1 **(a) (i)** hydrogen (atoms) replaced by (atoms) of a different element e.g. chlorine [1]
NOT: substitute

(ii) light required [1]

(b) exothermic reaction gives out energy [1]
endothermic reaction absorbs
takes in energy [1]

(c)

bonds broken	energy
C-	+412
C*l*-C*l*	+242
total energy	+654

[1]

bonds formed	energy
C-C*l*	–338
H-C*l*	–431
total energy	–769

[1]
energy change –115 [1]
negative sign indicates exothermic [1]

[Total: 8]

2 **(a)** $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ / $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$ [2]

marks are for correct reactants [1] correct products [1]
If ionic equation is given don't penalise SO_4^{2} spectator ions on both sides

(b) (exothermic because) a cell produces (electrical) energy/electricity [1]

the next two marks score for

electrons are lost **AND** gained / oxidation no. or state/valency **both** increases and decreases / two correct half equations i.e. $Zn \rightarrow Zn^{2+} + 2e$ and $2H^+ + 2e \rightarrow H_2$ [2]

(c) zinc [1]
cond it is the more reactive metal / it supplies electrons / it forms ions more readily than iron [1]

(d) replace zinc with magnesium
replace iron with copper
use (more) concentrated sulfuric acid
accept use a more concentrated acid / a more concentrated solution

any **two** [2]

3 **(a) (i)** any Group 1 metal [1]
accept: LiOH

(ii) $Cu(OH)_2 \rightarrow CuO + H_2O$ [2
note: products only = 1

(iii) reactivity of metals / metals have different reactivities [1]

(b) (i) zinc oxide, nitrogen dioxide, oxygen [2]
note: two correct = 1

(ii) $2KNO_3 \rightarrow 2KNO_2 + O_2$ [2]
note: unbalanced = 1, correct word equation = 1

(c) calculation:
M_r for $NaHCO_3$ = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g
M_r for Na_2CO_3 = 106 g

(i) number of moles of $NaHCO_3$ used = 3.36/84 = 0.04 [1]

(ii) if residue is Na_2O, number of moles of Na_2O = 2.12/62
=0.034 / 0.03

if residue is NaOH, number of moles of NaOH = 2.12/40
= 0.053 / 0.05

if reside is Na_2CO_3, number of moles of Na_2CO_3 = 2.12/106 =0.02 all three correct [2]
note: two correct = 1

(iii) equation 3 [1]
mole ratio 2:1 agrees with equation [1]

4 **(a** fractional [1]
distillation [1]

(b) (i) O=O / oxygen(–)oxygen / H–H / hydrogen(–)hydrogen [1]

(ii) O-H / oxygen(–)hydrogen / OH / bond between hydrogen and oxygen [1]
not H-O-H

(iii) endothermic. [1]

(c) (i) no pollution / no CO / no CO_2 / no oxides of nitrogen / only produces steam or water / no greenhouse gases / no global warming [1]
does not use up fossil fuels / water is not a finite resource / water is a renewable source of energy / hydrogen is renewable / available from electrolysis of water [1]

(ii) obtaining hydrogen from water requires fossil fuels / storage problems / transport problems / limited range of vehicles available / gaseous nature means only produces small amount of energy per unit volume / methane as a source of steam reforming is finite / lack of distribution network [1]
not expensive / anything regarding safety / flammability / explosiveness

5 **(a** (total endothermic change = 436 + 242 = +)678 kJ [1]
(total exothermic change = 2 × 431 = –)862 kJ [1]
accept correct sign/supplied/absorbed for endo etc.
accept correct sign/evolved/produced for exo etc.
change for reaction = –184 kJ [1]

not necessary to calculate –184, just show that exo change > than endo
ecf allowed provided negative
–184 kJ scores all 3 mark

(b) because it accepts a proton [2]
accepts hydrogen ion **or** H^+ **ONLY** [1]
proton and H^+ [2]

(ii) hydrogen chloride is a strong acid [1]
hydrogen fluoride is a weak acid [1]
weaker **or** stronger correctly applied for [2]

(iii) hydrogen chloride (aqueous) would have lower pH [1]
OR hydrogen fluoride (aqueous) would have higher pH
If values suggested, not over 7

[Total: 8]

6 (a) (fine powder) large surface area [1]
high/faster/collision rate/more collisions/fast collisions
(between solid and oxygen in air) [1]

(ii) carbohydrate + oxygen → carbon dioxide + water [1]
ACCEPT flour

(b) rate depends on light
more light more silver **or** blacker
thicker card less light [3]

(c) (i) biological catalyst [1]
accept protein catalyst

(ii) production of energy (from food) [1]
by living "things" **or** by cells, etc. [1]

(iii) "kill" yeast **or** denature enzymes (due to increase in temperature) [1]

(iv) all glucose used up [1]
yeast "killed" **or** denatured **or** damaged by ethanol/alcohol [1]

(v) filter **or** centrifuge [1]
fractional distillation [1]

[Total: 14]

7 (a) (i) $Zn(OH)_2 = ZnO + H_2O$
reactant [1] products [1] **[2]**

(ii) it would melt **or** it does not decompose **or** it does not react **[1]**
NOT no change

(iii) blue (solid) **[1]**
to black (solid) **[1]**
brown gas **[1]**

Mark consequentially to any error **but not involving simple integers**
There has to be some evidence that the candidate has attempted to work through the calculation and not merely inserted whole numbers.
For example 2, 1, 160 or 1, 0.5, 80
number of moles of $Fe_2(SO_4)_3$ = 1/40 **or** 0.025
number of moles of Fe_2O_3 formed = 1/40 **or** 0.025
mass of iron(III) oxide formed = 0.025 x 160 = 4g
number of moles of SO_3 produced = 3/40 **or** 0.075
volume of sulphur trioxide at r.t.p. = 0.075 x 25
= $1.8dm^3$ **[5]**

TOTAL = 11