AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.7.1 CARBON COMPOUNDS AS FUELS AND FEEDSTOCK (PACK 1)

SCORE	PERCENTAGE
/359	%

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Q1.

(a) $C_{12}H_{26}$

1

(b) alkane

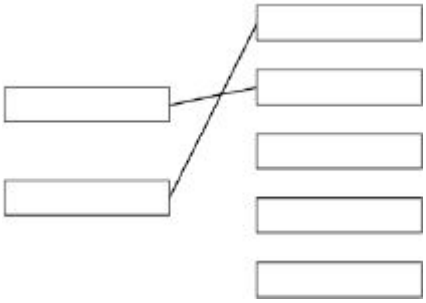
1

(c) air

allow atmosphere

1

(d)



particulates − global dimming

1

sulfur dioxide − acid rain

1

(e) carbon dioxide

1

carbon monoxide

1

(f) develop fuel efficient engines

use electric cars

1

[9]

Q2.

(a) C_5H_{12}

1

(b) 2:5

1

(c) **A**

1

(d) **A**

1

(e) carbon dioxide

1

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water

1

(f) propane

1

(g) (8 × 1) + (3 × 12)

1

= 44

1

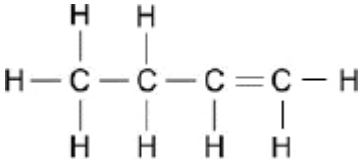
*an answer of 44 scores **2** marks*

[9]

Q3.

(a) C_5H_{10}

1

(b) 

1

(c) bar labelled petrol to 28.6 (%)

allow a tolerance of ± $\frac{1}{2}$ a square

1

(d) 100 tonnes

1

(e) 7.1 + 11.1 + 17.2 = 35.4

1

$$\frac{2000 \times 35.4}{100}$$

allow ecf from step 1

1

= 708 (kg)

*an answer of 1276 (kg) gains **2** marks*

1

(f) higher percentage (by mass) of heavier fractions
or
higher percentage of larger molecules

1

(g) **Level 3 (5-6 marks):**
Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

Level 2 (3-4 marks):
Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

Level 1 (1-2 marks):

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Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

Level 0
No relevant content.

Indicative content

fractional distillation
- oil heated / boiled / vaporised
- fractionating column used
- fractions have different boiling ranges / temperatures
- column hotter at bottom

or

column cooler at top
- fractions condense at different levels
- heavy fractions collect at bottom

or

light fractions collect at top

cracking
- high temperature
- catalyst or steam
- large molecules split into small molecules
- mixture of alkanes and alkenes produced

6

[14]

Q4.

(a) C_5H_{12}

1

(b) Alkanes

1

(c) (3) CO_2

1

(4) H_2O

1

*allow for **1** mark*
4 CO_2 + 3 H_2O

(d) contains hydrogen and carbon

1

(hydrogen and carbon) only

1

(e) *(diesel)*
produces more oxides of nitrogen
allow converse answers in terms of petrol

1

produces (more) particulate matter

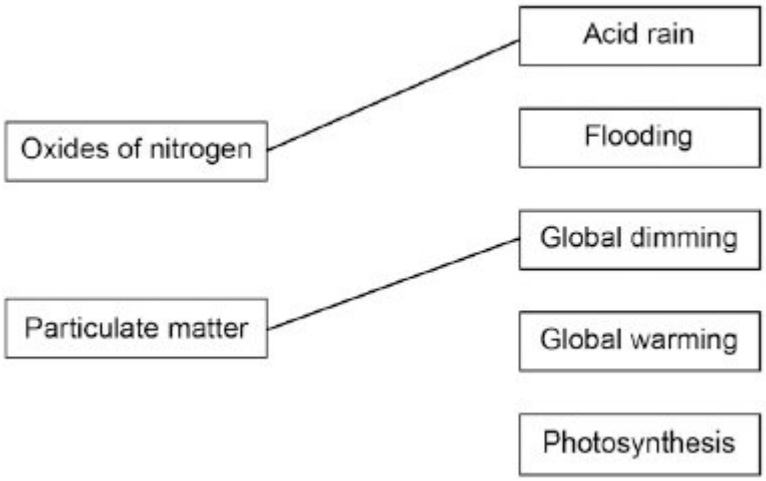
1

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produces less carbon dioxide

1

(f)



2

[11]

Q5.

