JABchem

Past Papers Higher Chemistry

2007

Marking Scheme

Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	76+	30.4%
B	62+	24.0%
C	48+	22.0%
D	41+	9.6%
No award	<41	14.2%

Section:	Multiple Choice	Extended Answer
Average Mark:	26.4 /40	36.5 /60

2007 Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	B	63	☒A Iron is a transition metal but oxygen is not a halogen as it is group 6 ☑B Silver is a transition metal and bromine is a group 7 halogen ☒C Group 1 potassium is not a transition metal and permanganate is not a halogen ☒D Copper is a transition metal but iod*ate* is not a hal*ide* due to –ate ending
2	A	84	☑A Potassium fluoride is ionic so conducts when molten but not as a solid ☒B Argon has only London dispersion forces so no conduction in any state ☒C Potassium conducts in both solid and liquid states as it is a metal ☒D tetrachloromethane (CCl_4) is covalent so does not conduct in any state.
3	D	59	☒A Electron Arrangements: Na^+ = 2,8 S^{2-}=2,8,8 ☒B Electron Arrangements: Mg^{2+} = 2,8 Cl^-=2,8,8 ☒C Electron Arrangements: K^+ = 2,8.8 Br^-=2,8,18,8 ☑D Electron Arrangements: Ca^{2+} = 2,8,8 Cl^-=2,8,8
4	C	86	Rate = $\frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{0.20 - 0.05}{20 - 0} = \frac{0.15}{20}$ = 0.0075 mol l^{-1} s^{-1}
5	C	68	☒A +30kJ mol^{-1} (P to top of hill) is the activation energy for the reverse reaction ☒B +10kJ mol^{-1} (R to P) is the enthalpy change for the forward reaction ☑C -10kJ mol^{-1} (P to R) is the enthalpy change for the reverse reaction ☒D -40kJ mol^{-1} (top of hill to R) is the negative of the forward activation energy
6	B	78	The enthalpy of neutralisation: the energy released when one mole of water is formed. For acid/metal hydroxide neutralisations, the formation of one mole of water happens to be equal to the neutralisation of one mole of H^+ ions but this is not the case for acid/metal oxide neutralisations or acid/metal carbonate neutralisations.
7	C	70	☒A X_2 is not in the gaseous state and covalent bond in X_2 must be broken first ☒B 1st Ionisation energy forms positive ions not negative ions ☑C The removal of 1 mol of electrons from 1 mol of atoms in the gaseous state ☒D 1st Ionisation energy forms positive ions not negative ions
8	A	53	Least ionic character = elements with lowest electronegativity difference ☑A Electronegativity: Be=1.5 and Cl= 3.0 ∴electroneg difference = 3.0-1.5 = 1.5 ☒B Electronegativity: Ca=1.0 and Cl= 3.0 ∴electroneg difference = 3.0–1.0 = 2.0 ☒C Electronegativity: Li=1.0 and Cl= 3.0 ∴electroneg difference = 3.0–1.0 = 2.0 ☒D Electronegativity: Cs=0.8 and Cl= 3.0 ∴electroneg difference = 3.0-0.8 = 2.2
9	D	58	☒A Barium chloride is ionic (polar) ∴insoluble in non-polar tetrachloromethane ☒B Caesium chloride is ionic (polar) ∴insoluble in non-polar tetrachloromethane ☒C Calcium chloride is ionic (polar) ∴insoluble in non-polar tetrachloromethane ☑D Phosphorus chloride is non-polar covalent∴ soluble in non-polar tetrachloromethane
10	A	63	☑A sulphur dioxide SO_2 has discrete covalent molecules (boiling point = -10°C) ☒B silicon dioxide SiO_2 is a covalent network (melting point = 1610°C) ☒C aluminium oxide Al_2O_3 is ionic ∴ has ionic lattice structure rather than molecules ☒D iron (II) oxide FeO is ionic so has ionic lattice structure rather than molecules
11	C	26	☒A Oxides of metallic elements are ionic so oxides must be solid at room temp ☒B Elements cannot be polar covalent as there is no difference in electronegativity ☑C element with mpt=3000°C is covalent network with non-polar covalent bonds as each atom in the substance has the same electronegativity ☒D Elements cannot have ionic bonding within them

