

(Total 5 marks)

5. This information about diesel was printed in a magazine.

Almost all of the crops that we eat can be converted into fuel for cars.
Vegetable oils can be used as biodiesel. Diesel from crude oil is called fossil diesel.
When either biodiesel or fossil diesel burn they both produce similar amounts of carbon dioxide.
Both types of diesel produce carbon monoxide. However, biodiesel produces fewer carbon particles and less sulfur dioxide.

(a) Carbon monoxide can be produced when diesel burns in a car engine. Explain how.

_____

_____

_____

_____

(2)

(b) Use the information at the start of this question and your knowledge and understanding to evaluate the use of biodiesel compared with fossil diesel as a fuel for cars.

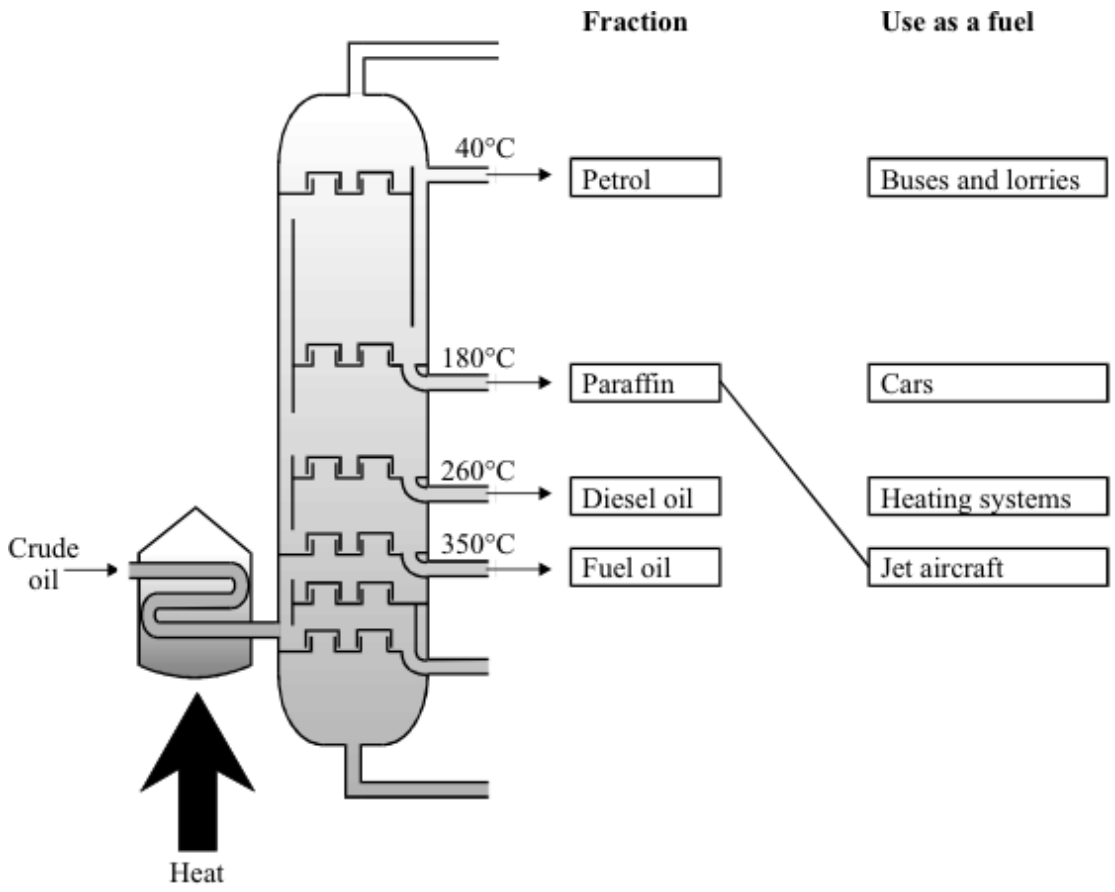
Remember to give a conclusion to your evaluation.

(5)

(Total 7 marks)

6. Fractional distillation is used to separate fractions in the crude oil mixture.

(a) Draw a line to join each fraction to its use as a fuel. One line has been drawn for you.



