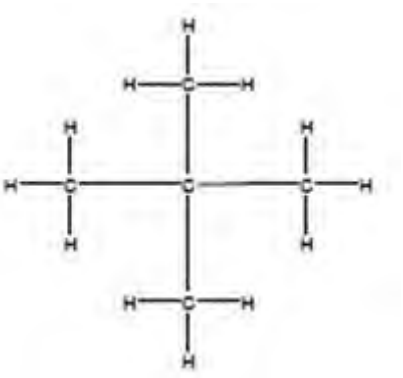
M1. (a) $C_n H_{2n+2}$

Allow x in place of n

1

(b)



Chain

Must show every bond

Allow branched chain

2

(c) C_9H_{20}

Only

1

To break the (C-C and/or C-H) bonds

M2=0 if break C=C

1

To make products which are in greater demand / higher value / make alkenes

Not more useful products

Allow specific answers relating to question

1

(d) $C_5H_{12} + 3O_2 \rightarrow 5C + 6H_2O$

Allow other balanced equations which give C and CO/CO_2

1

Causes global dimming / exacerbates asthma / causes breathing problems / makes visibility poor / smog

Apply list principle

Ignore causes cancer / toxic

1

(e) $\frac{106.5}{143}$ (x 100)

1

74.48%

Allow 74.5%

1

3

Only

1

(f) 2,3-dichloro-3-methylpentane

Ignore punctuation

1

C_3H_6Cl

Only

1

[13]

M2. (a) (i) single (C-C) bonds only/no double (C=C) bonds

1

Allow all carbon atoms bonded to four other atoms
Single C-H bonds only = 0
C=H CE

C and H (atoms) only/purely/solely/entirely

Not consists or comprises
Not completely filled with hydrogen
CH molecules = CE
Element containing C and H = CE

1

(ii) C_nH_{2n+2}

Formula only

C_xH_{2x+2}

1

(b) (i) $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

Accept multiples
Ignore state symbols

1

(ii) gases produced are greenhouse gases/contribute to Global warming/effect of global warming/climate change

Allow CO_2 or water is greenhouse gas/causes global warming
Acid rain/ozone CE = 0

1

(c) carbon

Allow C
Allow soot

1

(d) (i) $C_9H_{20} \rightarrow C_5H_{12} + C_4H_8$

OR

$C_9H_{20} \rightarrow C_5H_{12} + 2C_2H_4$

Accept multiples

1

(ii) Plastics, polymers

Accept any polyalkene/haloalkanes/alcohols

1

(iii) so the bonds break ***OR*** because the bonds are strong

IMF mentioned = 0

1

(e) (i) 1,4-dibromo-1-chloropentane/1-chloro-1,4-dibromopentane

Ignore punctuation

1

(ii) Chain/position/positional

Not structural or branched alone

1

[11]

M3. (a) Single bonds only /no double or multiple bonds;

1

Contains carbon and hydrogen only;

C and H only
not C and H molecules

1

Alkanes;

1

(b) (1) Fractions or hydrocarbons or compounds have different boiling points/ separation depends on bp;

Ignore mp and vdw

1

(2) bp depends on size/ M_r/ chain length;

If refer to bond breaking/cracking/ blast furnace/oxygen/air 2 max

1

(3) Temp gradient in tower or column / cooler at top of column or vice versa;

QWC

1

(4) Higher bp / larger or heavier molecules at bottom (of column) or vice versa;

Not increasing size of fraction
Not gases at top

1

(c) Large molecules or compounds or long chain hydrocarbons (broken) into smaller molecules or compounds or smaller chain hydrocarbons;

QWC

1

Zeolite or aluminosilicate (catalyst);

1

$C_{14}H_{30} \rightarrow C_8H_{18} + C_6H_{12}$;

Only

1

Smaller chain molecules are in more demand or have higher value or vice versa;

Insufficient to say more useful/have more uses

1

(d) $C_8H_{18} + 8½\ O_2 \rightarrow 8CO + 9H_2O$;

Allow multiples

1

Rh/ Pd/Pt/Ir or in words;

Penalise contradiction of name and symbol

1

$2CO + 2NO \rightarrow 2CO_2 + N_2$ / $2CO + O_2 \rightarrow 2CO_2$;

Allow multiples

1

Greenhouse gas/ absorbs infrared radiation;

1

(e) car less powerful/ car stops/ reduced performance/ won't run smoothly/ can't accelerate;

Not incomplete combustion or bad effect on engine

Not doesn't go as far.

1

Test it (before sale) /Quality control etc;

1

(f) (compounds with) same molecular formula / same no and type of atoms;

Not atoms/elements with same molecular formula.

If same <u>chemical</u> formula, can allow M2

1

And different structure/ structural formula;

M2 consequential on M1

Allow displayed formula for M2

1

2,2,4-trimethylpentane;

Only (but allow numbers in any order)

1

[20]

M4. (a) (i) fractional distillation or fractionation

1

(ii) C_9H_{20} only

1

(iii) $C_{11}H_{24} + 17O_2 \rightarrow 11CO_2 + 12H_2O$

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

- chemically similar or chemically the same or react in the same way
- same functional group
- same general formula
- differ by CH_2

(penalise same molecular formula or same empirical formula)

2

[8]