JABchem

Past Papers Higher Chemistry

2006

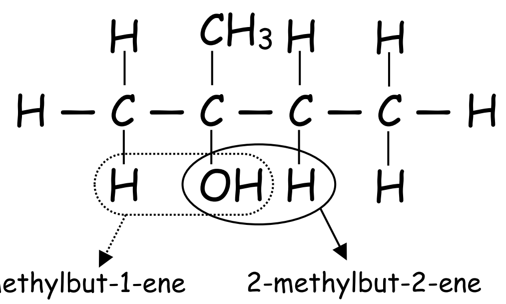
Marking Scheme

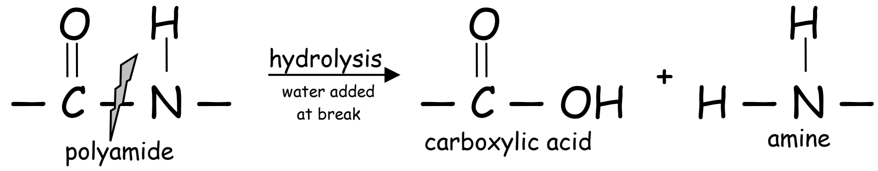
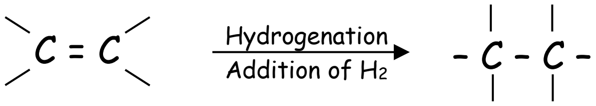
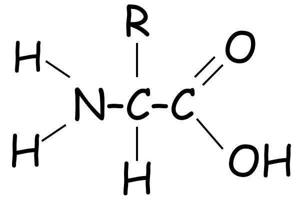
Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	78+	26.6%
B	64+	23.8%
C	50+	24.7%
D	43+	9.1%
No award	<43	15.8%

