AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.7.1 CARBON COMPOUNDS AS FUELS AND FEEDSTOCK (PACK 2)

SCORE	PERCENTAGE
/263	%

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Q1.

(a) 6

1

oxygen

1

(b) (i) heating the hydrocarbon to a high temperature

1

the presence of a catalyst

1

(ii) all bonds correct

four C—H bonds **and**

one C=C bond

1

(iii) water

accept hydrogen oxide/steam
allow H_2O

1

(c) (i) carbon dioxide

allow CO_2

1

(ii) by filtering/decanting/centrifuging (to remove yeast)

ignore sieving

1

(fractional) distillation (to separate ethanol from water)

accept a description of (fractional) distillation

1

[9]

Q2.

(a) (i) (1)

5

3

(6)

4

2

all numbers in the correct order gains both marks
*any two numbers in the correct position gains **1** mark*

2

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(ii) Water

ignore formula if correct name given

accept hydrogen oxide

allow H_2O

1

carbon dioxide

allow CO_2

*accept carbon monoxide / CO **or** carbon / C*

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 **basic** description of at least one advantage **or** one disadvantage caused by using plastic shopping bags made from poly(ethene)

Level 2 (3-4 marks)
There is a **clear** description of both an advantage **and** a disadvantage, caused by using plastic shopping bags made from poly(ethene).

Level 3 (5-6 marks)
There is a **detailed** description of both advantages **and** disadvantages caused by using plastic shopping bags made from poly(ethene)

examples of the chemistry/social points made in the response:
ignore cost unqualified

Advantages:

- Simple properties eg strong / low density / water resistant
- Bags can be reused (for shopping) **or** another specified use eg bin liners
- Money charged for bags can go to good causes **or** encourage reuse
- Poly(ethene) bags can be recycled eg made into milk bottle crates
- Poly(ethene) bags can be burned to provide heat for buildings/generation of electricity
- New bags are now made that can biodegrade

Disadvantages:

- (Older) bags can take many years to biodegrade
- There is a shortage of landfill space
- Bags are made from (crude) oil which is a non-renewable resource/running out

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- Large amounts of energy/fuel are used for the production of poly(ethene)
- Production of poly(ethene) releases carbon dioxide/causes global warming
- Specified issue caused by litter eg visual pollution or effect on wildlife
- Burning bags release carbon dioxide / causes global warming

6

[10]

Q3.

(a) C_2H_4

1

a correct other product **and** balanced eg C_4H_{10}

1

(b) bubbling / fizzing / frothing / effervescence

*ignore gas given off **or** solution goes cloudy*

1

(c) any **five** from the following bullet points:

allow converse for ethanol from crude oil

To gain full marks there should be both advantageous and disadvantageous issues and their importance

Advantageous issues using sugar cane:

ignore costs – unless specified
ignore safety
ignore simple/low technology process
ignore labour intensive as an advantage
linked importance

- sugar cane/plants absorb carbon dioxide / photosynthesise

  *so is carbon neutral **or** reduce global warming*

- sugar cane / plants are renewable / sustainable

  *and so save resources / oil **or** crude oil is non-renewable*

- low energy process

  *and so it saves fuel **or** / making ethanol from crude oil needs fuel for fractional distillation / cracking*

Disadvantageous issues using sugar cane:

ignore fermentation releases carbon dioxide; destruction of habitats/land to build production plants; types of pollution; waste products

- large areas of land are needed

  which leads to destruction of habitats / forest

- land could be used for food crops

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*may cause food shortages **or** increases the price of food **or** increasing world population*

- slow process

  so limits supply / production of ethanol

- ethanol is impure **or** contains 50% ethanol

  so needs further separation or ethanol from crude oil is 100% pure

- batch process

  so uses more labour

- the crop yield / supply of ethanol is unreliable

  *because growth is seasonal / weather dependent **or** possibility of crop failure*

a justified conclusion

***compensation mark,** if no other mark awarded allow one mark for two or more issues*

5

[9]

Q4.

(a) (i) hydrocarbons

accept alkanes

1

(ii) distillation

1

(b) (i) vaporising

1

(ii) cracking

1

(c) B

1

(d) (i) new plastic products are made from the used plastic bags

1

(ii) not biodegradable

accept does not decompose

allow does not rot

1

(iii) advantage – energy is released

1

disadvantage – carbon dioxide is produced

1

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[9]

Q5.

