Mark Scheme - AS 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% × 145, 000 = 1740g (1)
Moles of butane = 1740 ÷ 58.1 = 30 mol (1)
Volume of butane = 30 × 24 = 720 dm^3 (1) [3]

(ii) I. ultraviolet light [1]
II. $Cl_2 \rightarrow 2Cl\bullet$ [1]
III. (Propane forms) propyl radicals / $C_3H_7\bullet$ (1)
Two $C_3H_7\bullet$ radicals combine together to make hexane (1) [2]

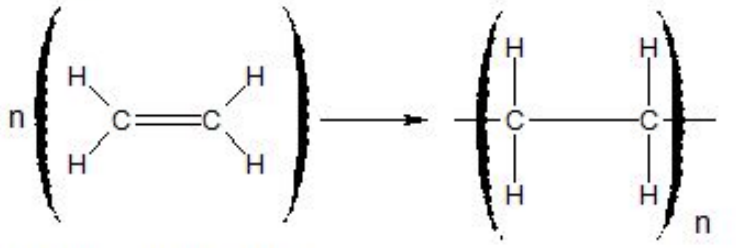
(c) Brent crude would be better as it has more naphtha (1)

Naphtha is cracked to produce alkenes (1)

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

Any valid equation that produces ethene e.g. $C_{10}H_{22} \rightarrow C_2H_4 + C_8H_{18}$ (1)

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



(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]

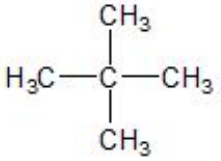
Total [16]

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

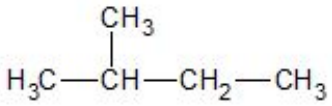
[2]

(ii) C_5H_{12} (1)

Branched chain therefore



or



(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]

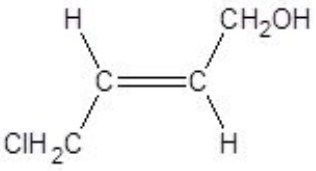
(ii) A step during which a radical reacts and another one is formed

[1]

(iii) $Cl\bullet + CH_4 \rightarrow \bullet CH_3 + HCl$

[or $\bullet CH_3 + Cl_2 \rightarrow CH_3Cl + Cl\bullet$] [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)

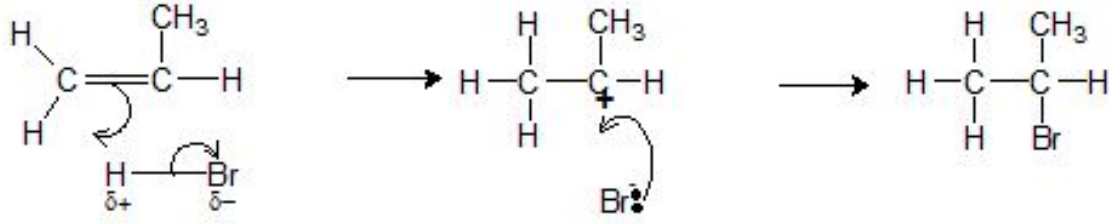
${}^{\bullet}CH_3 + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$ (1) [2]

(e) products: ${}^{\bullet}CFH_2$ and $Cl^{\bullet}$ (1)

C-Cl bond is the weakest/ **most** easily broken (1) [2]

Total [9]

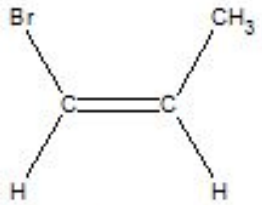
6 (a) (i) 1 mark for arrows in first diagram; 1 mark for arrow in second diagram; 1 mark for all charges



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 3030cm^{-1} = C–H (1)
Molecule is:



(1) [6]

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

Total [12]