(a) all points correct

±1 small square

allow 1 mark for 6 or 7 plots

2

Year	Percentage (%) of bottles made from other materials
1975	5
1980	10
1985	22
1990	42
1995	70
2000	72
2005	90
2010	95

1

(b) **Level 3 (5–6 marks):**
A detailed and coherent argument is provided which considers a range of issues and comes to a conclusion consistent with the reasoning.

Level 2 (3–4 marks):
An attempt to describe the advantages and disadvantages of the production and uses is made, which comes to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Simple statements made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

0 marks:

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No relevant content.

Indicative content

- glass – 2 stages in production of soda-lime glass
- glass – second stage, heating sand, limestone and sodium carbonate
- HDPE – 3 stages in production
- HDPE – second stage, cracking of naphtha to obtain ethene
- HDPE – third stage, polymerisation of ethene
- fewer stages in glass production, may be quicker
- higher temperature in glass manufacture, therefore maybe higher energy requirement
- glass bottle can be reused
- consideration of collection / cleaning costs to reuse glass bottles
- other glass products can be made from recycled glass
- plastic has greater range of sizes
- both produced from limited raw materials
- higher percentage recycled materials in glass conserves raw materials

This indicative content is not exhaustive, other creditworthy responses should be awarded marks as appropriate.

6

[9]

Q6.

(a) C_6H_{14}

1

(b) **A**

1

(c) **B**

1

(d) **C**

1

(e) Propanol

1

[5]

Q7.

(a) (i) high temperature

allow heating / hot / 250-900 °C

1

catalyst or steam

allow named catalyst eg zeolite, Al_2O_3, silica, ceramic

allow in the absence of air / oxygen

1

ignore any references to pressure

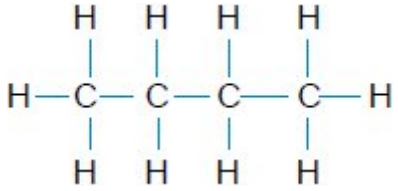
(ii) colourless

allow decolourised

ignore clear / discoloured

1

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(iii) 

1

(b) (i) 20.3(0) (kJ)

*if answer incorrect allow **1** mark for 24.36/1.2*

2

(ii) use a lid

allow insulate beaker or use draught shield

1

reduce energy / heat loss

ignore references to thermometer or repeats or distance of flame or loss of water vapour

allow stir (1) to distribute energy / heat (1)

allow use a metal can (1) as it's a better conductor (1)

1

(iii) carbon/soot

ignore tar, smoke

1

(produced by) incomplete combustion

allow from a limited supply of oxygen/air

1

(iv) hexane gives out the greatest energy (per 1.0 g)

ignore more energy

1

hexane produces the least smoke / carbon / soot

allow has the cleanest flame

ignore less smoke / carbon / soot

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. Examiners should also apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):
Descriptions of advantages **and** disadvantages that are linked to their own knowledge.

Level 2 (3 – 4 marks):
Descriptions of an advantage **and** a disadvantage with some use of their knowledge to add value.

Level 1 (1 – 2 marks):
Statements made from the information that indicate whether at least one statement is an advantage **or** a disadvantage
or a linked advantage or disadvantage

0 marks:
No relevant content

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Examples of the added value statements and links made in the response could include:
Note that link words are in bold; links can be either way round.
Accept reverse arguments and ignore cost throughout.