(a) (i) a reasonable attempt at a smooth curve

allow a curve which is close to but does not necessarily touch all points

1

(ii) any **two** from:

allow thicker / thinner / runny for viscous

- biodiesel is more <u>viscous</u> than petroleum diesel at all / lower temperatures
- biodiesel – as the temperature increases the <u>viscosity</u> decreases or vice versa
- petroleum diesel – the <u>viscosity</u> does not change

if no other mark awarded

*allow **1** mark for any correct conclusion based on time or rate of flow*

2

(iii) does not flow as easily (through pipes / engine)

allow could form a solid / block pipes / engine at low temperatures

or

needs a high temperature to flow

allow more difficult to vaporise / ignite

ignore burning

ignore references to viscosity

1

(b) (i) global dimming

allow correct description

1

(ii) 56 (%)

1

(iii) (increases) acid rain

1

because there is <u>more</u> nitrogen oxide(s)

ignore sulfur dioxide

if no other mark awarded

*allow **1** mark for nitrogen oxide(s) given*

1

(iv) *answer yes or no does not gain credit because the marks are for an explanation*

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ignore references to petroleum diesel
allow carbon for carbon dioxide

no

because carbon dioxide (26%) is released / produced

1

this will <u>not</u> all be absorbed by photosynthesis / growing plants for biodiesel

accept growing plants / farming uses machinery / fossil fuels releases carbon dioxide

OR

yes

because although carbon dioxide (26%) is released / produced (1)

this was absorbed by photosynthesis / growing plants (for biodiesel) (1)

allow this will be absorbed by photosynthesis / growing plants for biodiesel

1

[10]

Q6.

(a) *allow answers referring specifically to the naphtha fraction*

crude oil is <u>evaporated/vaporised</u> (by heating)

1

the vapours are <u>condensed</u> (by cooling)

1

(fractions condense) / boil at different temperatures

allow fractions have different boiling points

1

(b) any **four** from:

answer yes or no does not gain credit

ignore references to volume of milk held / number of bottles used / biodegradability / habitats / pollution / mining / dust

each marking point must be a comparison

milk bag points

- uses (75%) less **crude oil** to make (than a plastic milk bottle)

  allow eg uses 75% less

  poly(ethene) which is made from crude oil

- uses less **energy** / fuel to make (than a plastic / glass milk bottle)

- produces less **carbon dioxide** to manufacture (than a plastic / glass milk bottle)

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allow produces less greenhouse gases / causes less global warming

allow produces less CO_2 on burning

- produces less **waste** (than a plastic / glass milk bottle)

  allow takes up less landfill (space)

  allow an argued case for more waste eg milk bags are discarded / cannot be reused

- less fuel used for **transport** than glass milk bottles

- (produces waste because) milk bags are only used once whereas glass bottles can be **re-used**

  allow milk bags are discarded but glass bottles can be reused (24 / many times)

  allow glass bottles can be reused but milk bags can't

poly(ethene) points

- uses a limited **raw material** / crude oil whereas the raw materials for glass are almost unlimited

- **less** (5%) poly(ethene) is **recycled** (compared to glass (35%))

  allow (35%) glass is recycled or (5%) poly(ethene) (bottles) recycled BUT milk bags aren't / are discarded

  or

  recycled poly(ethene) is not used to make new bags whereas recycled glass is used to make new bottles

4

[7]

Q7.

(a) (i) carbon

1

hydrogen

accept in either order

ignore number eg 2 carbons

4 hydrogens

1

(ii) (a carbon carbon) double (bond)

1

(b) poly(ethene)

1

(c) any **two** from:

ignore pollution / cost / global warming / harms environment / recycling

- made from crude oil

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- non-renewable resources
  accept resources are running out
- litter
  accept go to landfill
- not biodegradable
- use energy to make
- when burned or biodegraded carbon dioxide is released
- encourage customers to reuse bags / use their own bags
  accept reduces carbon emissions / footprint

2

[6]

Q8.

(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

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- catalyst / aluminium oxide
  allow porous pot
  ignore names of other catalysts

2

[8]

Q9.