Section:	Multiple Choice	Extended Answer
Average Mark:	25.7 /40	37.3 /60

2006 Higher Chemistry Marking Scheme

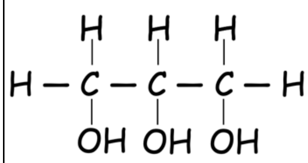
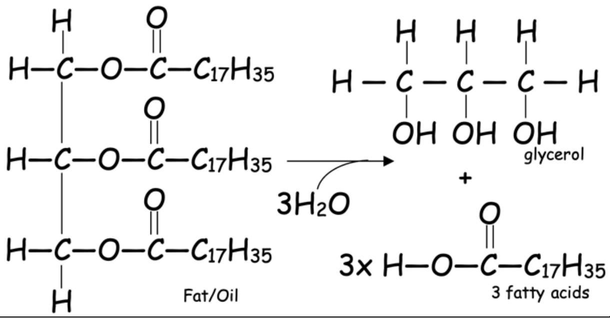
MC Qu	Answer	% Pupils Correct	Reasoning
1	A	78	☑A fluorine atom is 2,7 ∴ negatively charged Fluoride F^- ion is 2,8 ☒B sodium atoms are neutral and not negatively charged ☒C aluminium Al^{3+} ions are positively charged ☒D neon atoms are neutral and not negatively charged
2	C	52	☒A He is a noble gas ∴ monoatomic atoms ☒B CH_4 has 5 atoms per molecule ∴ penta-atomic ☑C CO has diatomic molecules with 2 atoms chemically bonded ☒D NaCl is ionic ∴ contains no molecules
3	D	62	☒A $X \rightarrow X^+$: No change to nucleus so no change to mass number ☒B $X \rightarrow X^+$: No change to nucleus so no change to the charge in the nucleus ☒C $X \rightarrow X^+$: No change to nucleus so no change to the charge in the nucleus ☑D $X \rightarrow X^+$: Group 1 elements have 1 outer electron which is removed e.g. 2,8,1 → 2,8
4	B	48	0.6mol of Cl^- ions ∴ 0.3 mol of $MgCl_2$ f.u. ∴ 0.3 mol Mg^{2+} ions 0.2mol of SO_4^{2-} ions ∴ 0.2mol of $MgSO_4$ f.u. ∴ 0.2 mol Mg^{2+} ions ∴ 0.3mol Mg^{2+} ions ($MgCl_2$) + 0.2mol Mg^{2+} ions ($MgSO_4$) = 0.5mol Mg^{2+}
5	A	74	☑A NH_3 neutralises acid as NH_3 dissolves in water to form alkali NH_4OH ☒B no reaction between H_2 and acid ☒C no reaction between CH_4 and acid ☒D SO_2 will dissolve in water to make acid ∴ pH decreases as acid increases
6	B	75	$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{0.035 - 0.025}{20 - 10} = \frac{0.01}{10} = 1.0\times10^{-3}\ \text{mol l}^{-1}\ \text{s}^{-1}$
7	D	70	☒A takes no account of particle's energy compared to Activation Energy ☒B enthalpy change is unaltered by increase in temperature ☒C activation energy is unaltered by increase in temperature ☑D while there are more collisions (Answer A), more importantly there are more particles with energy greater than activation energy
8	B	79	☒A increasing concentration of acid would not lower curve from P to Q ☑B less copper carbonate means less gas produced ☒C would give steeper curve initially and then end at same volume ☒D would give steeper curve initially and then end at same volume
9	D	58	no of mol $AgNO_3$ = volume x concentration = 1litre x 1mol l^{-1} = 1mol $AgNO_3$ = 1mol Ag^+ ions $2Ag^+_{(aq)} + Cu_{(s)} \rightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)}$ 2mol 1mol 2mol 1mol 1mol 0.5mol 1mol 0.5mol ☒A Copper nitrate solution produced would have the blue colour of Cu^{2+} ions. ☒B 0.5mol of $Cu_{(s)}$ reacts and 0.5mol of $Cu_{(s)}$ remains ☒C 1mol of $Ag_{(s)}$ is formed. 1mol Ag has mass 107.9g ☑D 1mol $Ag^+_{(aq)}$ is displaced by excess Cu metal to form 1mol $Ag_{(s)}$ metal
10	C	67	Activation Energy for forward reaction is measured from the reactants (X) to the top of the hill (Y) ∴ E_a = Y–X
11	A	58	ΔH_{sol} = +13.6kJ mol^{-1} ∴ process is endothermic ∴ temperature decreases Only answer C shows temperature decrease (no need to do $\Delta H = cm\Delta T$)
12	B	66	Large jump from 3rd ionisation energy to 4th ionisation energy so removal of 4th electron must break a complete electron shell. Element must have 3 electrons in outer shell ∴ Group 3 element