(2)

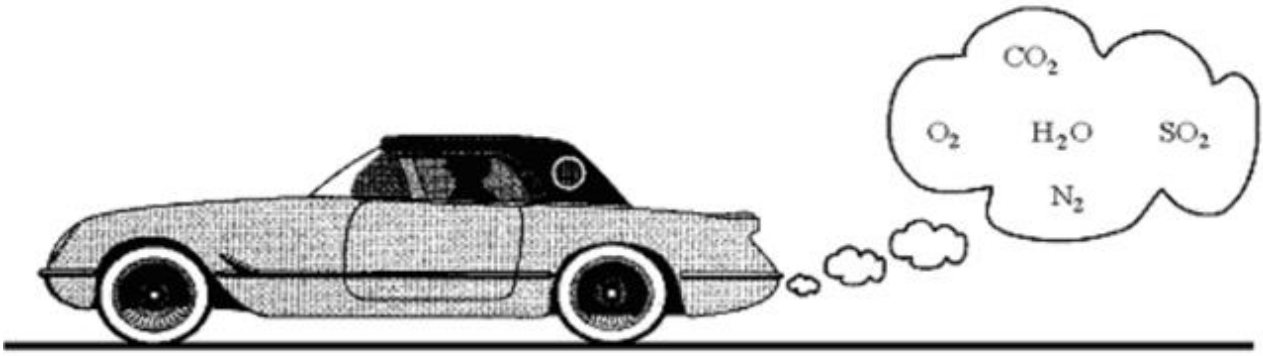
(b) (i) Why does petrol separate from the other fractions in the crude oil mixture?

_____

_____

(1)

(ii) Petrol contains the elements carbon and hydrogen only.



Which **two** of the substances in the diagram are formed when petrol burns?

1. _____

2. _____

(2)

(Total 5 marks)

1.

(a) (i) mixture (of different substances)

1

(ii) boiling (points)

1

(iii) distillation

1

(b) (i) combustion

1

(ii) (reactant)

oxygen

allow correct formulae

1

(products)

products in any order

carbon dioxide

allow carbon or carbon monoxide

and

water

allow water vapour or steam or hydrogen oxide

1

(iii) (burning sulfur) produces sulfur dioxide / $S0_2$

allow it / sulfur reacts with oxygen ignore sulfur oxide

1

causes acid rain

1

(c) (i) propane is a fuel

1

(ii) double bond drawn between carbon atoms

do not allow any other bonds or symbols

1

(iii) orange to colourless

1

(iv) poly(pentene)

allow polymer(s)

1

[12]

2. (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]

3. (a) crude oil / it is evaporated / vaporised

ignore heated

1

vapours / gases / fractions <u>cool and condense</u>

accept named fraction(s)

1

(different) vapours / gases / fractions (condense) at different temperatures

accept (different) vapours / gases / fractions have different boiling points

*max **2** marks for description of laboratory method **or** mention of cracking*

1

(b) (i) any **one** from:

- range of boiling points
- range of carbon atoms

1

(ii) greater the number (of carbon atoms) the higher the boiling point

*do **not** accept molecules / particles*

1

(c) (i) burning / combustion

allow oxidation / redox

1

(ii) any **two** from:

*reaction with hydrogen gains max of **1** mark only*

- cracking / (thermal) decomposition
- heat / vaporise
- catalyst / aluminium oxide

allow porous pot

ignore names of other catalysts

2

[8]

4. (a) (i) distillation

1

(ii) condense (at different temperatures)

accept they / fractions / hydrocarbons have different boiling points

ignore melting point / size of molecule

1

(b) contains hydrocarbons

1

has a high boiling point

1

(c) C_5H_{12}

1

[5]

5. (a) carbon / diesel / it reacts / burns in oxygen / air

1

limited supply (of oxygen / air)

accept incomplete combustion

$2C + O_2 \rightarrow 2CO$ ***or***

*$C + CO_2 \rightarrow 2CO$ gains **2** marks*

1

(b) any **four** from:

accept converse statements for fossil diesel.

ignore cost / ease of manufacture / usage issues

for biodiesel:

- less global dimming (because fewer carbon particles)
- less acid rain (because less sulfur dioxide)

  *if neither point awarded, fewer carbon particles and less sulfur dioxide = **1** mark*
- renewable resource / sustainable

  accept fossil fuel / diesel supplies are limited
- use <u>waste</u> vegetable oils / fats
- vegetables / plants absorbed carbon dioxide / carbon neutral

  accept fossil fuel / diesel releases locked up carbon / is not carbon neutral
- uses land which could be used to produce food
- third world countries can produce bio diesel
- biodegrades easily
- more NOx released

4

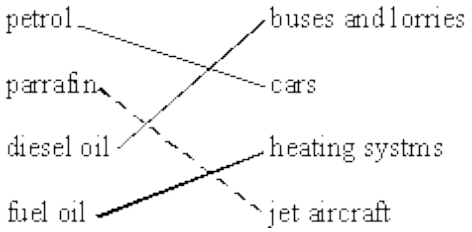
justified conclusion

1

[7]

6. (a) all **three** lines correct **two** marks
one or two lines correct **one** mark

two *ticks only*



accept diesel oil joined to cars

1

(b) (i) because it has a different boiling point

accept because of its boiling point
or *it has a boiling point of 40 °C*

1

(ii) CO_2 **or** carbon dioxide

1

H_2O **or** water

accept steam

1

[5]