GCSE
CHEMISTRY

Topic Paper: 7.1 Carbon compounds as fuels and feedstock
Part 1 & 2 Mark Scheme

MARK SCHEME

58 Marks

M1. (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]

M2. (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℃

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]

M3. (a) (i) *use of carbon throughout* = ***max 1***

burning biodiesel releases CO_2

ignore burning trees

1

CO_2 is absorbed / used by the crops/plants (used to produce the biodiesel)

allow CO_2 absorbed / used by trees

1

(ii) *allow use of carbon for carbon dioxide throughout*

increases CO_2 / greenhouse effect

accept causes global warming

OR

allow causes climate change

less CO_2 is absorbed (from atmosphere)

ignore other correct effects

1

because burning trees releases CO_2

accept fewer trees to absorb CO_2

***or** crops / plants do not absorb as much CO_2 as trees*

OR

because there is less photosynthesis

ignore habitats / biodiversity

*if no other mark awarded global dimming because of smoke / particles gains **1** mark*

1

(b) any **one** from:

ignore carbon neutral / cost / less harmful / environmentally friendly

crude oil / fossil fuel is running out / non-renewable

allow biodiesel is renewable / sustainable

demand for fuels / energy is increasing

ignore demand for biodiesel is increasing

new legislation / protocols

1

(c) (i) uses crops / land that could be used for food

*allow destroys habitats **or** reduces biodiversity*

ignore cost

1

(ii) increases the cost of food / land

ignore cost of machinery / process

ignore cheaper to produce biodiesel

1

[7]

M4. air or oxygen;
oxygen;
heat;
carbon dioxide;
water;
chemical

for 1 mark each

[6]

M5. (a) ethanol is made up of only one type of molecule **or** ethanol is a compound

allow ethanol is pure

1

diesel / petrol / rapeseed oil are mixtures

accept composition of diesel / petrol / rapeseed oil varies / changes

allow different hydrocarbons have different melting points

ignore diesel, petrol and rapeseed oil are impure

1

(b) (i) sugar is mixed with / dissolved in water

accept sugar cane for sugar

1

yeast (is added)

allow enzymes are added

*if no other mark awarded, allow correct word or chemical equation for **1** mark*

1

(ii) (growing sugar cane / rapeseed) plants absorbs carbon dioxide

accept carbon for carbon dioxide

accept carbon dioxide is used for photosynthesis

1

which is released (when the biofuel burns)

*do **not** accept <u>no</u> carbon dioxide is released (when biofuels burn)*

1

(c) nitrogen / N_2 **and** oxygen / O_2 (in the air)

*do **not** accept fuels contain nitrogen*

1

react in the hot engine / at high temperature

1

(d) any **three** from:

ignore references to melting point

3

ethanol needs a higher temperature to burn than petrol **or** ethanol has a higher flashpoint than petrol

ethanol releases less energy (per litre) than petrol

sugar is renewable **or** crude oil is non-renewable / will run out

sugar cane growth is unreliable / slow **or** crude oil is a reliable supply

*allow ethanol is not readily available **or** petrol is readily available*

ethanol is made by a batch / slow process **or** petrol is made by a continuous / fast process

ethanol is carbon neutral **or** petrol contains 'locked up' carbon dioxide

sugar / sugar cane should be used for food not for fuels

accept idea of food shortages

a justified conclusion that adds value

*accept one **additional** point from the list above as long as one comparison of replacing petrol with ethanol is made*

1

[12]

M6. (a) (i) acid rain

accept consequences of acid rain

allow asthma / bronchitis

ignore toxic gas

1

(ii) global dimming

accept dimming alone

1

(b) (i) **sustainable:**

maximum **two** from:

crops (that produce oil) can be grown in most places owtte

renewable

use less fossil fuels / diesel

use (refined) waste oils

low pollution:

maximum **two** from:

ignore references to CO_2 here

most emissions are lower **or** any two named emissions from CO / SO_2 / PM_{10} are lower

much / lot less SO_2 emissions (than the others) owtte

accept spillages / waste is biodegradable

less new CO_2 **or** (more) carbon neutral

3

(ii) plants / photosynthesis use carbon (dioxide) from the air*

1

it / biodiesel releases carbon (dioxide) from plants / crops / photosynthesis*

*(*) allow **1** mark for biodiesel is (more) carbon neutral*

1

(fossil) diesel releases 'locked up' / new carbon (dioxide) / doesn't absorb CO_2 / absorbed it millions of years ago

1

[8]

M7. (a) catalyst

1

(b) (i) made up of **only** carbon and hydrogen

1

(ii) C_8H_{18}

1

(c) (i) ethene

1

(ii) polymerisation

1

[5]