Reused

- saves raw materials / crude oil
  - *unable to reuse many times*
  - *bags easily split*
- saves energy / fuel / transport
- fewer bags needed / made
- reduces carbon / CO_2 emissions
- reduces use of landfill
- saves cost of a new bag
- no waste

1

Recycled

- saves raw materials / crude oil
  - *has to be collected / transported / washed / separated / melted*
- saves energy / use of fuel
- reduces carbon / CO_2 emissions
- reduces use of landfill
- can be used for new products
  ignore uses energy

1

Burned

- heat / energy released can be used (for heating / generating electricity)
  - *has to be collected / transported*
- reduces use of landfill
  - *wastes the resource / plastic*
  - *releases harmful gases / toxic gases / CO_2*

1

Dumped

- collected / transported with household waste

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- *wastes the resource*
- *plastic uses landfill*

- (slowly) biodegrades **or** produces methane which can be used as a fuel
  - *produces methane which is a greenhouse gas / could cause explosions*

- (not biodegradable so) does not release CO_2 / green house gas into the air
  - *not biodegradable / take years to decompose*

ignore cost / litter / waste / global warming / habitats unless mentioned above

1

[4]

Q10.

(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

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1

[7]

Q11.

(a) sulfur dioxide / SO_2

allow sulfur oxide

1

(b) global dimming

1

(c) oxygen / O_2

1

(d) (oil is a) limited resource / finite / non-renewable

*accept running out of oil **or** wood is sustainable*

*accept (burning oil) increases amount of carbon dioxide in the atmosphere / global warming **or** releases locked up carbon / global dimming / acid rain*

accept the oil (may become) too expensive

1

(e) carbon dioxide produced (from burning wood)

ignore global warming

1

carbon dioxide used by plants / trees **or** for photosynthesis

if no other mark awarded

*allow carbon emissions used by plants / trees **or** for photosynthesis for **1** mark*

1

[6]

Q12.

(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]

Q13.

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(a) (i) *if (fractional) distillation / hydrogenation mentioned as the method = max 1*

heat / high temperature / hot / vaporise

allow thermal decomposition

ignore evaporation

*do **not** accept 'burns'*

*do **not** accept temperature < 100*

1

catalyst **or** silica / alumina / porous pot

ignore other named catalyst

or steam

*allow heat (the vapour) to a very high temperature / >800°C for **2** marks*

1

(ii) C_2H_3Cl

ignore attempts to balance equation

1

(iii) single bonds between C – H, C – Cl **and** C – C

*do **not** accept symbols outside the bracket*

1

(b) (i) so that the amount of plasticiser / (sample of) PVC is the independent / only variable that affects the bending / flexibility of the samples

allow because different sizes would give different results

accept because size is a control variable

ignore references to reliability / precision etc

1

(ii) to improve the reliability (of the investigation)

accept to calculate a mean

*accept to check for anomalous results **or** to check the range of results*

ignore accuracy / precision etc

1

(iii) 23

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

if answer is incorrect

allow $\frac{22+23+24}{3}$

***or** 21 for **1** mark*

2

(iv) (PVC) sample had been stretched / used / tested in first three tests

accept higher temperature

*allow worn **or** become weaker*

ignore (human) error

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ignore more flexible / softer
ignore intermolecular forces

1

(c) does not bend (easily / much)
ignore non-biodegradable / low maintenance

or it is <u>not</u> flexible **or** it is rigid
ignore sturdy / stronger / harder

1

[10]

Q14.

(a) complete diagram with 2 carbon atoms and 5 hydrogen atoms each C–C and each C–H linked by a single line (bond)

1

(b) (i) the greater the number of (carbon) atoms (in an alkane molecule) the greater its boiling point **or** vice versa
allow as the (carbon) chain gets longer the boiling point increases
ignore melting points
*do **not** accept reference to greater number of molecules*

1

(ii) *they = hydrocarbons from the graph*
it = $C_{30}H_{62}$

any **two** from:

- low boiling point / volatile
  accept they are gases or liquids
- low viscosity
- high flammability
  accept easier to burn / ignite
- small molecules
  accept short chains
  ignore number of carbon atoms
- burn completely
  ignore speed of burning

2

(c) (i) 16 (CO_2) + 18 (H_2O)

1

(ii) (carbon dioxide in the Earth's early) atmosphere
accept from volcanoes (millions of years ago)
***or** from <u>dead</u> plants / animals*
allow dead sea creatures
ignore shells