12	B	68	☒A CO_2 molecules are non-polar due to linear shape cancelling out polarity ☑B NH_3 molecules are polar due to electronegativity and pyramidal shape ☒C CCl_4 molecules are non-polar due to tetrahedral shape cancelling out polarity ☒D CH_4 molecules are non-polar due to similar electronegativities of C and H
13	C	55	1 CO_2 molecule contains 2 oxygen atoms ∴ 1 mol CO_2 molecules contains 2 mol of O atoms ∴ 0.5 mol CO_2 molecules contains 1 mol of O atoms
14	A	39	gfm of C_{60} molecule = 60x12 = 720g 1 mol C_{60} = 720g = 6.02×10^{23}molecules 12g = 6.02×10^{23}molecules x $^{12}/_{720}$ = 1.0×10^{22}molecules
15	B	68	☒A 1mol O_2 = 32g ∴ 16g of O_2 contains 0.5 mol of O_2 molecules ☑B 1mol Ne = 20.2g ∴ 1 mole Ne atoms present ☒C 1 mol NaOH = 40g ∴ 20g NaOH contains 0.5 mol of NaOH formula units ☒D 1mol Na^+Cl^- f.u. = 58.5g ∴ 2mol of ions present in 1 mol of Na^+Cl^- formula units
16	C	56	$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ 1mol 5mol 3mol 4mol 1vol 5vol 3vol negligible vol $30cm^3$ $150cm^3$ $90cm^3$ - (∴$50cm^3$ O_2 leftover) Total volume of resulting gas = $90cm^3$ CO_2 + $50cm^3$ of leftover O_2 = $140cm^3$
17	D	50	$nCO + (2n+1)H_2 \rightarrow nH_2O$ + hydrocarbon **Multiply out brackets** $nCO + 2nH_2 + H_2 \rightarrow nH_2O$ + hydrocarbon **Separate out H_2 which forms H_2O** nC~~O~~+ ~~nH_2~~ $+nH_2 + H_2 \rightarrow$ ~~nH_2O~~ + hydrocarbon **Cancel out water** $nC + nH_2 + H_2 \rightarrow$ + hydrocarbon **Build hydrocarbon into general formula** $C_nH_{2n} + H_2 \rightarrow$ Hydrocarbon C_nH_{2n+2} = Hydrocarbon
18	A	80	☑A straight chains decrease efficiency as they fit closely together and cause auto-ignition before the spark ☒B branches help keep molecules far enough apart to prevent auto-ignition ☒C cyclo- rings help keep molecules far enough apart to prevent auto-ignition ☒D aromatic rings help keep molecules far enough apart to prevent auto-ignition
19	A	71	☑A Functional group is of an aldehyde ☒B Functional group is of a ketone ☒C Functional group is of a carboxylic acid ☒D Functional group is of an ester
20	C	66	☒A Dehydration of propan-2-ol produces only propene ☒B Dehydration of pentan-3-ol produces only pent-2-ene ☑C Dehydration of hexan-3-ol produces hex-2-ene and hex-3-ene ☒D Dehydration of heptan-4-ol produces only hept-3-ene
21	C	65	☒A Oxidation: Primary Alcohol → Carboxylic Acid ☒B Oxidation: Secondary Alcohol → Ketone ☑C Reduction: Ketone → Secondary Alcohol ☒D Oxidation: Aldehyde → Carboxylic Acid
22	B	76	☒A Aldehydes do not react with alkali ☑B Carboxylic Acids react with alkalis to form salt + water ☒C Ketones do not react with alkali ☒D Alcohols do not react with alkali

