Mark schemes

1

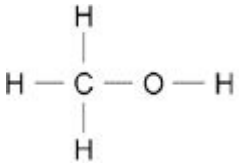
(a) Propanol

1

(b) Butanol has the highest boiling point

1

(c)



1

(d) ethene + water (→ ethanol)

allow answers in either order

allow steam for water

1

(e) goes back to reactor

allow is recycled

1

(f) air contains oxygen

1

which oxidises ethanol

allow ethanol reacted with oxygen

1

to produce ethanoic acid

1

[8]

2

(a) C_6H_{14}

1

(b) **A**

1

(c) **B**

1

(d) **C**

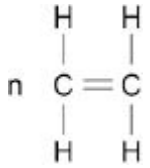
1

(e) Propanol

1

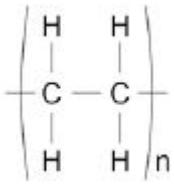
[5]

3 (a) *(ethene)*



1

(polyethene)



1

(b) any **four** from:

- poly(ethene) produced by addition polymerisation whereas polyester by condensation polymerisation
- poly(ethene) produced from one monomer wheareas polyester produced from two different monomers
- poly(ethene) produced from ethene / alkene whereas polyester from a (di)carboxylic acid and a diol / alcohol
- poly(ethene) is the only product formed whereas polyester water also produced
- poly(ethene) repeating unit is a hydrocarbon whereas polyester has an ester linkage

4

[6]

4 (a) water level above the start line
and
start line drawn in ink

allow water level too high

1

water level
food colours would dissolve into water
or
start line
the ink would 'run' on the paper

1

(b) (distance moved by **A**) 2.8cm **and** 8.2 cm (distance moved by solvent)

allow values in range 2.7 − 2.9 cm and 8.1 − 8.3 cm

1

$\frac{2.8}{8.2}$

1

0.34

allow 0.33 or 0.35

*allow ecf from incorrect measurement to final answer for **2** marks if given to 2 significant figures*

*accept 0.34 without working shown for **3** marks*

1

(c) 6.6 cm

allow values between 6.48 and 6.64 cm

1

(d) solvent moves through paper

1

different dyes have different solubilities in solvent

1

and different attractions for the paper

1

and so are carried different distances

1

(e) calcium ions

allow Ca^{2+}

1

sodium ions

allow Na^{+}

1

(f) two different colours

or

Ca^{2+} / one is orange-red and Na^{+} / the other is yellow

allow brick red for Ca^{2+} and / or orange for Na^{+}

*allow incorrect colours if consistent with answer to **7.5***

1

(so) colours mix

or

(so) one colour masks the other

1

(g) (Student **A** was incorrect)

because sodium compounds are white not green

or

because sodium carbonate is soluble

1

so can't contain sodium ions

1

(Student **B** was incorrect)

because adding acid to carbonate produces carbon dioxide

1

so must contain carbonate not chloride ions

1

[18]

5 (a) both water <u>vapour</u> and ethanol will condense

allow steam for water vapour

allow they both become liquids

allow ethane condenses at a lower temperature

allow some of the steam hasn't reacted

allow it is a reversible reaction / equilibrium

1

(b) amount will decrease

1

because the equilibrium will move to the left

1

(c) more ethanol will be produced

1

because system moves to least / fewer molecules

1

[5]

6 (a) (i) the products are at a lower energy level than the reactants

accept products have less energy / less energy at the end than the beginning

1

(ii) because a catalyst provides an alternative / different pathway / mechanism / reaction route

accept adsorption or 'increases concentration at the surface'

ignore absorption

1

(that has) <u>lower activation energy</u>

allow weakens bonds

allow idea of increased successful collisions.