Advantages of using hydrogen:
- Combustion only produces water **so** causes no pollution
- Combustion does not produce carbon dioxide **so** this does not contribute to global warming or climate change
- Combustion does not produce sulfur dioxide **so** this does not contribute to acid rain
- Incomplete combustion of petrol produces carbon monoxide **that is** toxic
- Incomplete combustion of petrol produces particulates **that** contribute to global dimming
- Petrol comes from a non-renewable resource **but** there are renewable/other methods of producing hydrogen
- Hydrogen releases more energy **so** less fuel needed or more efficient

Disadvantages of using hydrogen:
- Hydrogen is a gas **so** is difficult to store or transfer to vehicles
- Hydrogen gas is very flammable **so** leaks cause a greater risk of explosion
- Most hydrogen is produced from fossil fuels **which** are running out
- Cannot be used in existing car engines **so** modification / development or replacement is needed
- Lack of filling stations **so** difficult to refuel your vehicle

6

[18]

Q8.

(a) (i) (conical) flask

1

(ii) measuring cylinder / pipette / burette

1

(b) (i) any **two** from:
- so anomalous results could be identified / ignored
- so a mean / average could be taken
- (to improve) accuracy

2

(ii) 19

1

(iii) increases / gets longer / gets bigger

1

(iv) anomalous / does not agree with other times for $C_{10}H_{22}$

1

(v) any **one** from:
- shorter hydrocarbon used
- volume of hydrocarbon too small
- started timing late
- stopped timing too early / when liquid left in funnel

*must suggest why the result is **lower** than the others.*

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*allow the temperature was higher **or** the students used a wider funnel.*

1

(c) (i) flammable

1

(ii) suitable safety precaution

1

reason that links the safety precaution to the hazard symbols

eg:

- *wear gloves*
- *(because) it is hazardous to health / harmful / toxic / irritant*

or

- *do not pour down sink **or** dispose of properly*
- *(because) it is harmful to the environment / kills fish*

or

- *wear a mask or do it in the fume cupboard or a well-ventilated area*
- *respiratory irritant*

1

(d) (i) points plotted correctly (within half small square)

*all six points correct scores **2***

*3, 4 or 5 points correct scores **1***

2

smooth curve of best fit

1

(ii) point at 46 °C circled

allow point furthest from the line as drawn

1

(iii) working shown on graph

1

value read from graph line drawn (within half small square)

1

(iv) the higher the temperature the lower the viscosity

*allow the higher the temperature the lower / shorter the time taken for **1** mark*

2

non-linear **or** change gets smaller as temperature gets higher

*answer relating temperature to time taken can score a maximum of **2** marks.*

1

(v) identifying source of the error

1

method of avoiding the error

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eg:

- *the temperature will drop*
- *insulate the funnel*

or

- *runs out before all added*
- *put a tap on the funnel*

1

[22]

Q9.

(a) circle round any one (or more) of the covalent bonds

any correct indication of the bond − the line between letters

1

(b) Methane contains atoms of two elements, combined chemically

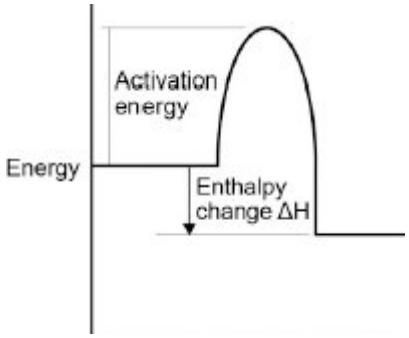
1

(c) (i) activation energy labelled from level of reagents to highest point of curve

ignore arrowheads

1

enthalpy change labelled from reagents to products



*arrowhead **must** go from reagents to products only*

1

(ii) 2 O_2

1

2 H_2O

*if not fully correct, award **1** mark for all formulae correct.*

ignore state symbols

1

(iii) carbon monoxide is made

1

this combines with the blood / haemoglobin **or** prevents oxygen being carried in the blood / round body **or** kills you **or** is toxic **or** poisonous

dependent on first marking point

1

(iv) energy is taken in / required to break bonds

accept bond breaking is endothermic

1

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energy is given out when bonds are made

accept bond making is exothermic

1

the energy given out is greater than the energy taken in

this mark only awarded if both of previous marks awarded

1

(d) (i) energy to break bonds = 1895

calculation with no explanation max = 2

1

energy from making bonds = 1998

1

1895 − 1998 (= −103)
or
energy to break bonds = 656
energy from making bonds = 759
656 − 759 (= −103)

allow:

bonds broken − bonds made =

413 + 243 − 327 − 432 = -103 for 3 marks.

