

Allow multiples

Ignore state symbols in equation

1

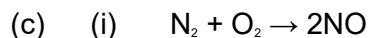
(b) Solidifies/freezes/goes viscous/waxing occurs

Allow does not vapourise/less volatile

Lack of Oxygen = 0

Apply list principle

1



Allow multiples/Ignore state symbols in equation

1

Spark/(very) high temp/2500 °C – 4000 °C

Ignore pressure/catalyst/low % of oxygen

Not just heat/hot

Apply list principle eg if high temp 150 °C = 0

1



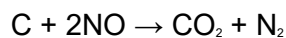
Allow multiples/Ignore state symbols in equation

OR

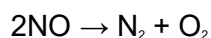


Allow other alkane reacting with NO in correctly balanced equation

OR



OR



1

Pt/Pd/Rh/Ir

Penalise contradiction of name and symbol

1

(iii) $4\text{NO}_2 + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4\text{HNO}_3$
Allow multiples/Ignore state symbols in equation 1

(d) (i) High temp/
anywhere in range 400 °C – 900 °C/
anywhere in range 670-1200K/high pressure/anywhere
in range 5000 kPa up to 8000 kPa/
Not catalyst/heat 1

(ii) $\text{C}_{16}\text{H}_{34} \rightarrow \text{C}_6\text{H}_{14} + 2\text{C}_4\text{H}_8 + \text{C}_2\text{H}_4$
Or $\text{C}_{16}\text{H}_{34} \rightarrow \text{C}_6\text{H}_{14} + \text{C}_4\text{H}_8 + 3\text{C}_2\text{H}_4$
Do not allow multiples
Ignore state symbols in equation 1

(iii) Polymers/plastics/named polymer
Allow polyesters or polyamides
Ignore object made from polymer 1

[10]

M2. (a) (i) any two from:
show a gradation/trend/gradual change in physical properties/
a specified property
differ by CH_2
chemically similar or react in the same way
have the same functional group
(penalise 'same molecular formula')
(penalise 'same empirical formula') 2

- (ii) fractional distillation or fractionation 1
- (iii) contains only single bonds or has no double bonds
(credit 'every carbon is bonded to four other atoms' provided it does not contradict by suggesting that this will always be H) 1
- (b) (i) the molecular formula gives the actual number of atoms of each element/type in a molecule/hydrocarbon/compound/formula
(penalise 'amount of atoms')
(penalise 'ratio of atoms') 1
- (ii) C₁₄H₃₀ only
(penalise as a contradiction if correct answer is accompanied by other structural formulae) 1
- (iii) C₁₀H₂₂ + 5½O₂ → 10C + 11H₂O
(or double this equation) 1
- (c) (i) ½N₂ + ½O₂ → NO
(or double this equation) 1
- (ii) Platinum or palladium or rhodium 1
- (iii) 2CO + 2NO → 2CO₂ + N₂ or
 2NO → N₂ + O₂ or
(ignore extra O₂ molecules provided the equation balances)
 C + 2NO → CO₂ + N₂
(or half of each of these equations)
 C₈H₁₈ + 25NO → 8CO₂ + 12½N₂ + 9H₂O
(or double this equation) 1

[10]

- M3.** (a) (i) Covalent;
If not covalent CE = 0.
If blank, mark on. 1
- Shared pair of electrons (one from each atom);
Not shared electrons. 1
- (ii) Hydrogen bonds / H bonds;
Not just hydrogen. 1
- Van der Waals/London/dispersion forces/temporary
induced dipole; 1
- (b) Showing all the lone pairs on both molecules;
*Allow showing both lone pairs on the O involved in the
H-bond.* 1
- Showing the partial charges on O and H on both molecules;
*Allow showing both partial charges on the O and H of the
other molecule involved in the H bond.* 1
- Showing the Hydrogen bond from the lone pair on O of one
molecule to the delta + on the H of the other molecule; 1
- (c) (i) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$;
Accept multiples.
Allow C_2H_6O . 1
- (ii) CO is (produced which is) toxic/ poisonous/C (may be produced)
which is toxic/ C is a respiratory irritant/ C (particles) exacerbate
asthma/C causes global dimming/ smog;

*Must relate to C or CO.
Any mention of SO₂ NO₂ or other pollutants CE = 0.*

1

- (iii) More fuel needed (which costs more)/Wastes fuel/
less fuel burnt (so need more to buy more)/engine gets sooty so
need to pay for engine to be cleaned/Have to fit catalytic converter;
*Not just costs more.
Not engine gets sooty unless qualified.*

1

- (d) (i) (React) with CaO/ calcium oxide/quicklime/lime;
*Accept CaCO₃/ calcium carbonate/limestone.
Not chalk.*

1

All the sulfur dioxide may not react with the CaO or CaCO₃ /
may not have time to react/ incomplete reaction;
Accept incomplete reaction.

1

- (ii) Occupies a (much) smaller volume;
Not easier to store or transport.

1

[13]

- M4.** (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 CO₂ 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]

- M5.** (a) O = 74.1% 1

$$\frac{25.9}{14} \quad \frac{74.1}{16}$$

If atomic numbers or molecular masses are used lose M2

$$\begin{array}{cc} 1.85 & 4.63 \\ 1 & 2.5 \\ \text{N}_2\text{O}_5 & \end{array}$$

*This ratio alone will not score the final mark. (It would get 2)
Allow 3 marks for N₂O₅*

- (b) Toxic/poisonous/forms an acidic gas/forms NO₂ which is acidic/
respiratory irritant/forms HNO₃ when NO reacts with water and oxygen/
triggers asthma attacks/greenhouse gas/photochemical smog/
contributes to global warming/formation of acid rain
*ignore NO is an acidic gas or NO is acidic in water
Not references to ozone layer* 1

- (c) $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
*Accept multiples or fractions of equation
Ignore wrong state symbols* 1

- (d) Nitrogen/N₂ and oxygen/O₂ combine/react
*QWC (not N and O combine)
Not nitrogen in fuel*

Allow $N_2 + O_2 \rightarrow 2NO$ for M1 only

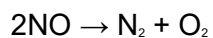
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spark/high temperature/2500-4000 °C

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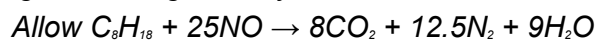


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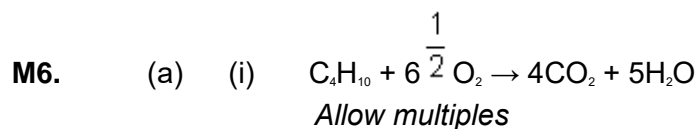
Accept multiples or fractions of equation

Ignore wrong state symbols



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[8]



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(ii) insufficient oxygen/low temperature/poor mixing of butane and air

Allow insufficient air

Allow lack of oxygen/air

Do not allow no oxygen

Not incomplete combustion

1

(b) (i) Sulfur dioxide/ SO_2
Allow sulfur trioxide/ SO_3
(allow spelling of sulphur to be sulphur)

1

(ii) It is basic/the gas (SO_2) is acidic

Idea of neutralisation
It = calcium oxide

1

(iii) bigger surface area to react
Do not allow cheaper

1

[5]