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1

(iii) <u>increase</u> in burning / use of fossil fuels

1

locked up carbon (carbon dioxide) is released

allow carbon / carbon dioxide from millions of years ago is released

accept extra carbon dioxide is not 'absorbed' (by the carbon cycle)

1

[8]

Q15.

any **four** from:

*to gain **4** marks both pros and cons should be given*

Arguments for biodiesel

max **three** from:

- sustainable / renewable
- (carbon neutral) absorbs CO_2 when growing / during photosynthesis
- burning biodiesel produces low amounts particulates / carbon monoxide

  allow burning biodiesel produces little / low amount of global dimming

  ignore sulfur dioxide
- can use waste vegetable oils / fats (from food industry) **or** can use waste plant material
- can be used to conserve crude oil (instead of / mixed with petroleum diesel)
- produced by a low energy / temperature process

  accept produced by a low tech process
- biodegrades (easily)

  ignore engine effects

Arguments against biodiesel

max **three** from:

- creates food shortages

  accept price of food increases
- deforestation to plant more crops leads to loss of habitat / biodiversity **or** deforestation leads to a reduction in absorption of CO_2

  allow burning trees increases CO_2

  allow deforestation increases global warming

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- burning biodiesel produces high amounts of nitrogen oxides
  allow increases acid rain

- crops takes time to grow
  allow crops can fail

- vast areas of land needed to grow crops

4

conclusion supported by the argument presented, which must give added value to the points for and against given above

1

[5]

Q16.

(a) elements

1

(b) (i) nucleus

1

(ii) six

1

(c) (i) CH_4

1

(ii) bond

1

(d) (i) oxygen

1

(ii) any **one** from:

- (water) does not pollute
  accept no harmful gas(es)
  allow less pollution

- (only) water is produced

- no carbon dioxide / monoxide (is produced)
  *accept no greenhouse gas(es) / effect **or** no global warming*

1

[7]

Q17.

(a) vaporise / evaporate
  allow boil for vaporise

1

different condensing points / temperatures
  accept condense at different levels
  ignore different size molecules or different densities
  *mention of cracking = max **1***

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*allow boils at different temperatures and condenses for **2** marks*
if no other marks awarded allow
*fractional distillation for **1** mark*

1

(b) (i) 3 (C_2H_4)
accept +C_4H_8

1

(ii) (decane / naphtha / hydrocarbon) vaporise / evaporate
allow crude oil
allow boil for vaporise

1

(passed over) a catalyst / alumina / porous pot
ignore other names of catalysts

1

(c) any **two** from:
'they' must be clarified

- alkanes / butane (molecules) do not have a (carbon carbon) double bond / are saturated / have (carbon carbon) single bonds
- alkenes / ethene (molecules) have (carbon carbon) double bonds

or
are unsaturated

- alkenes / ethene molecules are able to bond to other molecules

2

(d) single bonds between carbon atoms
– C - C –

1

the -CH_3 group appears on each pair of carbons on the 'chain'
*NB any double bonds = **0** marks*

1

[9]

Q18.

(a) acid rain → sulfur dioxide

1

global warming → carbon dioxide

1

global dimming → carbon particles

1

(b) (i) oxygen

1

(ii) carbon monoxide

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1

(c) (i) decreasing

accept running out / none left

1

(ii) any **two** from:

it = coal

- world needs (more) energy
  accept population is increasing
  allow (greater) demand for coal / fuels / energy
- plentiful supply
  accept readily available
  allow coal will 'last longer'
- (many) countries have coal
- easy to find / extract
- oil / gas is running out
  accept need to use less oil / gas
  accept need to use it to replace oil / gas
- cheap **or** cheaper than oil

2

[8]

Q19.