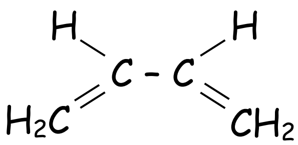
13	A	73	☑A 2nd Ionisation Energy: $E^{+}(g) \rightarrow E^{2+}(g) + e^{-}$ ☒B 2nd ionisation energy removes 1 electron from 1+ ion ☒C must be in gaseous state & 2nd ionisation energy removes 1 electron from 1+ ion ☒D must be in gaseous state
14	A	68	CO_2 is non-polar due to shape despite electronegativity difference. CO_2 contains discrete non-polar covalent molecules with only London dispersion forces between molecules (hence CO_2 is a gas at room temperature). SiO_2 is non-polar covalent network with strong covalent bonds holding network structure together (hence SiO_2 is a solid due to covalent network structure)
15	C	52	gfm He = 4g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{16}/_{4}$ = 4mol He atoms ☒A gfm CH_4 = 16g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{16}/_{16}$ = 1mol CH_4 molecules = 5mol atoms ☒B gfm O_2 = 32g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{16}/_{32}$ = 0.5mol O_2 molecules = 1mol atoms ☑C gfm NH_3 = 17g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{17}/_{17}$ = 1mol NH_3 molecules = 4mol atoms ☒D gfm Ar = 39.9g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{20}/_{39.9}$ = 0.50mol Ar atoms
16	B	58	1mol C = 6.02×10^{23} C atoms = 12g 1×10^{22} C atoms = $12g \times \frac{1 \times 10^{22}}{6.02 \times 10^{23}}$ = 0.2g
17	B	51	$C_2H_{6(g)} + 3\frac{1}{2}O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ 1mol 3.5mol 2mol 3mol 1vol 3.5vol 2vol - (NB Liquids have negligible volume) $20cm^3$ $70cm^3$ $40cm^3$ - (+$30cm^3$ O_2 leftover) Final Volume = <u>$70cm^3$</u> ($40cm^3$ CO_2 + $30cm^3$ leftover O_2)
18	A	71	☑A reforming increases formation of branches, cyclo- rings and aromatics ☒B molecules are rearranged but carbon number is unchanged ☒C reforming increases branching not decreases branching ☒D number of C=C double bonds unchanged
19	B	68	$CH_3CH_2CH_2CO$ ϕ CH_2CH_3 4 carbons on carboxylic acid side | 2 carbons on alcohol side ester ends in *butanoate* | ester starts with *ethyl*
20	D	69	☒A chloroethene C_2H_3Cl has no isomers as Cl is always on C_1 of molecule ☒B chloroethane C_2H_5Cl has no isomers as Cl is always on C_1 of molecule ☒C 1,1,2-trichloroethene has no isomers as numbering system will always be 1,1,2 ☑D $C_2H_4Cl_2$ has two isomers: 1,1-dichloroethane and 1,2-dichloroethane
21	D	88	☒A Secondary Alcohol (2 carbons directly attached to the carbon with –OH group) ☒B Secondary Alcohol (2 carbons directly attached to the carbon with –OH group) ☒C Tertiary Alcohol (3 carbons directly attached to the carbon with –OH group) ☑D Primary Alcohol (1 carbon directly attached to the carbon with –OH group)
22	B	64	
23	C	66	☒A Benzene C_6H_6 is not an isomer of cyclohexane C_6H_{12} ☒B Benzene does not quickly decolourise bromine solution as it has no C=C ☑C Benzene C_6H_6 and ethyne C_2H_2 have the same C:H ratio ☒D Hexene has C=C so undergoes addition, benzene has no C=C

