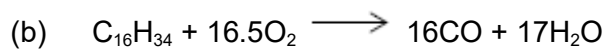


M1.(a) Saturated – single bonds only / no double bonds

1

Hydrocarbon – contains carbon and hydrogen (atoms) only

1



Allow multiples

1

(c) (On combustion) SO_2 produced

Allow equation to produce SO_2 . Ignore sulfur oxides.

1

Which causes acid rain

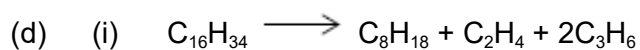
If formula shown it must be correct

M2 is dependent on M1. But if M1 is sulfur oxides, allow M2.

For M2 allow consequence of acid rain or SO_2 .

Ignore greenhouse effect and toxic

1



Allow multiples

1

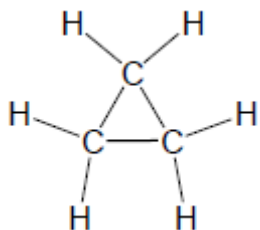
(ii) polypropene / propan(-1 or 2-)ol / propane(-1,2-)diol / isopropanol /
propanone / propanal

Accept alternative names

Ignore plastic and polymer

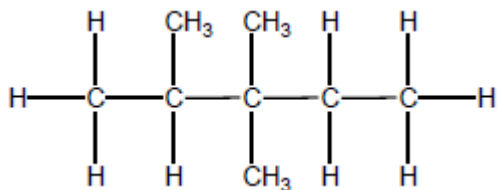
1

(iii)



1

(e)



Allow any unambiguous representation

1

(f) 2,4-dichloro-2,4-dimethylhexane

Only but ignore punctuation

1

[10]

M2.(a) Crude oil **OR** petroleum

Not petrol.

1

Fractional distillation / fractionation

Not distillation alone.

1

(b) $C_{12}H_{26} + 12.5O_2 \longrightarrow 12CO + 13H_2O$

Allow balanced equations that produce CO_2 in addition to CO .

Accept multiples.

1

- (c) (i) M1 Nitrogen and oxygen (from air) react / combine / allow a correct equation

If nitrogen from petrol / paraffin / impurities CE = 0 / 2.

1

M2 at high temperatures

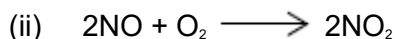
Allow temperatures above 1000 °C or spark.

Not just heat or hot.

M2 dependent on M1.

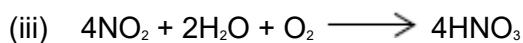
But allow 1 mark for nitrogen and oxygen together at high temperatures.

1



Allow multiples.

1

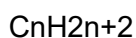


Allow multiples.

1

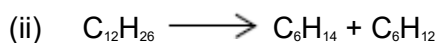


Allow $\text{C}_x\text{H}_{2x+2}$



Allow $\text{C}_x\text{H}_{2x+2}$

1



Only.

1



Only.

1

Zeolite / aluminosilicate(s)

Ignore aluminium oxide.

1

- (iii) Larger molecule / longer carbon chain / more electrons / larger surface area

1

More / stronger van der Waals' forces between molecules

Allow dispersion forces / London forces / temporary induced dipole-dipole forces between molecules.

If breaking bonds, CE = 0 / 2.

1

- (e) 2,2,3,3,4,4-hexamethylhexane

Only.

Ignore punctuation.

1

Chain

Ignore branch(ed).

1

- (f) Cl₂

Only.

Cl-Cl

Not CL₂ or Cl2 or CL2 or Cl² or CL².

Ignore Chlorine.

1

[16]