(a) it is a mixture (of hydrocarbons) **or** contains hydrocarbons with different boiling points

*accept to separate (crude) oil (into fractions) **or** obtain the naphtha (fraction)*

accept to get useful products

ignore removal of impurities

1

(b) (i) heat / vaporise

*mention of hydrogen = max **1***

accept thermal (decomposition) for heat

allow boil

do not allow temperatures below 100°C

ignore steam

1

catalyst

allow alumina / porous pot

ignore other catalysts

1

(ii) 4 × C – H **and** C = C

ignore brackets with or without an 'n' before them

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do not allow poly(ethene)

1

(c) *ignore ideas about carbon dioxide formation / photosynthesis or cost / economics / environmentally friendly*

any **four** from:

*candidates are only awarded **1** mark if they use equivalent pairs of bulleted points*

must be at least **one** advantage and **one** disadvantage for all four marks

<u>crops</u>
advantages eg:

<u>crude oil</u>

disadvantages eg:

- renewable (resource) / sustainable
  - *non-renewable (resource) / finite / running out*
- low / less energy / fuel needed for process **or** lower temperature [ignore heat or quoted temperatures]
  - *high / more energy needed for process **or**/ higher temperature*
- can use waste plant / crop material
- carbon neutral
  - *not carbon neutral **or** releases locked up carbon*
- low safety risk (processes)
  - *high safety risk (process)*
- low technology
  - *high technology*
  - *risk of major oil spillage*
  - *can be used to make other products*

disadvantages eg:

advantages eg:

- batch process / process is slow
  - *continuous process / process is fast*
- many steps in the process
  - *few steps in the process*
- ethanol is impure / may contain water
  - *ethanol is pure*
- food shortages
  - *'conserves' food*

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- need very large areas of (arable) land to grow crops **or** can only grow in certain areas / climates
- destruction of woodland / habitat
- slow growth of crops
- labour intensive
    - *can accept reverse arguments*

4

a conclusion
with a reasoned argument based on valid advantages **and** disadvantages

there must be at least one advantage and one disadvantage, however, a matched pair, although only awarded one mark would allow the conclusion mark to be awarded

1

[9]

Q20.

(a) (i) straight line through the 'points' and extended to C_8H_{18}

*do **not** accept multiple lines*

1

(ii) 5500

range 5400 to 5600
accept ecf from their graph

1

(iii) it is a straight line graph

allow directly proportional
accept constant difference between (energy) values
accept C_5H_{12} close to values on the graph
***or** C_5H_{12} comes in middle of the graph*
ignore 'fits the pattern' unqualified
ignore 'line of best fit'
ignore 'positive correlation'

1

(iv) expected ranges for working are:

accept correct numerical answer as evidence of working

(5400 to 5600) – (2800 to 2900) = (2500 to 2800)

or

their value from (a)(ii) – a value from 2800 to 2900

or

(5400 to 5600) / their (a)(ii) divided by 2

or

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a value from 2800 to 2900 - 2

1

no / not quite / almost / yes

this mark is only awarded on evidence from their correct working

1

(b) (i) incorrect / no **or** partially correct

ignore references to hydrogen

1

bio-ethanol produces least energy

mark independently

or

bio-ethanol produces 29 kJ

1

(ii) *ignore incorrect / correct*

any **two** from:

- hydrogen produces only H_2O
  accept hydrogen does not produce harmful gases / CO_2 / SO_2
- coal produces SO_2
  allow coal causes acid rain / respiratory problems
- coal produces smoke
  allow coal causes global dimming
- both renewable and non-renewable fuels produce CO_2
  accept bio-ethanol and natural gas / coal produce CO_2 / global warming
- (both) the non-renewable fuels produce CO_2
  accept coal and natural gas produce CO_2 / global warming
- (both) renewable fuels produce no smoke
  accept hydrogen and bio-ethanol do not produce smoke / global dimming
- (both) renewable fuels produce no SO_2
  accept hydrogen and bio-ethanol
  do not produce SO_2 / acid rain

2

[9]

Q21.

(a) (i) polyethene / poly(ethene)

accept polythene / polyethylene

1

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(ii) needs heat / energy / high temperature / fuel (for cracking)

ignore other processes

1

produces carbon dioxide / CO_2

ignore use of CO_2 ***or*** *'produces carbon'*

1

(b) any **three** from:

- use water from local sources **or** water from close to home
- recycle bottles in the UK / close to home

  accept do not recycle in other countries / Asia
- (reduction in distance travelled) would reduce CO_2 emitted by transport

  accept use of transport with low / no carbon dioxide emissions
- use tap water
- use glass bottles / waxed cartons / metal bottles

  do ***not*** *accept 'do not use plastic bottles' without an alternative material*
- do not put in landfill **or** recycle <u>more</u>
- reuse / refill plastic bottles
- <u>tax</u> imported water / plastic bottles (to offset carbon cost)
- make more / all plastic bottles in UK

  answers must be about the reduction of carbon cost

3

[6]

Q22.

