1 **(a) (i)** $35\,cm^3$ [1]
$40\,cm^3$ [1]

(ii) forms carbon monoxide [1]

poisonous **or** toxic **or** lethal **or** prevents blood carrying oxygen
or effect on haemoglobin [1]
NOT just harmful

(b) (chlorobutane **or** butyl chloride [1]
number not required but if given must be 1, it must be in correct position

(ii) light **or** UV**or** 200°C **or** lead tetraethyl [1]

(iii) any correct equation for example 2-chlorobutane
or dichlorobutane [1]

(c) correct repeat unit [1]
COND continuation [1]
-(CH(CH_3)-CH_2)-

(ii) butan-1-ol **or** butan-2-ol **or** butanol [1]
if number given then formula must correspond for second mark and number must be in correct position

structural formula of above [1]
CH_3-CH_2-CH_2-CH_2OH **or** CH_3-CH(OH)-CH_2-CH_3
NOT C_4H_9OH
if first mark not awarded then either formula will gain mark [1]
ACCEPT either formula for "butanol"

(iii) CH_3-CH(C*l*)-CH_3 **or** CH_3-CH_2-CH_2-C*l* [1]
NOT C_3H_7Cl
response must not include HC*l*
if equation given look at RHS only

[Total: 12]

2 **(a) (i)** any correct equation **[1]**

(ii) structural formulae from but-1-ene, but-2-ene, methylpropene **or** cyclobutane Any **TWO**

(b) (light **or** 200°C **or** lead tetraethyl **[1]**

(ii) substitution **or** photochemical **or** chlorination **or** free radical or halogenation **[1]**

(iii) 1-chlorobutane, 2-chlorobutane, dichlorobutane etc. Any **TWO** **[2]**

(c) (i) $CH_3CH_2CH_2OH$ **or** $CH_3CH(OH)CH_3$ **[1]**

(ii) $CH_3CH(Br)CH_2Br$ **[1]**
NOT 1,3-dibromopropane

(d) moles of CH_3-CH = CH_2 reacted = 1.4/42 = 0.033 **[1]**
conseq
maximum moles of CH_3-CH(I)-CH_3 that could be formed = 0.033 **[1]**
conseq
maximum mass of 2-iodopropane that could be formed = 5.61 g **[1]**
accept 170 x 0.033 = 5.61 and 170 x 0.033333 = 5.67
conseq unless greater than 100%
percentage yield 4.0/5.67 x 100 = 70.5% **[1]**
Do not mark consequently to a series of small integers. There has to be a serious attempt to answer the question, then consequential marking is appropriate.

[TOTAL = 13]

3 **(a** nitrogen and oxygen react [1]
at high temperatures (in engine) [1]

(b) M1 carbon monoxide (converted to) carbon dioxide **or** $2CO + O_2 \rightarrow 2CO_2$ [1]

M2 (by) oxides of nitrogen (which are reduced to) nitrogen
or $2NO \rightarrow N_2 + O_2$ **or** $2NO_2 \rightarrow N_2 + 2O_2$ [1]

M3 hydrocarbons (burn) making water [1]

M4 products: any **two** from:
carbon dioxide, water, nitrogen [1]

(c) lead compounds are toxic **or** brain damage **or** reduce IQ or nausea or kidney failure **or** anaemia [1]

[Total: 7]

4 **(a) (i)** C and H only (1) [1]

(ii) only single bonds (1) [1]

(b) C_nH_{2n+2} (1) [1]

(ii) $C_{14}H_{30}$ (1)
$(14 \times 12) + 30 = 198$ (g) (1) [2]

(c) $C_9H_{20} + 14\ O_2 \rightarrow 9CO_2 + 10H_2O$ (2) [2]

(ii) Volume ratio

$C_xH_y(g)$	+ $O_2(g)$	→ $CO_2(g)$	+ $H_2O(l)$	
20	160	100		all in cm^3
1	8	5		mole ratio

$C_5H_{12} + 8O_2 \rightarrow 5C_2 + 6H_2O$
For evidence of method (1)
for equation as above (2) [3]

(d)

alkanes	in petrol / fuel / solvent (1)
alkenes	to make alcohols / plastics / polymers / solvents (1)
hydrogen	to make ammonia / fuel / fuel cells, etc. (1)

[3]

(ii) a correct equation for example:
$C_{10}H_{22} \rightarrow C_8H_{16} + C_2H_4 + H_2$ (1) [1]

(e) light **or** lead tetraethyl / catalyst / high temperature (1) [1]

(ii) $CH_3–CHCl–CH_3$ (1) [1]

[Total: 16]