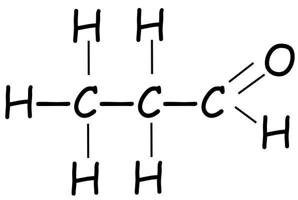
<table>
<tr><td>23</td><td>D</td><td>86</td><td>☒A Carbon dioxide causes the Greenhouse Effect and Carbon monoxide is poisonous
☒B Unburnt hydrocarbons like benzene can cause health problems like cancers
☒C Sulphur dioxide causes acid rain
☑D Chlorofluorocarbons (CFCs) causes the breakdown of ozone</td></tr>
<tr><td>24</td><td>B</td><td>56</td><td>☒A Propane does not have a C=C double bonds to react by addition reaction
☑B Cracking makes smaller molecules and produces C=C double bonds
☒C Propane does not have a C=C double bonds to react by hydrogenation reaction
☒D Propane does not react by oxidation reaction</td></tr>
<tr><td>25</td><td>D</td><td>60</td><td>☒A Linear polyester fibres are used in textile fibres not cured polyester resins
☒B Linear polyester fibres are long straight molecules and not used in cured resins
☒C Polyester is formed by a condensation polymerisation reaction
☑D Cured resins are strong due to their 3D cross-linked structure</td></tr>
<tr><td>26</td><td>D</td><td>87</td><td>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</td></tr>
<tr><td>27</td><td>C</td><td>91</td><td>Enzymes are made of protein. Protein is the polymer formed from the condensation polymerisation of amino acid monomer units.</td></tr>
<tr><td>28</td><td>B</td><td>64</td><td>☒A $-NH_2$ and -COOH groups are not attached to the same carbon
☑B $-NH_2$ and -COOH groups are attached to the same carbon
☒C $-NH_2$ and -COOH groups are not attached to the same carbon
☒D $-NH_2$ and -COOH groups are not attached to the same carbon</td></tr>
<tr><td>29</td><td>A</td><td>72</td><td>☑A Benzene has to be purified from crude oil and is not found naturally by itself
☒B Water is a widely available raw material
☒C Iron ore (iron oxide) is dug out of the ground to be used in a blast furnace
☒D Sodium chloride (salt) is extracted out of the ground for its many uses.</td></tr>
<tr><td>30</td><td>C</td><td>81</td><td>❶ $N_2 + 2O_2 \rightarrow 2NO_2$ $\Delta H = +88$ kJ
❷ $N_2 + 2O_2 \rightarrow N_2O_4$ $\Delta H = +10$ kJ

❶x-1 $2NO_2 \rightarrow N_2 + 2O_2$ $\Delta H = -88$ kJ
❷ $N_2 + 2O_2 \rightarrow N_2O_4$ $\Delta H = +10$ kJ