(a) (i) the greater the number (of carbon atoms), the higher its boiling point

do ***not*** *accept hydrocarbons for carbon atoms*

allow converse

allow melting point

1

(ii) accept answers in the range 344 to 350

1

(iii) 216

1

(b) (i) **EITHER**

shortage of petrol **or** demand for petrol is higher than supply

diesel is in excess **or** supply of diesel is higher than demand

1

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OR

petrol low supply **and** diesel high supply (1)

petrol high demand **and** diesel low demand (1)

*petrol / diesel not specified = max **1***

1

(ii) any **one** from:

- use diesel to make petrol
  *accept crack diesel **or** description of cracking*
- make diesel cheap(er) (than petrol)
  or make petrol more expensive
  accept lobby the government to reduce the tax on diesel / increase tax on petrol
- mix ethanol with petrol
  ignore biodiesel

1

[6]

Q23.

(a) (i) wood

1

(ii) 30 (kJ)

1

(iii) carbon / C

or hydrogen / H

or sulfur / S

or oxygen / O

1

(iv) 3 / three (g)

1

(b) (i) 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

(ii) any **one** from:

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- expensive
- difficult to produce
  accept large volume needed
- not available in large quantities
- explosive / dangerous
- not a natural fuel / resource
  allow will run out / non-renewable
- made from fossil fuels
- difficult to store

1

[7]

Q24.

(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 <u>years</u> **or** plastics not broken down*

ignore cost / waste of resources / not biodegradable / wildlife

1

(iii) less (crude) oil / fuels / energy used

accept (crude) <u>oil</u> is a non-renewable resource

1

[5]

Q25.

(a) (i) many ethene / molecules / monomers

accept double bonds open / break

1

join to form a long hydrocarbon / chain / large molecule

accept addition polymerisation

ignore references to ethane

*correct equation gains **2** marks*

1

(ii) (can be deformed but) return to their original shape (when heated or cooled)

ignore 'it remembers its shape'

1

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(iii) cross links / extra bonds in PEX

accept inter-molecular bonds
ignore inter-molecular forces

1

molecules / chains in PEX are held in position

accept rigid structure

1

molecules / chains in PEX unable to slide past each other / move

it = PEX throughout

1

(b) any **four** from:

- less (hydrocarbon) fuels used
  allow less energy
- less / no electrical energy used
  allow no electrolysis
- reduce carbon / carbon dioxide emissions
  allow less global warming
- reduce / no pollution by sulfur dioxide / acid rain
- continuous process
  allow less / no transportation
- conserve copper which is running out or only low-grade ores available
- reduce the amount of solid waste rock that needs to be disposed
  allow less waste
- reduce the need to dig large holes (to extract copper ores)
  allow less mining
  ignore costs / sustainability / non-renewable

4

[10]

Q26.

(a) (i) made up of one sort of atom

accept it is in the periodic table
or
has its own symbol

1

(ii) nitrogen / N / N_2 **or** oxygen / O / O_2

*do **not** accept argon **or** helium*
*do **not** accept oxide*

1

(b) (i) compound

1

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carbon

1

(ii) bond

1

[5]

Q27.

(a) (i) monomers

1

(ii) crude oil

1

(b) any **three** from:

- metal may not corrode away / remains
- plastic remains / does not break down (decay) / not affected by microorganisms
  accept non-biodegradable
- should recycle / conserve resources / mend the kettle / burn (plastic) as a fuel
  accept it is a waste of materials / resources
- landfill sites are limited / filling up
- water pollution
  *ignore harms wildlife / habitats **or** problems caused by burning the kettle*

3

[5]

Q28.

(a) any **two** from:

- naphtha has a different / low(er) boiling point
  accept different volatility
- condenses at a different temperature / height / place in the column / when it reaches it's boiling point
- different size of molecules

2

(b) (i) $C_{10}H_{22} \rightarrow C_6H_{14} + \mathbf{2}C_2H_4$
allow multiples

1

(ii) (hydrocarbon) heated / vapours

1

(passed over a) catalyst / alumina / porous pot
ignore other catalysts

1

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(iii) it / ethene is unsaturated **or** decane and hexane / they are saturated

accept decane and hexane are alkanes / C_nH_{2n+2}

***or** ethene is an alkene / C_nH_{2n}*

***or** different homologous series / general formula*

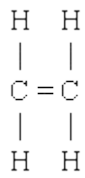
1

ethene has a double (carbon carbon) bond **or** decane and hexane have only single (carbon carbon) bonds

