

M1.D

[1]

- M2.(a) (i) (Compounds with the) same molecular formula
Allow same number and type of atom for M1
Ignore same general formula.

1

But different structural formula / different displayed formula / different structures / different skeletal formula

M2 dependent on M1

Not different positions of atoms / bonds in space.

1

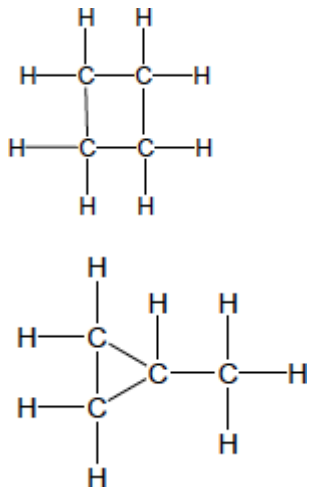
- (ii) But-2-ene
Allow but-2-ene.
Allow but 2 ene.
Ignore punctuation.

1

- (iii) (2)-methylprop-(1)-ene
Do not allow 2-methyleprop-1-ene.

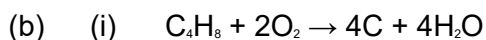
1

- (iv)



*Do not allow skeletal formulae.
Penalise missing H and missing C*

1



Accept multiples.

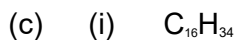
1

- (ii) Exacerbates asthma / breathing problems / damages lungs / smog / smoke / global dimming

Ignore toxic / pollutant / soot / carcinogen.

Do not allow greenhouse effect / global warming / acid rain / ozone.

1



Allow $H_{34}C_{16}$

C and H must be upper case.

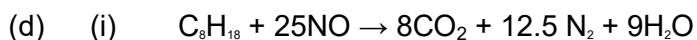
1

- (ii) Jet fuel / diesel / (motor) fuel / lubricant / petrochemicals / kerosene / paraffin / central heating fuel / fuel oil

Ignore oil alone.

Not petrol / bitumen / wax / LPG / camping fuel.

1



Accept multiples.

(ii) Ir / iridium

OR

Pt / platinum

OR

Pd / palladium

OR

Rh / rhodium

1

[11]

M3.(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

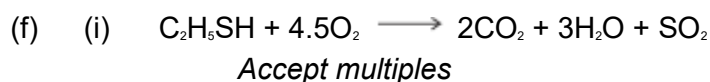
1

(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



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 $\geq 10 \text{ atm}$, $\geq 1 \text{ MPa}$ $\geq 1000 \text{ kPa}$

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]

M4.(a) Saturated – single bonds only / no double bonds

1

Hydrocarbon – contains carbon and hydrogen (atoms) only

1

(b) $C_{16}H_{34} + 16.5O_2 \longrightarrow 16CO + 17H_2O$

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

- (d) (i)
- $\text{C}_{16}\text{H}_{34} \longrightarrow \text{C}_8\text{H}_{18} + \text{C}_2\text{H}_4 + 2\text{C}_3\text{H}_6$

Allow multiples

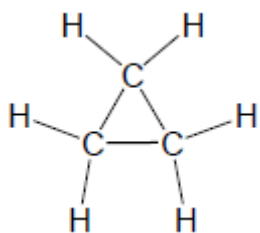
1

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

*Accept alternative names**Ignore plastic and polymer*

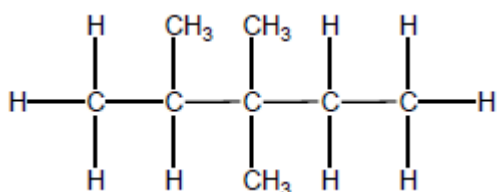
1

- (iii)



1

- (e)

*Allow any unambiguous representation*

1

- (f) 2,4-dichloro-2,4-dimethylhexane
Only but ignore punctuation

1

[10]

M5.(a) Crude oil **OR** petroleum

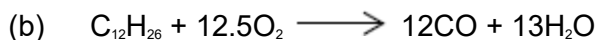
Not petrol.

1

Fractional distillation / fractionation

Not distillation alone.

1



Allow balanced equations that produce CO₂ 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

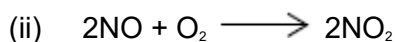
Allow temperatures above 1000 °C or spark.

Not just heat or hot.

M2 dependent on M1.

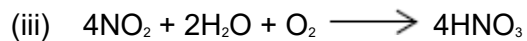
But allow 1 mark for nitrogen and oxygen together at high temperatures.

1



Allow multiples.

1

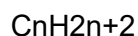


Allow multiples.

1

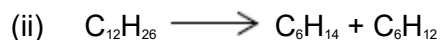


Allow $\text{C}_x\text{H}_{2x+2}$



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]