DO NOT ALLOW answers stating catalysts provide energy for M1 and M2

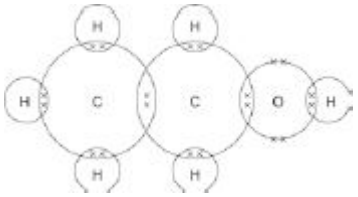
1

(b) one pair of electrons in each overlap (8 pairs in total)

allow any combination of dots, crosses or other symbols

1

the rest of the diagram correct with four non-bonding electrons on the oxygen giving a total of eight electrons in oxygen outer energy level.



*gains **2** marks*

1

(c) (i) ±3024 (J)

*correct answer with or without working gains **3** marks*

*if the answer is incorrect, award up to **2** marks for the following steps:*

- *ΔT = 14.4(°C)*
- *50 x 4.2 x 14.4*

allow ecf for incorrect ΔT

3

(ii) 0.015(2173913)

*correct answer with or without working gains **3** marks*

if answer is incorrect, allow 1 mark each for any of the following steps up to a max of 2.

- *0.70g*
- *M_r of ethanol = 46*
- *0.70 / 46*

allow ecf in final answer for arithmetical errors

3

(iii) ±198 720(J / mole)

c(i) ÷ c(ii)

*allow ecf from **(c)(i)** and **(c)(ii)***

0.015 gives 201600

0.0152 gives 198947

0.01522 gives 198686

1

(d) (as the molecules get bigger **or** the number of carbon atoms increases) the intermolecular forces

allow intermolecular bonds

1

(intermolecular forces) increase

allow more / stronger (intermolecular forces)

1

and therefore require more (heat) energy to overcome

*breaking covalent bonds or unspecified bonds max **1** mark (M3)*

1

[15]

7 (a) (i) 25 °C

1

(ii) (fractional) distillation

1

(b) (i) (fertile) land is used to grow fuel crops **or** crops are grown for fuel **or** farmers get a better price for crops for fuel **or** crops for biofuels take up space

ignore biofuels are made from food or plants

1

less food grown **or** food prices rise **or** less (fertile) land to grow food

1

(ii) (crops / plants) take in carbon dioxide (while growing / during photosynthesis)

1

so the CO_2 given out was previously taken in

*do **not** accept burning biofuels does not release CO_2 or releases less CO_2 unqualified*

*if no other mark awarded, a statement of "carbon neutral" scores **1** mark*

1

(c) 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 in the Marking Guidance and apply a 'best–fit' approach to the marking.

0 marks
No relevant content

Level 1 (1−2 marks)
At least one statement about the effect of a condition on either rate **or** yield.

Level 2 (3−4 marks)
Correct statements about the effect of at least one condition on rate **and** yield.

Level 3 (5−6 marks)
Correct statements about the effect of at least one condition on rate and yield **and** at least one correct statement about compromise conditions.

Examples of the points made in the response

Temperature
- a higher temperature gives a lower yield
- a higher temperature gives a faster rate

Pressure
- a higher pressure gives a higher yield
- increase in yield gets less as pressure increases
- a higher pressure gives a faster rate
- increase in rate increases as pressure increases

Catalyst
- using a catalyst speeds up reaction
- catalysts allow a lower temperature to be used and so save energy / reduce energy costs

Compromise
- a higher pressure gives a greater yield but increases costs / (safety) risks
- a high pressure gives a faster rate but increases costs / risks
- a high temperature makes reaction faster but reduces yield
- a catalyst makes reaction faster so a lower temperature can be used which will increase the yield

6

[12]

8 (a) oxygen

allow correct answer shown in box if answer line blank

1

(b) vinegar

allow correct answer shown in box if answer line blank

1

(c) C

1

(d) Ester

1

(e) pleasant smell

1

volatile

allow low boiling point / evaporates

1

[6]

9 (a) any **two** from:

- fuel

  allow source of energy
- solvent

  allow perfume / aftershave
- antiseptic

  allow antibacterial

2

(b) Hydrogen

1

(c) (i) oxidation

*do **not** allow redox*

1

(ii) correct structure

1

(iii) ethanoic acid is a weak / weaker acid

it = ethanoic acid

1

because it does not completely ionise.