*accept ethene has a reactive double (carbon carbon) bond for **2** marks*

1

(c) <u>all</u> bonds drawn correctly



1

(d) **economic argument** against recycling

any **one** from:

- poly(ethene) / plastic must be collected / transported / sorted / washed
- this uses (fossil) fuels which are expensive

1

environmental argument against recycling

any **one** from:

- uses (fossil) fuels that are non-renewable / form CO_2 / CO / SO_2 / NO_x / particulates

  ignore pollution / harmful gases / etc

- washing uses / pollutes water

1

counter arguments

any **two** from:

- collect / transport alongside other waste
- use biofuels (instead of fossil)
- landfill is running out
- landfill destroys habitats
- incinerators are expensive to build
- saves raw materials / crude oil
- saves energy needed to make new plastic

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- incinerators may produce harmful substances
- incinerator ash goes to landfill
- poly(ethene) is non-biodegradable
- poly(ethene) can be made into other useful items
- more jobs / employment for people

2

[12]

Q29.

(a) (i) hydrogen

must be name

1

(ii) a line of four or more ethene molecules joined to the original two with single bonds

*at least two other ethene molecules joined to the original two in a chain gains **1** mark*

2

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

- non-biodegradable
  accept remains a long time
- landfill sites are filling up / limited
  accept land / space used up
- <u>waste of a resource</u> / could be recycled / reused
  ignore references to tablets / animals

2

(ii) any **one** from:

- (two) different polymers / plastics / materials
- need to be separated
- limited collection points / many need to be collected
- tablets may still be present

1

[6]

Q30.

(a) any **one** from:

- gasoline / petrol / it contains short(er) chains / hydrocarbons **or** small(er) molecules **or** contains few(er) carbons

  *accept fuel oil contains long(er) chain length / large(r) molecules **or** contains many carbons*

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ignore particles

- gasoline / petrol / it has weak(er) / small(er) intermolecular forces
  accept fuel oil has strong(er) / great(er) intermolecular forces

1

(b) only accept figures if used in a comparative statement

any **two** from:

- gasoline / petrol / it is in high demand
  accept fuel oil is in low demand

- gasoline / petrol / it is in short supply
  accept fuel oil is plentiful
  *accept answers such as 'gasoline / petrol / its supply is less than demand for **2** marks*
  ***or** gasoline / petrol / its percentage in crude oil is less than demand for **2** marks*

- (high) tax / duty

- cracking costs in terms of money / energy
  accept cracking expensive

2

(c) any **two** from:
ignore particles

- (fuel oil / it) heated / vaporised

- with catalyst
  accept a named catalyst
  *if first two bullet points are not awarded 'cracking' gains **1** mark*

- (to give / form / produce) short(er) chains / hydrocarbons **or** small(er) molecules **or** contains few(er) carbons
  *if wrong process named max **1** mark*

2

[5]

Q31.

(a) (i) heat / evaporate the crude oil / change to gas or vapour
*do **not** accept heat with catalyst*

1

cool / condense (hydrocarbons)
allow small molecules at top and / or large molecules at bottom

1

at different temperatures / boiling points
if the answer describes cracking ' no marks

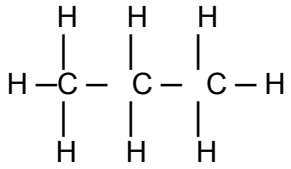
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1

(ii) C_4H_{10}

1

(b)



1

(c) (i) C_5 to C_8 fraction are fuels **or** easier to burn or petrol (fraction)

accept C_{21} to C_{24} fraction not useful as fuels

***do not** accept produce more energy*

1

(ii) C_2H_4

*do **not** accept C_4H_8*

1

(iii) any **three** from:

- use different / lighter crude oils
- develop markets for low demand fractions
- develop new techniques / equipment to use low demand fractions as fuels
- cracking
- convert low demand fractions to high demand fractions or bigger molecules to smaller molecules
- develop alternative / bio fuels

*do **not** accept price*

3

[10]

Q32.