1

(ii) The C — Br bond is weaker than the C — Cl bond

1

[15]

Q10.

(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

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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]

Q11.

(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

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1

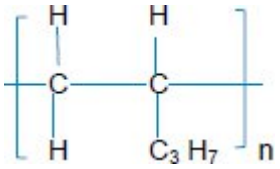
(c) (i) C_2H_4

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]

Q12.

(a) (i) Neutron (top label)

1

Electron (bottom label)

1

(ii) 13

1

(iii) electrons

1

(b) (i) compound

1

hydrogen

1

bond

1

(ii) C_4H_{10}

1

[8]

Q13.

(a) (i) ethanol

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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) H_2O

1

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(ii) ethyl ethanoate

1

(iii) any **one** from:

- flavourings
- perfumes
- solvents
- plasticisers

allow any correct use of esters

1

[7]

Q14.

(a) Sulfur dioxide causes acid rain.

1

(b) red / orange / yellow

*do **not** accept any other colours*

1

because sulfur dioxide (when in solution) is an acid

1

(c) (there are) <u>weak</u> forces (of attraction)

*do **not** accept any reference to covalent bonds breaking*

1

between the molecules

*do **not** accept any other particles*

1

(these) take little energy to overcome

award third mark only if first mark given

1

(d) 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 on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
A relevant comment is made about the data.

Level 2 (3 – 4 marks)
Relevant comparisons have been made, and an attempt made at a conclusion.

Level 3 (5 – 6 marks)
Relevant, detailed comparisons made and a justified conclusion given.

examples of the points made in the response

effectiveness

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- W removes the most sulfur dioxide
- D removes the least sulfur dioxide

material used

- Both W and D use calcium carbonate
- Calcium carbonate is obtained by quarrying which will create scars on landscape / destroy habitats
- D requires thermal decomposition, this requires energy
- D produces carbon dioxide which may cause global warming / climate change
- S uses sea water, this is readily available / cheap

waste materials

- W product can be sold / is useful
- W makes carbon dioxide which may cause global warming / climate change
- D waste fill landfill sites
- S returned to sea / may pollute sea / easy to dispose of

6

[12]

Q15.

(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) C_8H_{18} smaller molecule

It = C_8H_{18}

1

therefore there are weaker intermolecular forces

allow intermolecular bonds

*do **not** accept breaking covalent bonds / bonds*

or

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weaker intermolecular forces in C_8H_{18} (1)

allow intermolecular bonds

so less energy to break (1)

1

(c) add bromine water

1

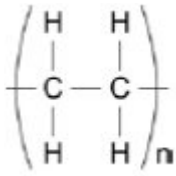
turns (from orange / yellow / red / brown) to colourless **or** decolourises

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]

Q16.

(a) hydrocarbons **or** hydrocarbon

1

(b) (i) distillation

1

(ii) evaporation

1

(iii) condensation

1

(c) (i) bond

1

(ii) $(C_6H)_{14}$

1

(iii) cracking

1

(d) (i) poly(butene)

allow with or without brackets

1

(ii) Advantage = energy is released

*do **not** accept more than one tick in the advantage column*

1

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Disadvantage = carbon dioxide is produced

*do **not** accept more than one tick in the disadvantage column*

1

[10]

Q17.