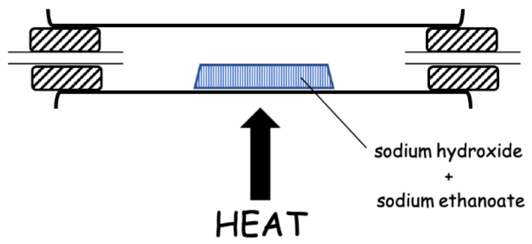
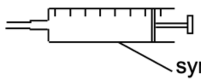
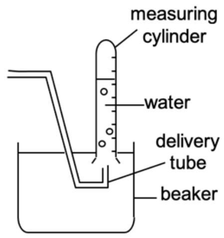
24	D	73	Esters are used for Flavourings + Perfumes due to their sweet smell and are also used as solvents for non-water soluble substances.
25	A	48	
26	D	71	☒A Addition/Hydration Reaction: $C_2H_4 + H_2O_{(g)} \rightarrow C_2H_5OH$ ☒B Combustion Reaction: $C + O_2 \rightarrow CO_2$ ☒C Combustion Reaction: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ ☑D Production of Synthesis Gas: $CH_4 + H_2O_{(g)} \rightarrow CO + 3H_2$ (also called steam reforming)
27	B	74	☒A Poly(ethyne): polymer which conducts electricity ☑B Poly(ethenol): polymer which is soluble in water ☒C Biopol: polymer which is biodegradable (broken down by bacteria) ☒D Kevlar: Strong polymer used in bullet-proof vests
28	A	50	Cracking produces compounds that are unsaturated (contains C=C double bonds) and are usually smaller: $C_3H_8 \rightarrow C_3H_6 + H_2$
29	C	76	
30	C	72	☒A lacks $-NH_2$ amine group ☒B lacks -COOH carboxyl group ☑C contains all groups shown in diagram opposite ($R=-CH_3$) ☒D lacks $-NH_2$ amine group 
31	B	72	❶ $C + O_2 \rightarrow CO_2$ $\Delta H=-393.5$ kJ ❷ $CO + \frac{1}{2}O_2 \rightarrow CO_2$ $\Delta H=-283.0$ kJ ❶ $C + O_2 \rightarrow CO_2$ $\Delta H=-393.5$ kJ ❷x-1 $CO_2 \rightarrow CO + \frac{1}{2}O_2$ $\Delta H=+283.0$ kJ ❶ +❷' $C + \frac{1}{2}O_2 \rightarrow CO$ $\Delta H=-110.5$ kJ
32	C	76	☒A equilibrium does not stop either forward or reverse reactions ☒B equilibrium rarely has 50% reactants and 50% products ☑C rate of forward reaction = rate of reverse reaction ☒D activation Energy for forward and reverse reactions are different
33	D	65	$I_{2(g)} + H_{2(g)} \rightleftharpoons 2HI_{(g)}$ 1mol 1mol 2mol 1vol 1vol 2vol (at same conditions of temp and pressure) 2vol → 2vol ∴ 2 volumes of reactants turn into 2 volumes of product ∴ no change to volume of gas as reaction proceeds ∴ pressure inside container is unchanged
34	D	65	☒A sodium hydroxide is strong alkali so has a higher pH than weak ammonia ☒B no. of moles of solute is the same but mass of 1 mole is different ☒C Sodium hydroxide will conduct better as it contains more ions ☑D The same no. of moles of acid will be neutralised by both.
35	C	50	pH = 2 ; pH = 4 ; pH 2 → 4 ∴ $[H^+]$ decreases $10^{-2} \rightarrow 10^{-4}$ $[H^+] = 10^{-2}$; $[H^+] = 10^{-4}$; Concentration decreases by factor of 100 pH=2 → pH=4 is a 1 in 100 dilution. $1cm^3$ of acid made up to $100cm^3$ with water is a 1 in 100 dilution.

<table>
<tr><td>36</td><td>B</td><td>47</td><td>☒A made from strong acid (nitric acid) & strong alkali (NaOH) ∴ neutral pH
☑B made from weak acid (ethanoic acid) & strong alkali (KOH) ∴ alkaline pH
☒C made from strong acid (hydrochloric acid) & weak alkali (ammonia) ∴ acidic pH
☒D made from strong acid (sulphuric acid) & strong alkali (LiOH) ∴ neutral pH</td></tr>
<tr><td>37</td><td>A</td><td>42</td><td>☑A Oxidation: $Sn^{2+} \rightarrow Sn^{4+} + 2e^-$
☒B Sn^{4+} is found in $SnCl_4$ and is a product not a reactant
☒C Reduction: $Hg^{2+} + 2e^- \rightarrow Hg$
☒D Cl^- is a spectator ion</td></tr>
<tr><td>38</td><td>C</td><td>36</td><td>Unlabelled line is for reaction: $Cu^+ + e^- \rightarrow Cu$
$Cu^{2+} + 2e^- \rightarrow Cu$ reaction requires twice number of electrons to produce same mass of copper so line C is correct as half the mass of copper is produced for the same number of electrons.</td></tr>
<tr><td>39</td><td>C</td><td>66</td><td><table>
<tr><th>Time (years)</th><th>% Remaining</th><th>No. of Half Lives</th></tr>
<tr><td>0</td><td>100%</td><td>0</td></tr>
<tr><td>5600</td><td>50%</td><td>1</td></tr>
<tr><td>11200</td><td>25%</td><td>2</td></tr>
</table></td></tr>
<tr><td>40</td><td>B</td><td>70</td><td>β-emission: atomic number increases by 1 & mass number remains constant.
$^{231}_{90}Th \rightarrow ^{231}_{91}Pa + ^{0}_{-1}e$</td></tr>
</table>