(a) (i) poly(ethene)

accept polythene

1

(ii) cracking

1

(iii) hydrogen

1

(b) (i) bar labelled 9

1

bar drawn to correct height

1

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(ii) (boiling point) increases

1

(iii) heat / evaporate (the crude oil)

accept separate by boiling point

1

cool / condense (hydrocarbons at different temperatures)

accept smaller molecules go to top / larger molecules stay at bottom

*accept fractional distillation for two marks **or** distillation / fractionation for **one** mark*

1

(c) **yes**

any **two** from:

- because plastic does not biodegrade **or** running out of space for landfills **or** land cannot be used for a long time
- it provides heat energy
- which can be used to generate electricity / heat homes or greenhouses
- any other advantage of burning
- any other disadvantage of landfill

or

no

- burning plastic produces carbon dioxide / carbon emissions / toxic gases

accept landfill does not produce carbon dioxide / carbon emissions

- causes global warming / climate change / increase greenhouse effect / global dimming / acid rain
- any other disadvantage of burning
- any other advantage of landfill

2

[10]

Q33.

(a) hydrogen

ignore formulae

1

(b) any **two** from:

- different sized molecules / more or less (carbon) atoms (in molecules)

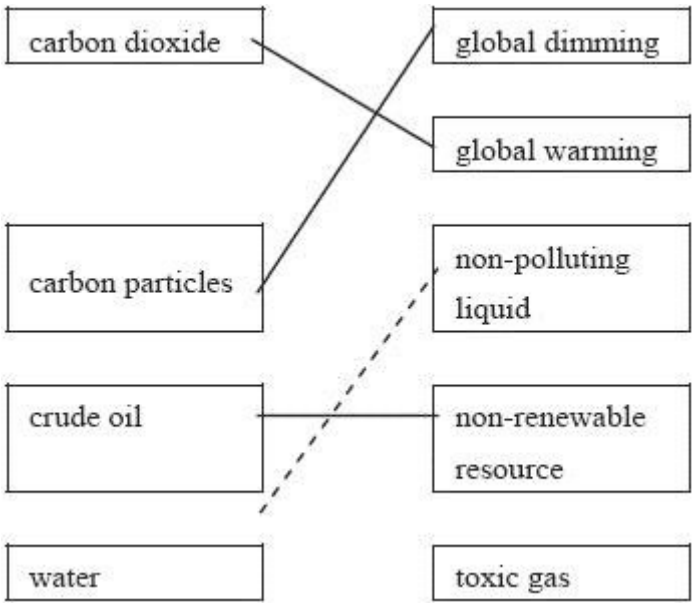
ignore different densities

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- fuels have <u>different</u> boiling points
- fuels condense at <u>different</u> temperatures

2

(c)



*all three correct = **3** marks*
*two correct = **2** marks*
*one correct = **1** mark*

3

[6]

Q34.

(a) (i) by (fractional) distillation

*accept a description of the distillation process (heat and how separation works) eg heat **and** condense*
accept boil / vapourise etc for heat

or

fractionation

1

(ii) CO_2

note the order of these products must be correct

1

H_2O

*wrong way round = **1** mark*

1

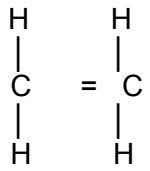
(b) (i) (hexane) has been broken down (into smaller hydrocarbons / molecules)

1

accept (thermal) decomposition / cracked / split / broken up owtte

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(ii)



accept $CH_2 = CH_2$

1

(iii) water / hydrogen oxide / steam

accept H_2O

1

(c) candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks.
if they do not then the maximum mark is three

any **four** from:

<u>advantages of using sugar</u>

- country has no wealth to buy (large quantities of) crude oil
  not 'expensive' alone
- country has limited technological development

  or

  underdeveloped / third world country
- able / suitable climate to grow sugar cane
- enough land to grow sugar cane / land cannot be used to grow food / deforestation
- sugar is a renewable source

  or

  crude oil is a non-renewable resource / finite resource / limited resources
- CO_2 / carbon neutral

<u>advantages of using alkanes:</u>

- economic costs are low
- continuous process
- country has large oil resources
- country has oil refineries / cracking plants
- very pure product
- faster process

4

[10]

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Q35.

(a) hydrocarbons

1

(b) evaporation

1

condensation

1

distillation

allow fractional distillation

1

(c) lower **and** more

1

[5]

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