(a) (i) 2,4 drawn (as dots / crosses / e^-)

1

(ii) Water (vapour) / steam

allow hydrogen oxide / H_2O

*do **not** accept hydroxide*

1

(b) any **two** pairs from:

carbon dioxide (1)

causes global warming (1)

allow greenhouse effect / climate change / sea level rise / melting of polar ice caps

or

carbon (particles) / soot (1)

allow particulates

causes global dimming (1)

allow blocks out sunlight / smog / prevents plant growth / causes breathing difficulties

or

carbon monoxide (1)

is toxic (1)

or

sulfur dioxide (1)

causes acid rain (1)

allow kills plants / erosion / acidifies water

4

[6]

Q18.

(a) Methane has the lowest melting point and icosane has the highest boiling point

1

Decane and icosane are liquid at 100°C

1

(b) water / H_2O

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either order

1

carbon dioxide / CO_2

allow hydrogen oxide

1

(c) (i) fermentation

1

(ii) any **two** from:

- sugar cane / plants absorb carbon dioxide
  ignore oxygen released
- growing sugar cane / plants reduces global warming
  allow ethanol from plants is carbon neutral
- renewable resource / sustainable
  accept conserves fossil fuels / petrol

2

(iii) any **two** from:

- destruction of habitats / forests (to grow sugar cane/crops)
- fermentation releases carbon dioxide
- production plants cause visual pollution
- pollution from the transportation of sugar cane / Ethanol
- growing sugar cane / plants uses a lot of land

2

[9]

Q19.

(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 <u>only</u>

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

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(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]

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Q20.

(a) (i) wood

1

(ii) 30 (kJ)

1

(iii) 3 / three (g)

1

(b) carbon / C

or hydrogen / H

or sulfur / S

allow oxygen / O

1

(c) releases most energy

accept releases a lot of energy / burns rapidly

ignore references to cost

1

no harmful gases / no or less pollution formed / no global warming / no climate change / no greenhouse gas

accept produces water (only) / steam

accept does not produce sulfur dioxide / carbon dioxide / carbon monoxide / particles / smoke

1

[6]

Q21.

(a) (i) C_2H_4

1

(ii) poly(ethene)

1

(b) (i) is not biodegradable

1

(ii) not enough landfill sites / space

*accept landfill sites are filling up **or** plastics remain for years **or** plastics not broken down*

ignore cost / waste of resources / not biodegradable / wildlife

1

(iii) recycle / burn

accept reduce the amount of packaging used

ignore reused

1

[5]

Q22.

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(a) any **two** from:

asks for cause therefore no marks for just describing the change

must link reason to a correct change in a gas

carbon dioxide has decreased due to:

accept idea of 'used' to indicate a decrease

- plants / microorganisms / bacteria / vegetation / trees
- photosynthesis

  ignore respiration
- 'locked up' in (sedimentary) rocks / carbonates / fossil <u>fuels</u>
- dissolved in oceans

  ignore volcanoes

oxygen has increased due to:

accept idea of 'given out / produced'

- plants / bacteria / microorganisms / vegetation / trees
- photosynthesis

  ignore respiration

nitrogen increased due to:

accept idea of 'given out / produced'

- ammonia reacted with oxygen
- bacteria / micro organisms

  ignore (increase in) use of fossil fuels / deforestation

2

(b) (because methane's) boiling point is greater than the average / surface temperature **or** Titan's (average / surface) temperature is below methane's boiling point

*ignore references to nitrogen **or** water*

1

any methane that evaporates will condense

accept boils for evaporates

accept cooling and produce rain for condensing

1

(c) C_nH_{2n}

1

[5]

Q23.

(a) (i) hydrogen / H and carbon / C

answers can be in either order

if letters given, must be capital H

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1

(ii) C_nH_{2n+2}

1

(b) (most) crude oil <u>vaporises / evaporates</u> **or** crude oil enters as a <u>vapour</u>

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]

Q24.