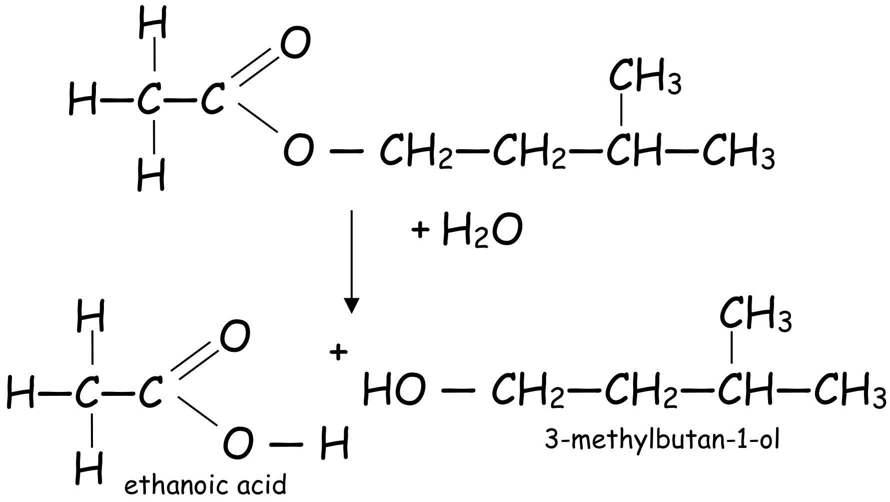
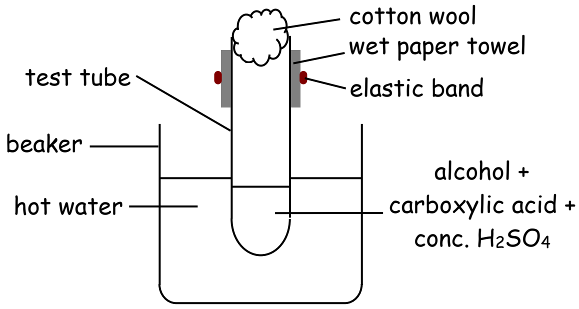
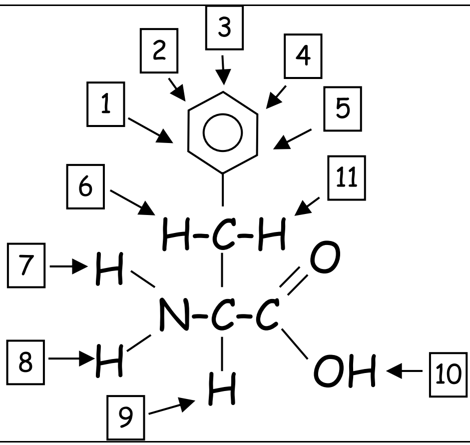
❶' + ❷ $2NO_2 \rightarrow N_2O_4$ $\Delta H = -78$ kJ</td></tr>
<tr><td>31</td><td>C</td><td>82</td><td>☒A Catalysts increase the rate of the forward and reverse reactions
☒B Catalysts increase the rate of the forward and reverse reactions
☑C Catalysts increase the rate of the forward and reverse reactions
☒D Catalysts do not change the position of equilibrium</td></tr>
<tr><td>32</td><td>B</td><td>80</td><td>☒A Forward reaction: 2mol gas → 1mol gas ∴forward reaction decreases pressure
☑B Forward reaction: 2mol gas → 2mol gas ∴no change in pressure
☒C Forward reaction: 4mol gas → 2mol gas ∴forward reaction decreases pressure
☒D Forward reaction: 3mol gas → 2mol gas ∴forward reaction decreases pressure</td></tr>
<tr><td>33</td><td>D</td><td>67</td><td>☒A Aldehyde groups (-CHO) do not ionise to become acidic
☒B Hydroxyl groups (-OH) do not ionise to become acidic
☒C C-H groups do not ionise to become acidic
☑D Carboxyl groups (-COOH) do ionise ($-COO^-$) and release H^+ (acid)</td></tr>
<tr><td>34</td><td>C</td><td>73</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>
<tr><td>35</td><td>A</td><td>45</td><td>Lemon Juice: pH= 3 ∴$[H^+] = 10^{-3}$ mol l^{-1} Apple Juice: pH= 5 ∴$[H^+] = 10^{-5}$ mol l^{-1}
pH=3 → pH=5 is a decrease in concentration of H^+ by a factor of 100
Lemon Juice : Apple Juice
100 : 1</td></tr>
</table>

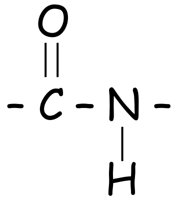
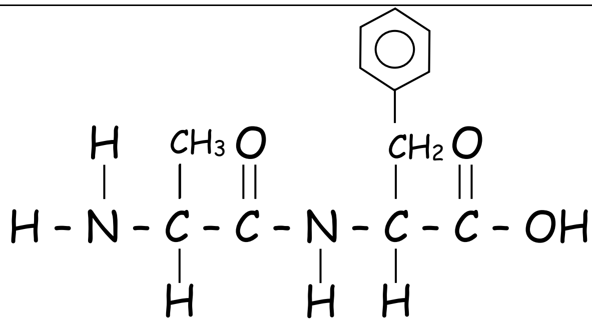
36	B	61	pH: Sodium hydroxide has a **higher** pH than ammonia solution as sodium hydroxide is fully dissociated and all OH^- ions are released into solution. In ammonia, there is only partial dissociation of OH^- ions hence the lower pH of ammonia Conductivity: Sodium hydroxide has more ions present and therefore has a **higher** conductivity than partially dissociated ammonia solution
37	D	55	Write down the main species involved in the reaction $IO_3^- \rightarrow I_2$ Balance all atoms except O and H $2IO_3^- \rightarrow I_2$ Add H_2O to other side to balance O atoms $2IO_3^- \rightarrow I_2 + 6H_2O$ Add H^+ ions to other side to balance H atoms $2IO_3^- + 12H^+ \rightarrow I_2 + 6H_2O$ Add e^- to most positive side to balance charge $2IO_3^- + 12H^+ + 10e^- \rightarrow I_2 + 6H_2O$
38	A	55	☑A Redox: Oxidation Step: $Mg \rightarrow Mg^{2+} + 2e^-$ and Reduction Step: $2H^+ + 2e^- \rightarrow H_2$ ☒B Neutralisation reactions do not involve the transfer of electrons ☒C Neutralisation reactions do not involve the transfer of electrons ☒D Neutralisation reactions do not involve the transfer of electrons
39	C	57	Number of protons = atomic number = 38 Number of neutrons = mass number – atomic number = 90 – 38 = 52 Neutron : Proton 52 : 38 1.37 : 1
40	D	72	Alpha Particles are positive ∴ attracted towards negative plate (Path X) Beta Particles are negative ∴ attracted towards positive plate (Path Z) Gamma Rays have no charge ∴ travel straight through (Path Y)