2006 Higher Chemistry Marking Scheme

Long Qu	Answer	Reasoning
1	A covalent molecular D covalent network C ionic B metallic	A Covalent Molecular – Does not conduct and has low mpt and bpt D Covalent Network – High mpt and bpt and does not conduct C Ionic – high mpt and conductor when molten but not solid B Metallic – conducts when solid and molten
2a	number of protons increases	Increased positive charge across period pulls in outer electrons more. Across a period the same electron shell is being filled and atoms do not get bigger)
2b	fullerene	Fullerene has C_{60} carbon structures which are discrete covalent molecules.
2c	no difference in electronegativity	Nitrogen and Chlorine both have an electronegativity value =3.0 and the electrons are shared equally in the covalent bond making it pure/non-polar covalent bonding
3a	carbon dioxide and nitrogen	$2CO + 2NO \rightarrow 2CO_2 + N_2$
3b	Answer to include:	molecules adsorb on surface / more successful collisions / product formed / molecules desorb/leave
4a	-297.2	$\Delta H = cm\Delta T = 4.18 \times 0.1 \times 10 = 4.18kJ$ gfm CH_3OH = 32g 0.45g $CH_3OH \leftrightarrow 4.18kJ$ 32g $\leftrightarrow 4.18kJ \times {}^{32}/_{0.45}$ $= -297.2\ kJ\ mol^{-1}$
4b	Incomplete combustion heat lost to surroundings evaporation of methanol	Any 2 from 3 answers, 1 mark each (PPA Question)
4b	Any two from:	incomplete combustion / heat lost to surroundings / evaporation of methanol
5a(i)		Glycerol is also known as propane-1,2,3-triol. **propane-1,2,3-triol** propane: 3 carbon mainchain with C-C single bonds 1,2,3: Functional groups in carbons C_1, C_2 and C_3 triol: Three hydroxyl -OH groups
5a(ii)	fats or oils	
5b	Equation showing:	$4C_3H_5N_3O_9 \rightarrow 6N_2 + 10H_2O + 12CO_2 + O_2$
6a	Answer to include:	count number of bubbles / per unit time / valid method of altering temperature
6b	enzyme denatures or changes shape	Active site of enzyme changes shape so substrate no longer fits the active site.
7a	ethene has to be produced from another chemical	Ethene is made as a product of cracking naphtha from crude oil or ethane from natural gas.