allow because it does not completely dissociate

allow it has a lower concentration of hydrogen ions

allow converse for hydrochloric acid

*do **not** allow ionising*

1

(d) (i) ethyl ethanoate

1

(ii) acid

allow any strong acid

allow correct formulae

1

(iii) evaporates easily / quickly

allow low boiling point

*do **not** allow flammable*

1

[10]

10 (a) colourless

ignore clear

1

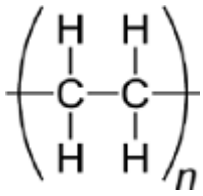
(b) (i) decomposition

1

(ii) C_8H_{18}

1

(c) (i)



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

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

2

(ii) any **two** from:

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

allow converse for poly(ethene)

2

[7]

11 (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

weaker intermolecular forces in C_8H_{18} (1)

allow intermolecular bonds

so less energy to break (1)

1

(c) add bromine water

1

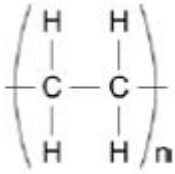
turns (from orange / yellow / red / brown) to colourless **or** decolourises

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]

12 (a) (i) alkanes **and** alkenes

any order

*allow saturated **and** unsaturated (hydrocarbons)*

1

(ii) high temperature

allow temperatures from 300 – 900 °C

allow vapours

*ignore heat / hot **or** pressure*

1

catalyst **or** steam

allow zeolite / aluminium oxide

ignore names of other catalysts

1

(iii) *oxygen* could react / *burn* with the hydrocarbons

allow oxygen could cause an explosion

1

(iv) *(fractional)* distillation

1

(b) (i) displayed structure of butene drawn

1

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

1

*form chains **or** very large molecules*

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

1

[8]

13 (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

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]

14 (a) CO_2 (+) H_2O
correct products

1

3 (O_2) **2** (CO_2) **3** (H_2O)
correct balancing

1

(b) (i) add bromine water
allow iodine

1

changes (from orange) to colourless / decolourised
ignore clear

1

(ii) octane vapours
ignore any references to butane ($C_4 H_{10}$)

1

are passed over a catalyst (to produce ethene)
ignore incorrect names of catalysts

1

OR

octane mixed with steam (1)

at a (very) high temperature (1)

for steam cracking, second mark is conditional on 'steam'

steam is added (to ethene)

ignore the formula H_2O / water

1

in the presence of a catalyst (to produce ethanol)

*if no other marks awarded then allow **1** mark for cracking of octane **or** hydration of ethene*

1

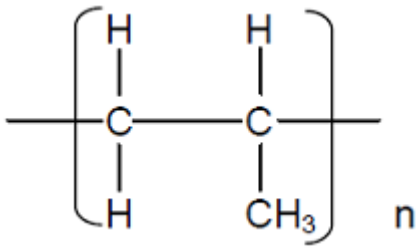
[8]

15 (a) (i) ethene

allow C_2H_4

1

(ii)



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

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

1

(b) (i) nickel

accept Ni

1

(ii) 75(%)

1

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

it = stainless steel

accept (pure) iron is soft

1

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

accept (pure) iron rusts / corrodes / reacts

*do **not** allow corrosive*

1

(c) **Advantage** : Conserves resources of crude oil and ores

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

1

Disadvantage : High cost of separating materials

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

1

[8]

16 (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

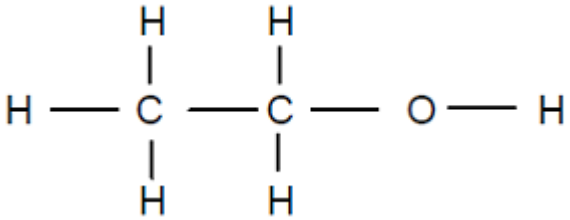
a justified conclusion that adds value

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

1

[12]

