

Mark Scheme - 2.5 Hydrocarbons

1.

- (a) Boiling temperatures increase with increasing chain length / number of carbon atoms / relative mass (1)
 More carbon atoms leads to greater number of van der Waals' forces between molecules (1) [2]

- (b) (i) Mass of petroleum gases = $1.2\% \times 145,000 = 1740\text{g}$ (1)
 Moles of butane = $1740 \div 58.1 = 30\text{ mol}$ (1)
 Volume of butane = $30 \times 24 = 720\text{ dm}^3$ (1) [3]

- (ii) I. ultraviolet light [1]
 II. $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$ [1]
 III. (Propane forms) propyl radicals / $\text{C}_3\text{H}_7\cdot$ (1)
 Two $\text{C}_3\text{H}_7\cdot$ radicals combine together to make hexane (1) [2]

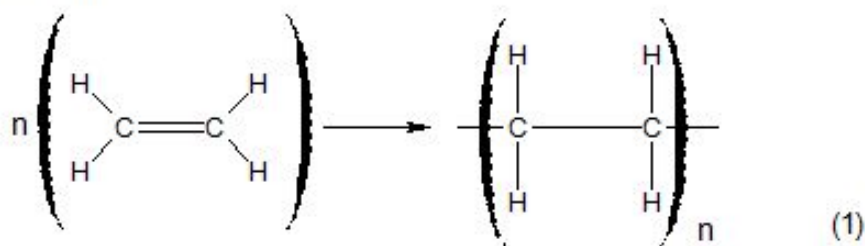
- (c) Brent crude would be better as it has more naphtha (1)

Naphtha is cracked to produce alkenes (1)

Cracking is caused by heating / zeolites / aluminosilicates / porcelain (1)

Any valid equation that produces ethene e.g. $\text{C}_{10}\text{H}_{22} \rightarrow \text{C}_2\text{H}_4 + \text{C}_8\text{H}_{18}$ (1)

Polymerisation: Many small molecules joining together to make a large molecule (1)



Addition polymerisation (1)

e.g. polystyrene, PVC, PTFE and relevant monomer (1)

MAX 6 [6]

QWC: organisation of information clearly and coherently; use of specialist vocabulary where appropriate [1]

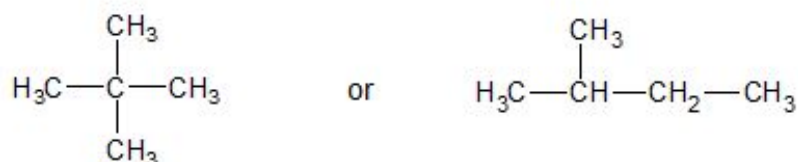
Total [16]

2. (a) (i) Petroleum is heated/evaporated (1)
Fractions condense at different temperatures / separated into fractions with different boiling temperatures (1)

[2]

- (ii) C_5H_{12} (1)

Branched chain therefore



(1)

[2]

- (b) (i) It enables more useful compounds to be made from the compound

[1]

- (ii) $C_9H_{20} \rightarrow CH_4 + C_4H_6 + C_4H_{10}$

[1]

- (c) (i) UV light

[1]

- (ii) A step during which a radical reacts and another one is formed

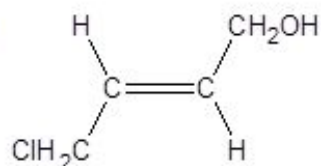
[1]

- (iii) $Cl\cdot + CH_4 \rightarrow \cdot CH_3 + HCl$



[1]

- (d) (i)



[1]

- (ii) Aqueous sodium hydroxide

[1]

- (iii) Pt / N / Pd

[1]

- (iv) Compound **E** does not contain an O—H bond (1)

This is present in Compound **D** at a frequency of 2500-3550 cm^{-1} (1)

[2]

Total [14]

3.

C

[1]

4.

(a) $C_{19}H_{40}$

[1]

(b) $C_{19}H_{40} \rightarrow C_8H_{18} + C_{11}H_{22}$ - allow ecf

[1]

5.

(a) incomplete p sub-shell/ outer electron configuration s^2p^5 / outer electrons in p subshell/ outer electrons in p orbitals/ valence electrons in p subshell/ valence electrons in p orbital [1]

(b) (i) gaining one electron completes shell/ gives p^6 / takes an electron from another species/gains an electron
- do not accept 'attracts an electron' [1]

(ii) **fluorine** because it is the smallest/ has the greatest electron affinity/ has the least shielding/ has the greatest effective nuclear charge/ oxidising power decreases as the group is descended [1]

(c) oxidation state is (+)5/ V
- do not accept '5+' [1]

(d) (i) $Cl_2 \rightarrow 2Cl^\bullet$ - ignore hf [1]

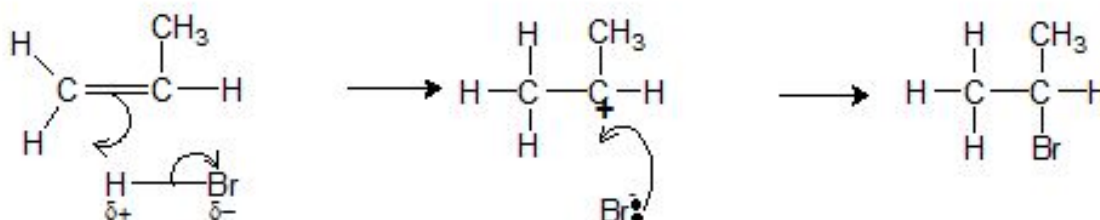
(ii) $CH_4 + Cl^\bullet \rightarrow HCl + \bullet CH_3$ (1)
 $\bullet CH_3 + Cl_2 \rightarrow CH_3Cl + Cl^\bullet$ (1) [2]

(e) products: $\bullet CFH_2$ and Cl^\bullet (1)
C-Cl bond is the weakest/ most easily broken (1) [2]

Total [9]

6.

- (a) (i) 1 mark for arrows in first diagram; 1 mark for arrow in second diagram;
1 mark for all charges



2 max if incorrect isomer given [3]

- (ii) 2-bromopropane formed from a secondary carbocation (1)
Secondary carbocations are more stable than primary carbocations (1)
[2]

- (b) Empirical formula = C_3H_5Br (1)

Molecular formula = C_3H_5Br

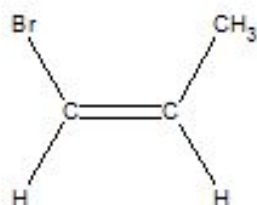
(must show use of mass spectrum to gain this mark) (1)

Two molecular ion peaks as there are two isotopes of bromine (1)

Peaks at 15 = CH_3^+ and 41 = $C_3H_5^+$ (1)

550 cm^{-1} = C-Br 1630 cm^{-1} = C=C 3030 cm^{-1} = C-H (1)

Molecule is:



(1) [6]

QWC: legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning [1]

Total [12]