(a) (i) CH_4

allow H_4C

*do **not** allow lower-case h*

*do **not** allow superscript*

1

(ii) single

1

(iii) alkanes

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1

(b) (i) carbon / C

any order

1

hydrogen / H

allow phonetic spelling

1

sulfur / sulphur / S

1

(ii) air / atmosphere

1

(iii) acid rain

1

damages trees / plants **or** kills aquatic organisms **or** damages buildings / statues **or** causes respiratory problems

allow harmful to living things

1

(c) carbon / C

accept soot / particulates / charcoal

1

(d) any **four** from:

- (supports hypothesis) because when the fuel contained more carbon the temperature of the water went up more / faster (in 2 minutes)
- (does not support hypothesis as) temperature change per gram decreases as the number of carbons increases
- (does not support hypothesis) because the more carbon in the fuel the more smoke **or** the dirtier / sootier it is
- only tested hydrocarbons / alkanes / fuels with between 5 and 12 carbon atoms
- valid, justified, conclusion

accept converse statements

4

(e) (i) 0.15

*correct answer with or without working gains **2** marks*

*if answer incorrect, M_r carbon dioxide = 44 gains **1** mark*

*allow 0.236 / 0.24 / 0.2357142 (ecf from M_r of 28) for **1** mark*

2

(ii) 0.4(0)

1

(iii) C_3H_8

*correct formula with or without working scores **2** marks*

0.15 / 0.05 = 3

*allow ecf from **(e)(i)***

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and

0.4 / 0.05 = 8 (1)

*allow ecf from **(e)(ii)***

*allow **1** mark for correct empirical formula from their values*

If use 'fall-back-values:

0.50 / 0.05 = 10

and

0.20 / 0.05 = 4

1 mark

C_4H_{10}

1 mark

if just find ratio of C to H using fall-back values, get C_2H_5
*allow **1** mark*

2

[19]

Q25.

(a) (i) red

ignore pink

1

(ii) add silver nitrate (solution)

1

white precipitate

dependent on addition of silver nitrate

ignore addition of another acid

*if hydrochloric acid added max **1** mark*

1

(b) suitable named alkali / sodium hydroxide solution in burette

1

add alkali solution until (indicator) becomes pink / red

1

*if acid to acid titration described, first two marking points **not** available*

any **two** from:

- wash / rinse equipment
- add dropwise or slowly (near end point)
- swirl / mix
- read (meniscus) at eye level
- white background
- read start and final burette levels / calculate the volume needed
- repeat

2

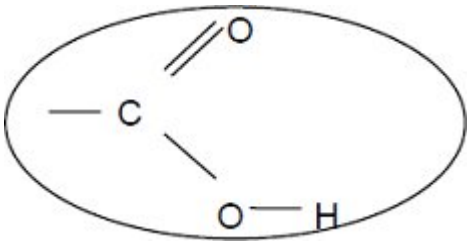
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(c) does not ionise / dissociate completely

allow <u>for acids of the same concentration</u>, weak acids have a higher pH or fewer hydrogen ions

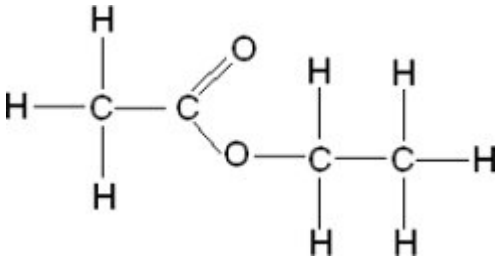
1

(d) (i) ring round COOH

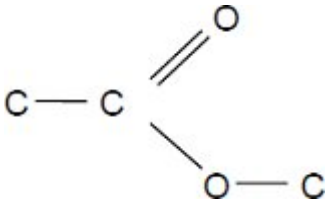


1

(ii)



*if not fully correct, allow **1** mark for correct ester group − minimum*



2

[11]

Q26.

(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) $C_3 H_8$

must be formula

*do **not** accept lower case h*

1

(iii) water

1

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(c) ethane and butane boil at temperatures less than 20°C

1

ethene and hexene each have a carbon-carbon double bond

1

[6]

Q27.

(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

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- 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]

Q28.