- M3.** (a) (i) fractional distillation or fractionation

1

- (ii) C₉H₂₀ only

1

- (iii) C₁₁H₂₄ + 17O₂ → 11CO₂ + 12H₂O

1

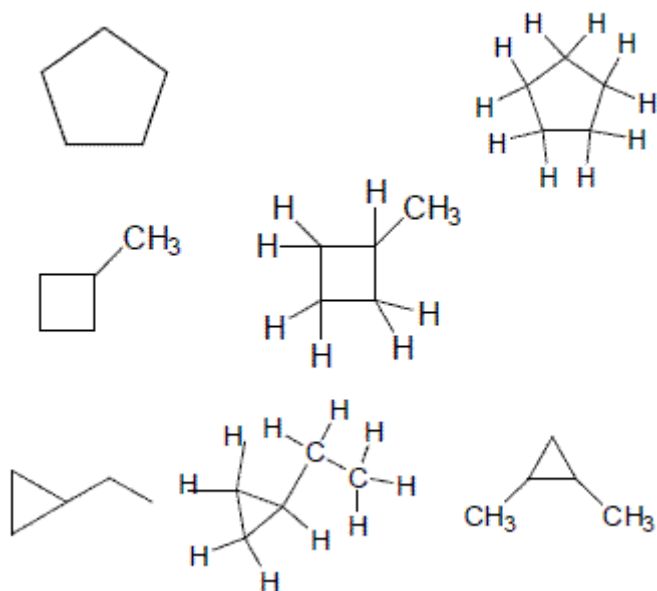
- (iv) $C_{11}H_{24} + 6O_2 \rightarrow 11C + 12H_2O$ 1
- (b) (i) $C_{10}H_{22} \rightarrow C_3H_6 + C_7H_{16}$ 1
- (ii) correctly drawn structure of methylpropene
(insist on clearly drawn C-C and C=C bonds) 1
- (c) Any two from
- o chemically similar or chemically the same or react in the same way
 - o same functional group
 - o same general formula
 - o differ by CH_2
(penalise same molecular formula or same empirical formula) 2
- M4.** (a) (Different) boiling points
Ignore mp's, references to imf, different volatilities 1
- (b) (i) Compound which have the same molecular formula
*Accept same no and type of atom for M1
But If same (chemical) formula M1 = 0 but allow M2
If empirical formula CE = 0/2* 1
- but different structures/different structural formulae/different displayed formulae
M2 dependent on M1 1

[8]

- (ii) 3-methylbut-1-ene
only
ignore commas and hyphens

1

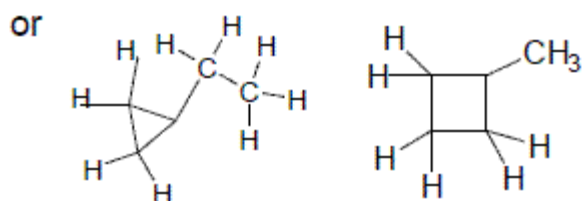
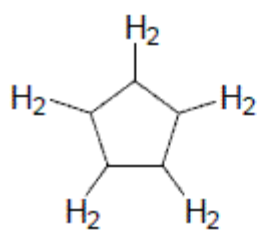
(iii)



Allow any correct structure with a cyclic alkane

1

Do not allow



i.e with an H missing on one C

(c) $C_{13}H_{28}$

only

1

Making plastics/used to make polymers or polythene/used to make antifreeze/make ethanol/ripening fruit/any named additional polymer

not used as a plastic/polymer/antifreeze

not just 'polymers' – we need to see that they are being made

1

[6]

M5.(a) Fractional distillation / fractionation / GLC / gas liquid chromatography

1

(b) C_4H_{10}

Need C_4H_{10} and the reason for the mark

Because it has a higher bp / has stronger IMF / larger molecule / longer chain / larger surface (area)

1

(c) $C_4H_{10} + 6\frac{1}{2} O_2 \longrightarrow 4CO_2 + 5H_2O$

Accept multiples

Ignore state symbols

1

(d) CO_2 or H_2O evolved is a greenhouse gas / CO_2 or H_2O evolved contribute to global warming / the products are greenhouse gases

Ignore climate change

1

(e) $CH_3CH_2CH_2CH_3 + 3.5O_2 \longrightarrow C_2H_2(CO)_2O + 4H_2O$

Accept multiples

Allow with or without a number 1 before the organic molecules

1

(f) (i) $C_2H_5SH + 4.5O_2 \longrightarrow 2CO_2 + 3H_2O + SO_2$
Accept multiples 1

(ii) Calcium oxide / calcium carbonate
Allow any base or alkali
Allow correct formulae 1

Neutralises the SO_2 / acid base reaction / it is a base
Can only score M2 if base or alkali used in M1
Allow M2 if blank in M1 1

(iii) Ethanol contains hydrogen bonding
Breaking covalent bonds CE = 0 / 2

Which is stronger than IMF (VDW / dipole-dipole forces) in ethanethiol / (H bonding) is the strongest IMF
Only award M2 if M1 given, but allow IMF in ethanol are stronger than in ethanethiol for maximum 1 mark 1

(g) (i) (2,2-)dimethylpropane
Ignore punctuation 1

(ii) Because molecule is smaller / less polarisable / has less surface (area) / is more spherical / molecules can't get as close to one another (to feel the vdW forces)
Allow converse answers referring to straight chain isomers
CE = 0 / 2 if breaking bonds 1

vdW intermolecular forces or vdW force between molecules are weaker or fewer
Need vdW rather than just IMF

1

(iii) 1 or one

1

(h) (i) C_9H_{20}
 $H_{20}C_9$

1

(ii) Thermal (cracking)

If not thermal cracking CE = 0 / 2

1

High pressure AND high temperature

If blank mark on

Allow high P and T

1

OR

Pressure of ≥ 10 atm, ≥ 1 MPa ≥ 1000 kPa

AND temp of $400\text{ }^\circ\text{C} \leq T \leq 1000\text{ }^\circ\text{C}$ or $650\text{ K} \leq T \leq 1300\text{ K}$

Do not allow high heat

If no units for T, then range must be 650 – 1000

1

[17]