<table>
<tr><td>7b(i)</td><td>recycling of ethene from separator A</td><td>Recycling of unused reactants or by-products in a chemical process will improve efficiency by saving money and reducing waste.</td></tr>
<tr><td>7b(ii)</td><td>distillation</td><td>ethanol boils at 78°C and will evaporate from the solution and condenses to form concentrated ethanol</td></tr>
<tr><td>7c(i)</td><td>hydration or addition</td><td>water is added across C=C double bond is an example of hydration/addition reactions</td></tr>
<tr><td>7c(ii)</td><td>shifts to the left</td><td>temperature increase favours endothermic reaction
endothermic reaction is the reverse reaction.
products break down quicker than products form and equilibrium shifts to left.</td></tr>
<tr><td>7c(iii)</td><td>10%</td><td>$C_2H_4 + H_2O \longrightarrow C_2H_5OH$
1mol → 1mol
28g → 46g
28kg → 46kg
10kg → 46kg x $^{10}/_{28}$
= 16.4kg (Theoretical)
$\%Yield = \frac{Actual}{Theoretical} \times 100 = \frac{1.64}{16.4} \times 100 = 10\%$</td></tr>
<tr><td>8a</td><td>to ensure same volume of gas is used</td><td>The breath test involves the inflation of the bag so that the same volume of breath is used in every test to make the comparison a fair one.</td></tr>
<tr><td>8b</td><td>H^+ ions are reactants in the reaction</td><td>$Cr_2O_7^{2-} + \underline{14H^+} + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$</td></tr>
<tr><td>8c</td><td>ethanal
or
ethanoic acid</td><td>Oxidation: Primary Alcohol " Aldehyde " Carboxylic Acid
ethanol ethanal ethanoic acid
<table>
<tr><td rowspan="3">Oxidation of alcohols</td><td>Primary alcohol</td><td>→</td><td>aldehyde</td><td>→</td><td>carboxylic acid</td></tr>
<tr><td>Secondary alcohol</td><td>→</td><td>ketone</td><td>-X→</td><td>[No oxidation]</td></tr>
<tr><td>Tertiary alcohol</td><td>-X→</td><td>[No oxidation]</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>9a(i)</td><td></td><td></td></tr>
<tr><td>9a(ii)</td><td>addition</td><td>C=C double bonds split to C-C single bonds and molecules join up to make long polymer chain</td></tr>
<tr><td>9b</td><td>hard-wearing
stronger
more rigid</td><td>Cross-linking between chains adds strength to the chains as they support each other</td></tr>
<tr><td>10a</td><td>$NO_3^- + 4H^+ + 3e^-$
↓
$NO + 2H_2O$</td><td>
<table>
<tr><td>Write down main species involved</td><td>NO_3^-</td><td>→</td><td>NO</td></tr>
<tr><td>Balance all atoms other than O and H</td><td>NO_3^-</td><td>→</td><td>NO</td></tr>
<tr><td>Add H_2O to other side to balance O atoms</td><td>NO_3^-</td><td>→</td><td>$NO + 2H_2O$</td></tr>
<tr><td>Add H^+ to other side to balance H atoms</td><td>$NO_3^- + 4H^+$</td><td>→</td><td>$NO + 2H_2O$</td></tr>
<tr><td>Add e^- to most positive side to balance charge</td><td>$NO_3^- + 4H^+ + 3e^-$</td><td>→</td><td>$NO + 2H_2O$</td></tr>
</table></td></tr>
<tr><td>10b</td><td>3.8</td><td>gfm Cu = 63.5g   no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{10g}{63.5g\ mol^{-1}}$ = 0.157mol
$Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$
1mol → 1mol
0.157mol → 0.157mol
Volume = no. of mol x Molar Volume = 0.157mol x 24$_{litres\ mol^{-1}}$ = 3.8$_{litres}$</td></tr>
<tr><td>11a</td><td>2</td><td>
<table>
<tr><td>pH</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr>
<tr><td>$[H^+]$</td><td>10^0</td><td>10^{-1}</td><td>10^{-2}</td><td>10^{-3}</td><td>10^{-4}</td><td>10^{-5}</td><td>10^{-6}</td><td>10^{-7}</td><td>10^{-8}</td><td>10^{-9}</td><td>10^{-10}</td><td>10^{-11}</td><td>10^{-12}</td><td>10^{-13}</td><td>10^{-14}</td></tr>
<tr><td>$[OH^-]$</td><td>10^{-14}</td><td>10^{-13}</td><td>10^{-12}</td><td>10^{-11}</td><td>10^{-10}</td><td>10^{-9}</td><td>10^{-8}</td><td>10^{-7}</td><td>10^{-6}</td><td>10^{-5}</td><td>10^{-4}</td><td>10^{-3}</td><td>10^{-2}</td><td>10^{-1}</td><td>10^0</td></tr>
</table></td></tr>
</table>