2007 Higher Chemistry Marking Scheme

<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1a</td><td>electronegativity</td><td>Electronegativity is a measure of the attraction for electrons within a bond. Elements on the Right Hand Side of the Periodic Table have a higher electronegativity than the elements on the Left Hand Side.</td></tr>
<tr><td>1b</td><td>decreases</td><td>As you go across a period from left to right, atoms get smaller. This is due to the nucleus having a larger positive charge pulling in the same outer electron shell more.</td></tr>
<tr><td>1c</td><td>Electrons in potassium are further away from nucleus (1mark)
Inner electron shells have shielding effect on outer shell
(1mark)</td><td>1st Mark awarded for:
• Bigger atom or
• larger size or
• more electron shells or
• outer electron is further from the nucleus (or protons)
2nd Mark awarded for:
• inner electrons (electron shells) reduce the attraction between the nucleus and the outer electron or
• inner electrons (electron shells) shield (screen) the outer electron from the attraction of the nucleus</td></tr>
<tr><td>2a</td><td>Reforming</td><td>Reforming rearranges the carbons from straight chain to branched chain hydrocarbons. The number of carbons in the molecule does not change. Straight chains can be reformed into cyclo-rings and armomatic rings also.</td></tr>
<tr><td>2b</td><td></td><td>
<table>
<tr><td>Primary Alcohol</td><td>→</td><td>Aldehyde</td><td>→</td><td>Carboxylic Acid</td></tr>
<tr><td>Propan-1-ol</td><td></td><td>Propanal</td><td></td><td>Propanoic Acid</td></tr>
<tr><td>C_4H_9OH</td><td></td><td>C_2H_5CHO</td><td></td><td>C_2H_5COOH</td></tr>
<tr><td>(C_3H_8O)</td><td></td><td>(C_3H_6O)</td><td></td><td>($C_3H_6O_2$)</td></tr>
</table>
</td></tr>
<tr><td>2c</td><td>Bullet-Proof Vests</td><td>Kelvar is a very strong plastic. Other acceptable answers: making ropes, making jackets for fencers, making clothing for motorcyclists, in aircraft wings, to line aircraft holds, in car tyres, body armour or kayaks</td></tr>
<tr><td>3a</td><td>${}^{3}_{1}H \rightarrow {}^{3}_{2}He + {}^{0}_{-1}e$</td><td>
<table>
<tr><th>Radiation Type</th><th>Effect on Atomic Number</th><th>Effect on Mass Number</th></tr>
<tr><td>Alpha</td><td>decrease by 2</td><td>decrease by 4</td></tr>
<tr><td>Beta</td><td>increase by 1</td><td>no change</td></tr>
<tr><td>Gamma</td><td>no change</td><td>no change</td></tr>
</table>
</td></tr>
<tr><td>3b(i)</td><td>Tritium is being replaced as fast as it is decaying</td><td>Tritium is formed in the upper atmosphere by cosmic rays. An equilibrium has evolved over a long period of time so that the rate of formation of Tritium is balanced by the rate of decay of tritium.</td></tr>
<tr><td>3b(ii)</td><td>36.9 years</td><td>
<table>
<tr><th>Percentage Remaining</th><th>Fraction Remaining</th><th>Time Taken</th></tr>
<tr><td>100%</td><td>1</td><td>0 years</td></tr>
<tr><td>50%</td><td>$\frac{1}{2}$</td><td>12.3 years</td></tr>
<tr><td>25%</td><td>$\frac{1}{4}$</td><td>24.6 years</td></tr>
<tr><td>12.5%</td><td>$\frac{1}{8}$</td><td>36.9 years</td></tr>
</table>
</td></tr>
<tr><td>4a(i)</td><td>Synthesis Gas</td><td>Synthesis gas is a mixture of carbon monoxide and hydrogen and is made by steam reforming of methane</td></tr>
<tr><td>4a(ii)</td><td>4</td><td>❶ $CH_4 + H_2O \rightarrow CO + 3H_2$
❷ $CO + H_2O \rightarrow CO_2 + H_2$
Add Equations ❶ + ❷
$CH_4 + 2H_2O \rightarrow CO_2 + \underline{4}H_2$</td></tr>
<tr><td>4b(i)</td><td>Negative</td><td>Hydrogen ions (H^+) are positive and are attracted to the negative electrode by electrostatic attraction.</td></tr>
</table>