(a) any **one** advantage from:

- conserves resources (of crude oil / metal ores)
  ignore can be made into other items
  allow the materials (in the pen) are non-renewable
  allow less expensive than producing from the raw material
- reduces use of landfill
  ignore less waste
- less use of fuels/energy
- less carbon dioxide produced
  ignore global warming unqualified

1

any **one** disadvantage from:

- made of different polymers / alloys / materials
- difficulty / cost of separating the different materials
  allow not all the materials can be recycled

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1

(b) hard / strong / durable

1

resistant to corrosion **or** unreactive

allow do not rust

*do **not** allow corrosive*

1

(c) (i) vapours (of decane)

ignore pressure / hot / heat

allow high temperature (≥150 °C)

1

passed over a catalyst **or** porous pot **or** aluminium oxide

allow catalyst even if incorrectly named

1

or

mixed with steam (1)

at a (very) high temperature (1)

if temperature quoted, must be ≥ 500 °C

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

1

join / bond

allow addition polymerisation for second mark

1

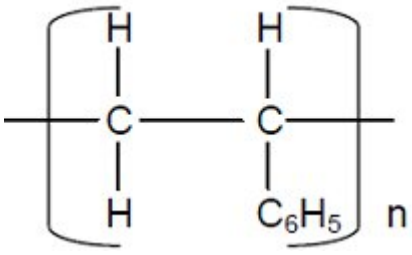
OR

monomers / ethene molecules (1)

form chains **or** very large molecules (1)

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

(d)



allow bonds that do not extend through brackets

7 single bonds are used and are in the correct places with no additional atoms (1)

the brackets and the n are in the correct place (1)

2

[10]

Q29.

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

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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

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- 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]

Q30.

(a) (i) hydrocarbons

1

(ii) ethane has the smallest molecules

1

heptadecane has the highest boiling point

1

(iii) evaporating

1

condense

1

(b) (i) **W**

1

Y

1

(ii) floats

if no answer written on line, allow correct answer indicated in the box

1

(iii) open the tap

allow let the water out

ignore remove water

1

stop the flow of liquid when the water has run out

allow until oil is left behind

ignore filter

1

[10]

Q31.

(a) (i) C_7H_{16}

mark answer line first

answer may be given in the table

1

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(ii) C_nH_{2n+2}

1

(b) (i) carbon monoxide

*do **not** accept carbon oxide*

*do **not** accept water*

ignore CO

1

(ii) because of partial / incomplete combustion (in reaction 2) **or** complete combustion (in reaction 1)

*allow because there is less / insufficient oxygen (in reaction 2) **or** sufficient oxygen (in reaction 1) allow different amounts of oxygen used (in the reactions) **or** $19O_2$ (in reaction 1) **and** $13O_2$ (in reaction 2)*

ignore air

1

(c) (i) 15 (%)

ignore units

1

(ii) water (vapour)/steam

allow H_2O / OH_2 / hydrogen oxide

1

(iii) sulfur in petrol / crude oil (reacts with oxygen)

it = sulfur dioxide

1

(ii) because nitrogen **and** oxygen (are in the air and) react

*allow nitrogen **and** oxygen burn*

*accept nitrogen + oxygen → nitrogen oxide **or** symbol equation*

ignore air

1

at high temperature (inside a petrol engine)

allow heat / hot (engine)

1

(d) because carbon dioxide / it causes global warming **or**

allow because carbon dioxide / it causes greenhouse effect / climate change

1

because carbon dioxide / it has an impact on oceans

because this carbon dioxide / carbon / it was '<u>locked up</u>' (in fossil fuels) **or**

because the percentage/amount of carbon dioxide / it in the atmosphere is <u>increasing</u>

1

[11]

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Q32.

(a) (i) $C_{11}H_{24}$

1

it does not have a (carbon carbon) double bond **or** it has only single (carbon carbon) bonds.

*linked to first mark point accept it is an alkane **or** it is (a) saturated (hydrocarbon)*

accept converse statement

1

(ii) ethene 4 x single C-H bonds

1 x double C=C bond

1

ethanol 5 x single C-H bonds

1 x single C-C bond

*if additional bonds are given on water molecule then both ethene and ethanol must be correct for **1** mark*

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 apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)
There is a simple description of advantages **and / or** disadvantages of environmental or economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane.
There is a weak or no conclusion.