17 (a) (i)



allow other arrangements provided connectivity is correct

allow —— *OH*

1

(ii) oxygen

accept O_2

allow O

1

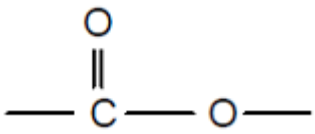
oxidation

allow oxidisation / oxidising / oxidised

allow redox

1

(b) (i) ring around



1

(ii) ester(s)

*do **not** allow ether(s)*

1

(iii) propanol

propanol accept propan-1-ol

allow propyl alcohol

1

[6]

18 (a) (i) fermentation

1

(ii) cloudy

accept milky / white

1

there is carbon dioxide / CO_2

accept calcium carbonate forms

1

allow a (white) solid / precipitate forms

(b) (i) (the amount of ethanol used) increases (from 1970) to 1989

*if no year(s) or incorrect year(s) indicated then max **1***

correct year(s) only needs to be indicated once to gain full marks

accept values in range 1987-1992

1

then it decreases from 1989 (to 2000)

1

(ii) any **one** from:

- Brazil had more oilfields
- cost of crude oil had decreased
- cost of ethanol / sugar (cane) had increased
- demand for ethanol / sugar (cane) had increased
- availability of ethanol / sugar (cane) had decreased

accept availability of land to grow sugar (cane) had decreased

- climate change affects growing sugar (cane)

1

[6]

19 (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:

- 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

<u>Disadvantage</u>

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]

20 (a) (iron (steel) is) strong

*allow abundant **or** easy to extract **or** cheap*
ignore other correct properties

1

(b) less dense

allow low mass

1

more abundant

accept copper is 'running out'
allow copper is more expensive
ignore other correct statements

1

(c) (i) C_2H_4

1

(ii) double bond

1

(iii) poly(ethene)

1

[6]

21 (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]

22 (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

  *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]

23 (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
- 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]

24 (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

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*
- 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]

25 (a) kills bacteria / sterilises (water)

allow kills microorganisms / microbes / germs
allow 'makes (water) safe (to drink)' ***or*** *disinfectant*
ignore cleans water ***or*** *removes impurities / bacteria*

1

(b) goes colourless / decolourised (from red / red-brown / brown / yellow / orange)

allow colour disappears
ignore 'goes clear' ***or*** *discoloured*
do ***not*** *accept incorrect initial colour*
do ***not*** *accept precipitate*

1

(c) (i) Br_2 **and** $2Cl^-$

allow multiples / fractions if whole equation balanced

1

(ii) changes to red / red-brown / brown / yellow / orange

do ***not*** *accept effervescence / fizzing / precipitate / gas given off*
ignore vapour / temperature changes / ignore initial colour

1

(d) (i) 7 <u>outer</u> electrons **or**

same number of <u>outer</u> electrons

allow last / final shell for outer
allow energy level / orbit / ring for shell
allow 'need to gain 1 e^- to have a full outer shell'
ignore 'similar number of outer electrons'

1

(ii) bromine / it (atom) is bigger **or**

must be a comparison

outer electrons (level / shell) further from nucleus **or** more shells

*do **not** accept more outer shells*
ignore more electrons

forces / attractions are weaker **or** more shielding **or** attracts less

*do **not** accept magnetic / gravitational / intermolecular forces*
allow 'electron(s) attracted less easily'

electron(s) gained less easily

*"outer / last / final" must be mentioned once, otherwise max **2** marks.*
accept converse for chlorine throughout where clearly stated

3

(e) (i) white precipitate **or** white solid

ignore names of chemicals

1

(ii) cream precipitate **or** cream solid

allow pale yellow / off-white precipitate / solid
ignore names of chemicals

1

[10]

26 (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

(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*

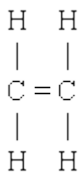
1

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) all 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
- 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]

27 (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 <u>decreased</u> due to:

accept idea of 'used' to indicate a decrease

- plants / micro organisms / bacteria / vegetation / trees
- photosynthesis

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

  ignore volcanoes

oxygen has <u>increased</u> due to:

accept idea of 'given out / produced'