4b(ii)	Time (½mark) Volume of Hydrogen (½mark)	The time is used to calculate the charge which has been passed through the solution by the calculation Q = I x t. The volume of hydrogen is required to calculate the proportion of 1mole of hydrogen has been formed.
5a	Endothermic	Endothermic reactions absorb energy from its surrounding and the temperature of the surroundings decreases as a result.
5b	53.8	ΔH = 45kJ mass of water = 0.2kg c = 4.18 kJ kg^{-1} $°C^{-1}$ (p22 databooklet) $\Delta H = c\ m\ \Delta T \quad \Delta T = \frac{\Delta H}{c \times m} = \frac{45}{4.18 \times 0.2} = 53.8°C$
6a(i)	purple →colourless	Permanganate MnO_4^- ions are purple and present at the start of the experiment. Permanganate MnO_4^- ions react with oxalate ions and become colourless Mn^{2+} ions.
6a(ii)	the temperature may continue to change/rise when you stop heating	Other acceptable answers: Temperature measured during heating is only roughly measured **or** the temperature may continue to rise (change) when you stop heating **or** the temperature at the end is measured accurately **or** there might be a time delay between heating and carrying out the experiment **or** during heating, the temperature of the solution may rise too quickly **or** because the temperature goes up when you add the oxalic acid **or** addition of the oxalic acid may cool the solution
6b	Many more molecules have energy greater than activation energy.	Curve moves to right as temperature increases. E_A remains the same value. Other acceptable answers: more molecules (particles) have enough energy to collide successfully **or** more molecules have sufficient energy to react **or** more molecules with (kinetic) energy greater than the activation energy
7a	Magnesium hydroxide is insoluble and can be filtered	Magnesium hydroxide is insoluble in water (p21 of data booklet) Calcium chloride is soluble in water (p21 of data booklet)
7b	Neutralisation	ACID + ALKALI ⟶ SALT + WATER hydrochloric acid + magnesium hydroxide ⟶ magnesium chloride + water
7c	Chlorine can be recycled (1 mark) Sea water is cheap (1 mark)	Any 2 from: • Indication that the chlorine produced can be recycled • water from the neutralisation can be recycled • sea water is free **or** cheap **or** plentiful **or** renewable **or** similar • can sell other products **or** there are useful biproducts
7d	1.5kg	Q = I x t = 200 000 x (1x60) = 12 000 000 C Mg^{2+} + $2e^-$ ⟶ Mg 1mol 2mol 1mol 2x96500C 24.3g 193000C 24.3g 12 000 000C 24.3g x 12 000 000/193000 = 1511g = 1.511kg

8a	ethanoic acid	
8b(i)	concentrated sulphuric acid	Concentrated sulphuric acid is the catalyst for condensation reactions where esters are formed.
8b(ii)	Put condenser on end of test tube	Condenser used was paper towel soaked in cold water wrapped around end of test tube 
8c	3.8g	$C_5H_{12}O$ + $C_2H_4O_2$ → $C_7H_{14}O_2$ + H_2O alcohol + carboxylic acid → ester + water 1 mol → 1mol 88g → 130g 4.0g → 130g x $^{4.0}/_{88}$ = 5.9g (theoretical) $\% \text{ Yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100$ ∴ $\text{Actual} = \text{theoretical} \times \frac{\% \text{ Yield}}{100} = 5.9g \times \frac{65}{100} = 3.835g$
9a(i)	An amino acid which we get into our body from the food we eat	Essential amino acids are ones which are only found in the food we eat and cannot be manufactured in the body.
9a(ii)	11	