Level 2 (3-4 marks)
There a clear description of advantages **and / or** disadvantages of environmental **and** economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane.
There is a conclusion based on the factors described.

Level 3 (5-6 marks)
There is a detailed description of the advantages **and / or** disadvantages of environmental **and** economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane, considering both processes.
There is a justified conclusion.

examples of the chemistry points made in the response

Sugar cane

<u>Advantage</u>

Environmental:

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- it is renewable / sustainable
- it grows absorbing CO_2 which makes it 'carbon neutral'

Economical / Social:

- growing it is labour intensive so provides (local, rural) employment
- low amount of energy / fuel needed so process costs are low
- simple / low technology process so process / investment costs are low

Disadvantage

Environmental:

- destruction of habitats / biodiversity to provide land to grow sugar cane

Economical / Social:

- land should be used to grow food (shortage / cost / population increase)
- growing or process is slow / batch / unreliable (crop failure)

Crude oil

Disadvantage

Environmental:

- it is non-renewable / will run out
- it contains 'locked up' carbon / CO_2 **or** when released increases global warming
- destruction of marine habitats caused by accidents / spillages

Economical / Social:

- process requires small number of trained workers
- high amount of energy / fuel needed so process costs are high
- complex / high tech process so process / investment costs are high

Advantage

Environmental:

- does not use land as it is offshore

Economical / Social:

- no loss of food crops
- extracting or process is fast / continuous / reliable

6

[10]

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Q33.

(a) (i) bar drawn between 84 and 86

1

(ii) sulfur dioxide linked to acid rain

1

carbon particles linked to global dimming

1

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

- plants / trees <u>absorb</u> (carbon dioxide)
- coal '<u>locks up</u>' (carbon dioxide)

1

(ii) it <u>increases</u> the amount (of CO_2)

1

because carbon in coal (forms carbon dioxide)

accept because carbon / coal burns / reacts <u>with oxygen</u> (to produce CO_2)

1

[6]

Q34.

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

<u>burning biodiesel</u> releases CO_2

ignore burning trees

1

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

allow CO_2 <u>absorbed</u> / <u>used</u> by trees

1

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

<u>increases</u> CO_2 / greenhouse effect

accept causes global warming

OR

allow causes climate change

<u>less</u> $CO_2$is absorbed (from atmosphere)

ignore other correct effects

1

because <u>burning</u> trees releases CO_2

accept <u>fewer</u> trees to absorb CO_2

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

OR

because there is <u>less</u> photosynthesis

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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]

Q35.

(a) carbon dioxide <u>decreased (by plants / trees)</u>

allow plants / trees absorbed carbon dioxide

1

oxygen <u>increased</u> (by plants / trees)

allow plants / trees released oxygen

if neither of these marks awarded

allow plants / trees

*photosynthesise for **1** mark*

1

because coal 'locks up' / traps / stores carbon dioxide / carbon

allow trees 'locked up' carbon dioxide / carbon

1

(b) carbon / C

hydrogen / H

sulfur / S

*all 3 correct **2** marks*

*1 or 2 correct **1** mark*

allow H_2

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ignore oxygen

2

(c) (i) 2 2

balancing must be correct
*do **not** accept changed formulae*

1

(ii) <u>increases atmospheric pollution</u>

carbon dioxide / CO_2 released

1

from the (thermal) decomposition of calcium carbonate **or**
*accept causes global warming **or** CO_2 is a greenhouse gas*

description of this decomposition **or** equation
ignore sulfur dioxide and effects in this part

1

<u>decreases atmospheric pollution</u>

sulfur dioxide / SO_2 is removed
accept less acid rain produced

1

by reaction with calcium oxide **or** calcium carbonate
*accept neutralisation **or** forms calcium sulfate*

1

[10]

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