- plants / bacteria / micro organisms / vegetation / trees
- photosynthesis

  ignore respiration

nitrogen <u>increased</u> 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

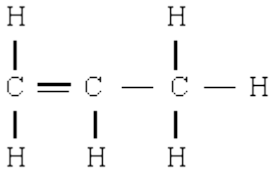
any methane that evaporates will condense

accept boils for evaporates

accept cooling and produce rain for condensing

1

(c) (i)



bonds must be displayed correctly

ignore bond angles

1

(ii) poly(propene) / polypropene / polypropylene

*do **not** allow polypropane*

any **two** from:

- double bonds open up / break / become single(*)
- propene molecules / monomers / they join / undergo addition polymerisation(*)

1

- form chains / long molecules(*)

*(*)correct chemical equation gains **2** marks*

ignore large

*using monomer incorrectly max **2** marks*

2

[8]

28 (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*

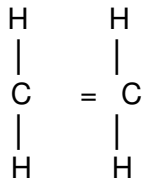
1

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

1

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

(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]

29

(a) not broken down by microorganisms **or** not bio-degradable

accept alternative answers such as:
do not rot / corrode / fade / react with atmosphere etc
any answers which imply the inertness or non-biodegradability of this plastic
accept they don't react, they are 'inert'
ignore rusting
*do **not** accept weathering*

1

(b) (i) (have a) double bond **or** do not have maximum number of (hydrogen) atoms attached

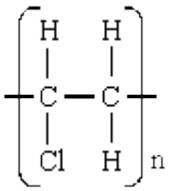
accept can add / react with hydrogen
accept can take part addition reactions
*do **not** accept it is a double bond*
*do **not** accept additional reactions*
*do **not** accept has 'spare' / 'free' bond*
*do **not** accept alkene alone*

1

(ii) single bond between carbon atoms

1

all atoms correct + 2 'linking' bonds
(linking bonds need not go through bracket)



1

n moved to bottom right of bracket i.e. is below $\frac{1}{2}$ way on the right

first 2 marks are possible for chain structures
accept $[– CHCl–CH_2–]_n$

1

(iii) many molecules **or** many monomers

1

joined / bonded / linked **or** form long chain molecules / large molecules **or** to form a long chain polymer

*accept many alkenes **or** many (ethene) molecules*
*do **not** accept many ethene alone etc.*
to form a long polymer is not enough for 2nd mark

1

(iv) no other substances formed
(A + B → C)

allow because double bond breaks so other atoms can add
allow one product only
*do **not** accept saturation occurs*

1

[8]

30 (a) (i) by heating

pressure is neutral

using a catalyst/pot/ceramic/porcelain/aluminium oxide

1

(ii) use bromine water/(alkaline) permanganate

accept bromine

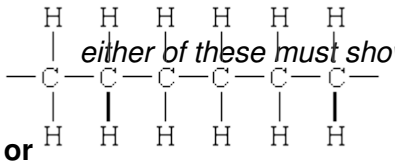
1

alkene makes bromine go colourless or lose its colour

accept alkane does not change the red/orange colour of bromine
***not** change colour/goes clear*

1

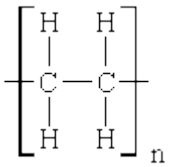
(b) (i)



either of these must show bonds at end

1

or



***not** H on ends*
*allow 3 instead of n **not** any other number*

(ii) poly(ethene) – brackets not essential

accept polythene

1

(iii) **large amount** of waste polymer/poly(ethene)/polythene/litter

*accept large amount of crude oil **or** finite resource used*

1

it is not biodegradable

accept it does not

decompose/decay/break down

it causes pollution/it creates toxic

fumes when burnt are neutral

***not** it is not recyclable*

2

[8]

31 air/gases
oxygen O_2
chemical change/reaction
gases
carbon dioxide/CO_2
water [vapour] H_2O
(heat or heat energy or energy)

for 1 mark each

[7]

32 (a) fuels
heat – allow light

for 1 mark each

2

(b) gases

for 1 mark

1

[3]