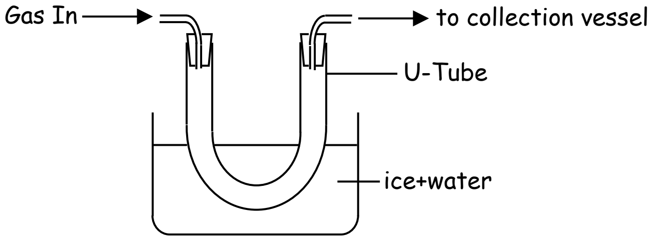
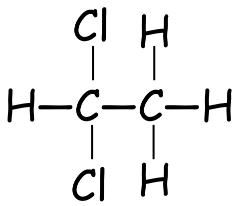
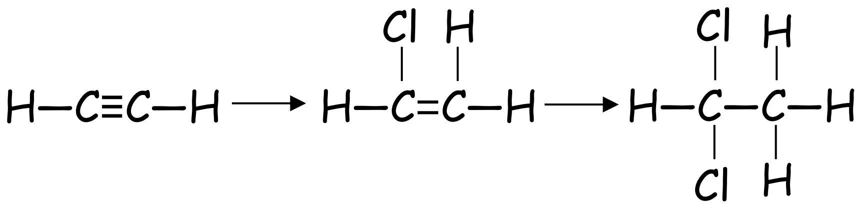
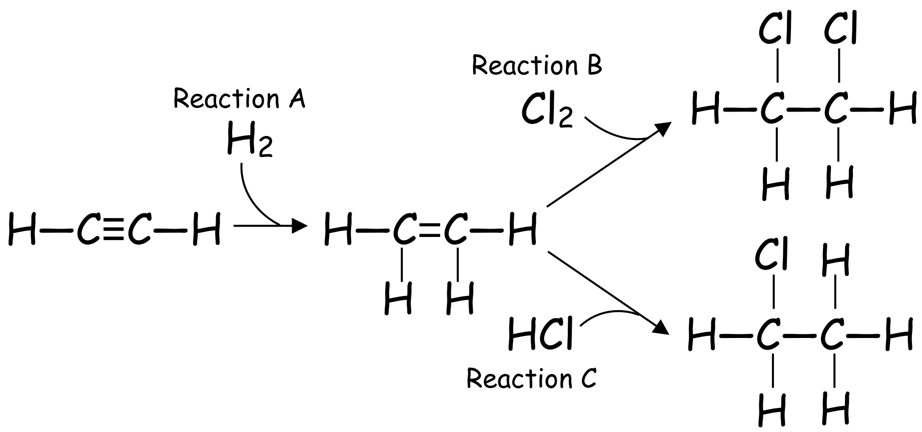
9b		The peptide link and the amide link are structurally the same. • Peptide links are formed between amino acids by condensation polymerisation during production of a protein • Amide links are formed in plastics like nylon
9c	Diagram showing:	
10a	**Experiment 2** Initial gradient steeper levels off at same height as line 1 **Experiment 3** Initial gradient less steep Levels off at half height of line 1	see table below
10b	0.26g	no. of mol H_2SO_4 = volume x concentration = 0.1litres x 0.1mol l^{-1} = 0.01mol $$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$$ 1mol 1mol 0.01mol 0.01mol **gfm** Mg = 24.3g **mass** = **no.** of mol x **gfm** = 0.01mol x 24.3g mol^{-1} = 0.243g Magnesium unreacted = total magnesium – magnesium reacted = 0.5 g – 0.243g = 0.257g
11a(i)	$2NH_3 + 2\frac{1}{2}O_2$ ↓ $2NO + 3H_2O$	$$2NH_3 + 2\tfrac{1}{2}O_2 \rightarrow 2NO + 3H_2O$$ or $$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$
11a(ii)	Catalyst is in different state from reactants	see table below
11a(iii)	Yield of NO_2 increases	Reaction Mixture is cooled • system fights back to raise temperature • exothermic reaction (forward reaction) is favoured • rate of forward reaction increases to make more products • Yield of product (NO_2) increases
11b(i)	0.51 litres	**gfm** $Cu(NO_3)_2$ = (1x63.5) + (2x14) + (6x16) = 63.5 + 28 + 96 = 187.5g **no.** of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{2.0g}{187.5\ g\ mol^{-1}}$ = 0.0107mol $$Cu(NO_3)_{2(s)} \rightarrow CuO_{(s)} + 2NO_{2(g)} + \tfrac{1}{2}O_{2(g)}$$ 1mol 1mol 2mol 0.0107mol 0.0213mol **V**olume = **no.** of mol x **M**olar **V**olume = 0.0213mol x 24litres mol^{-1} = 0.512litres

