1 **(a** biodegradable or breaks down naturally
made from a renewable source **or** does not use up petroleum

reduce visual pollution **or** reduces need for landfill sites **or** less danger to wildlife
any **TWO** [2]
ignore mention of toxic gases

(b) (i) ester [1]
accept polyester **or** fat **or** lipid **or** vegetable oil **or** carboxylic acid

(ii) acid **or** carboxylic acid **or** alkanoic acid [1]
alcohol **or** hydroxyl **or** alkanol [1]
NOT formulae **NOT** hydroxide

(iii) condensation [1]
COND because water is formed in reaction
or monomer does not have C=C bond [1]

(c) (i) lactic acid $\rightarrow$ acrylic acid + water [1]

(ii) add bromine (water) or bromine in an organic solvent [1]
remains brown/orange/yellow [1]
goes colourless **NOT** clear [1]
If mark 1 near miss e.g. bromide allow marks 2 and 3
Colour of reagent must be shown somewhere for [3] otherwise max [2]

OR acidified potassium manganate(VII)
purple/pink to colourless

OR alkaline potassium manganate(VII)
purple/pink to green
or purple/pink to brown precipitate

2 **(a) (i)** heat [1]
catalyst [1]

(ii) an equation that gives:
alkene + alkane
or alkene + alkene + hydrogen [1]

a correct and balanced equation for the cracking of decane, $C_{10}H_{22}$ but not but-1-ene [1]

(iii) water **or** steam [1]

(b) (i) $C_4H_9OH + 6O_2 \rightarrow 4CO_2 + 5H_2O$ [2
If only error is balancing the oxygen atoms [1]

(ii) butanol + methanoic acid → butyl methanoate + water [2]
correct products **or** reactants ONLY [1]

(c) (i) correct structural formulae [1] each [2]
accept either propanol and –OH in alcohol and acid
penalise once for CH_3 type diagrams
For either C_3H_8O **or** $C_3H_6O_2$ [0]

(ii) to conserve petroleum **or** reduce greenhouse effect [1]

(d) have same boiling point [1]

[Total: 13]

3 **(a) (i)** C_6H_5COOH **or** $C_6H_5CO_2H$ [1
NOT $C_7H_6O_2$ /C_6H_6COO

(ii) sodium hydroxide + benzoic acid = sodium benzoate + water [1]
correct spelling needed **NOT** benzenoate
ACCEPT correct symbol equation

(iii) sodium carbonate **or** oxide **or** hydrogencarbonate
any **TWO** [2]
NOT Na

(b) 7.7% [1]

(ii) for any number: equal number ratio [2]
for example 1:1 **or** 6:6

(iii) empirical formula is CH [1]
molecular formula is C_6H_6 [1]
no e.c.f., award of marks not dependent on **(ii)**

(c) $C_6H_8O_6$ [1]

(ii) carbon – carbon double bond **or** alkene [1]
alcohol **or** hydroxyl **or** hydroxy [1]
NOT hydroxide
hydroxide and alcohol = 0

[Total: 12]

4 **(a) (i)** heat (energy) [1]

(ii) exothermic [1]

(iii) $C_2H_5OH + 3O_2 = 2CO_2 + 3H_2O$ [2
For $CO_2 + H_2O$ **ONLY** [1]

(iv) plotting points correctly [1]
straight line [1]
between –2640 and –2700kJ/mol [1]
NOTE minus sign needed

(v) general (molecular) formula
same functional group
consecutive members differ by CH_2
similar chemical properties **or** react same way
NOT a comment about physical properties
ANY TWO [2]

(b) CH_3- CH(OH)-CH_3 [1]
NOT C_3H_7OH
propan-2-ol "2" is needed [1]
NOTE the name and the formula must correspond for both marks
accept full structural formula – all bonds shown correctly
accept formulae of the ether
NOT CH_3- CH(HO)-CH_3

(c) (i) <u>cracking</u>
heat (alkane) **or** (alkane) and catalyst
NOTE thermal cracking or catalytic cracking [2]
alkane = alkene + hydrogen
ANY TWO [2]

OR steam reforming
$CH_4 + H_2O = CO + 3H_2$ [2]
or water/steam [1]
catalyst **or** heat [1]

(ii) combustion **or** burning [1]
incomplete **or** insufficient oxygen/air [1]
OR ACCEPT steam reforming as above [2]

(iii) high pressure [1]
COND forward reaction volume decrease
or volume of reactants greater than that of products
or fewer moles of gas on the right
or fewer gas molecules on right [1]
NOTE accept correct arguments about either reactants **or** products

(d) methyl ethanoate [1]

(ii) propanoic acid **or** propanal [1]

(iii) ethene [1]

[Total: 20]

5 **(a)(i)** boiling **[1]**

(ii) lower temperature **or**
over temperature range or no plateau **[1]**

(iii) direct continuation of E to F **[1]**

(iv) close **or** touching far apart **[2]**
fast and random **[1]**
cannot move apart can move apart **[2]**

(b)(i) calcium ethanoate + hydrogen **[1]**

(ii) zinc oxide **or** hydroxide **[1]**

(c) $CH_3COOH + NaOH \rightleftharpoons CH_3COONa + H_2O$ **[2]**
reactants **[1]** products **[1]**

TOTAL = 12