11b	ethanoic acid: higher sulphuric acid: lower	ethanoic acid is a weak acid so $[H^+]$ is lower ∴ pH is higher Sulphuric and hydrochloric acids are strong acids but H_2SO_4 releases $2H^+$ when dissolved in water while HCl releases one H^+ ion when dissolved in water. Sulphuric acid is more acidic than hydrochloric acid and has a lower pH.
11c	hydrogen bonding	Hydrogen bonding takes place between molecules containing one the following bonds: O-H , N-H or H-F
12a(i)	2. temp of KOH 3. Temp of HCl 4. Vol of HCl/KCl 5. Final/max temp of KCl	PPA Technique Question
12a(ii)	-391	❶ $KClO_3 + 3Mg \rightarrow KCl + 3MgO$ $\Delta H=-1852$ kJ ❷ $K + \frac{1}{2}Cl_2 \rightarrow KCl$ $\Delta H=-437$ kJ ❸ $Mg + \frac{1}{2}O_2 \rightarrow MgO$ $\Delta H=-602$ kJ ❶x-1 ~~KCl~~ + ~~3MgO~~ → $KClO_3$ + ~~3Mg~~ $\Delta H=+1852$ kJ ❷ $K + \frac{1}{2}Cl_2$ → ~~KCl~~ $\Delta H=-437$ kJ ❸x3 ~~3Mg~~ + $1\frac{1}{2}O_2$ → ~~3MgO~~ $\Delta H=-1806$ kJ ❶'+❷+❸' $K + \frac{1}{2}Cl_2 + 1\frac{1}{2}O_2 \rightarrow KClO_3$ $\Delta H=-391$ kJ
12b	$2Na(s) + \frac{1}{2}O_2(g)$ ↓ $Na_2O(s)$	Definition of Enthalpy of Formation: The formation of one mole of a substance from its elements in their natural state. $2Na_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow Na_2O_{(s)}$
13a	Diagram containing:	1 mark vessel containing reactants being heated  1 mark gas collection system (one needed)  
13b	ethane	CH_3COONa splits up with $-CH_3$ joins up with -H from NaOH to form CH_4 CH_3CH_2COONa splits up with $-C_2H_5$ joins up with -H from NaOH to form C_2H_6
14a(i)	Equation showing:	$^{241}_{95}Am \longrightarrow {}^{237}_{93}Np + {}^{4}_{2}He$
14a(ii)	alpha particle not very penetrating	Alpha particles are stopped by paper and are not very penetrating. Beta particles are stopped by aluminium and are more penetrating. Gamma rays are (not completely) stopped by lead and are very penetrating.
14b	0.00022g	gfm AmO_2 = 273 mass of Americium-241 = 0.00025g x 241/273 = 0.00022g $\% \text{ mass} = \frac{\text{mass of Americium-241}}{\text{gfm } AmO_2} \times 100 = \frac{241}{273} \times 100 = 88.3\%$ mass of ^{241}Am in 0.00025g AmO_2 =88.3% of 0.00025g = $^{88.3}/_{100}$ x 0.00025g = 0.00022g
15a	$2Cl^-_{(aq)} + 2H_2O_{(l)}$ ↓ $Cl_{2(g)} + H_{2(g)} + 2OH^-_{(aq)}$	$2Cl^-_{(aq)} + 2H_2O_{(l)} \rightarrow Cl_{2(g)} + H_{2(g)} + 2OH^-_{(aq)}$
15b(i)	sodium hydroxide	Na^+ ions travel across the membrane to the RHS OH^- ions created by the chemical reaction: $2Cl^- + 2H_2O \rightarrow Cl_2 + H_2 + 2OH^-$

15b(ii)	used as a fuel or renewable/not finite or no CO_2 produced	Hydrogen gas is a fuel which released large amounts of energy when it joins up with oxygen in either a combustion reaction or to produce electricity in a fuel cell. No CO_2 is produced so there is no contribution to the Greenhouse Effect
15c	1059000g or 1059kg	Q=It = 80000 x (10x60x60) = 2880000000C $2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$ 1mol 2mol 71g ↔ 2x96500C $^{2880000000C}/_{2x96500C}$ x 71g ↔ 2880000000C = 1059000g
16a	C–O	Wavenumber for absorption at T = 1075cm^{-1}. Match wavenumber value against table in question.
16b(i)	S or C≡C–H Q or C≡C	The addition of hydrogen across the C≡C triple bond turns the triple bond into a C=C double bond. This would remove the peaks at S for C≡C–H adsorption and at Q for the C≡C absorption .
16b(ii)	propan-1-ol	3-hydroxypropyne → 3-hydroxypropene → propan-1-ol