

- M1.** (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*/ 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;

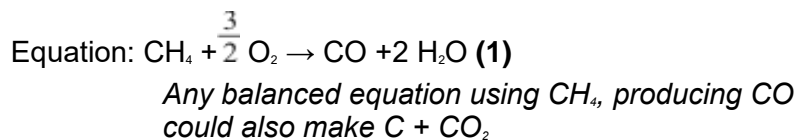
- Insufficient to say more useful/have more uses* 1
- (d) $C_8H_{18} + 8\frac{1}{2} O_2 \rightarrow 8CO + 9H_2O;$
Allow multiples 1
- Rh/ Pd/Pt/Ir or in words;
Penalise contradiction of name and symbol 1
- $2CO + 2NO \rightarrow 2CO_2 + N_2 / 2CO + O_2 \rightarrow 2CO_2;$
Allow multiples 1
- Greenhouse 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 chemical 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]

- M2.** (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
- 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

[8]

- M3.** (i) $C_{15}H_{32} + 23 O_2 \rightarrow 15 CO_2 + 16 H_2O$
Products (1)
Balance (1)
If wrong reactant C.E
- (ii) Identity of product: CO or carbon monoxide **(1)**



[4]

- M4.** (a) A catalyst in the same phase/phase as the reactants 1
- (b) (i) A reaction in which a product acts as a catalyst 1
- (ii) Mn^{2+} or Mn^{3+}
"Self-catalysing" not allowed 1
- (c) (i) $2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$
 or $4\text{CO} + 2\text{NO}_2 \rightarrow 4\text{CO}_2 + \text{N}_2$
C not allowed as a product 1
- Reducing agent CO 1
- (ii) Pt, Pd or Rh 1
- Deposited on a ceramic honeycomb or matrix or mesh or sponge 1
- To increase surface area of catalyst 1
- (d) (i) Reactants cannot move on surface or products not desorbed or
 Active sites blocked 1
- (ii) Reactants not brought together or
 No increase in reactant concentration on catalyst surface or
 Reactants not held long enough for a reaction to occur or

Reactant bonds not weakened

1

[10]

- M5.**
- (a) (i) Prevents release of toxic CO
More energy efficient (releases more energy on combustion) 1
- (ii) $C_6H_{14} + 6.5O_2 \rightarrow 6CO + 7H_2O$ 1
- Suitable product eg CO or C 1
- Balanced equation 1
- (iii) Detect CO gas or C (soot or particles) in exhaust gases 1
- (b) $CH_3CH_2CH_2CH(CH_3)_2$ 1
- 2-methylpentane 1
- $CH_3CH_2CH(CH_3)CH_2CH_3$ etc 1
- (c) (i) $CH_3CH_2CH_2CH=CH_2$ 1
- (ii) Alumino silicate etc 1

(iii) Can be made into polymers (or alcohols etc)

1

(d) (i) % atom economy = mass CH_2Cl_2 /total mass
reactants = $85 \times 100/158$

1

= 53.8%

1

(ii) Because expensive chlorine is not incorporated into
desired product Raise money by selling HCl

1

[14]