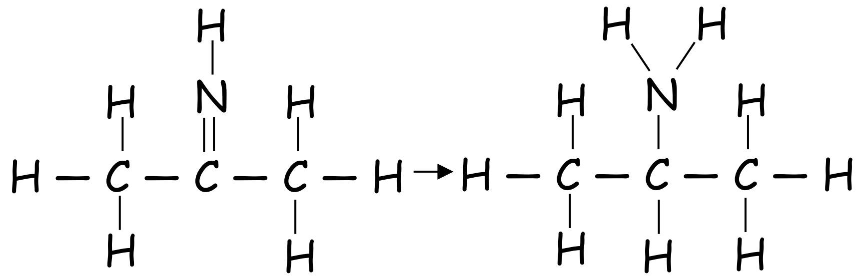
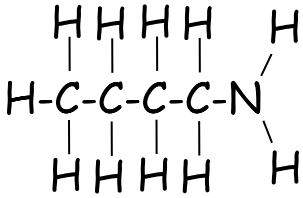
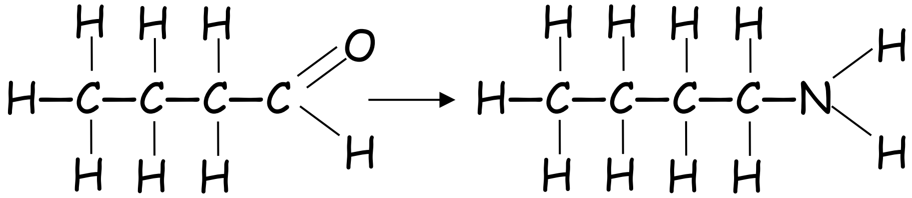
10a:

Experiment	Description	Reasoning
2	Initial gradient steeper	Experiment 2 has a higher concentration of sulphuric acid
	levels off at same height as line 1	Both experiments have 0.01mol of sulphuric acid present
3	Initial gradient less steep Levels off at half height of line 1	Although both acids have same volume and concentration, HCl has half as many H^+ ions present due to formula of H_2SO_4

11a(ii):

Type of Catalyst	Definition
Homogeneous	Catalyst is in *same* state as reactants
Heterogeneous	Catalyst is in *different* state from reactants

11b(ii)	½ mark method of condensation e.g. cold surface ½ mark method of collection e.g. U-tube in ice	
12a(i)		
12a(ii)	A: hydrogen B: chlorine C: hydrogen chloride	
12b	226	❶ $C + O_2 \rightarrow CO_2$ ΔH = -394kJ ❷ $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ ΔH = -286kJ ❸ $C_2H_2 + 2\frac{1}{2}O_2 \rightarrow 2CO_2 + H_2O$ ΔH = -1300kJ ❶x2 $2C + 2O_2 \rightarrow 2CO_2$ ΔH = -788kJ ❷ $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ ΔH = -286kJ ❸x-1 $2CO_2 + H_2O \rightarrow C_2H_2 + 2\frac{1}{2}O_2$ ΔH = +1300kJ add $2C + H_2 \rightarrow C_2H_2$ ΔH = +226kJ

13a	Answer to include:	1st Mark: Hydrogen bonds (½mark) are strong between molecules (½mark) 2nd Mark: Hydrogen bonding is formed due to: • the difference in the electronegativity of N and H atoms (½mark) • N-H covalent bonds are very polar (½mark)
13b(i)	Addition or Hydrogenation	Addition of hydrogen across C=N double bond • C=N double bond splits to become C-N single bond • Hydrogen atoms add across former C=N double bond 
13b(ii)		
14a	To increase the melting point of product or to turn oil into solid margarine	Oils have C=C double bonds which changes the shape of the oil molecule so that the molecules cannot get so close together to allow the liquid oil to be a solid. By adding hydrogen across C=C double bond, molecules become straight, fit together more closely and becomes a solid.
14b	Sorbic acid is a weak acid	Potassium sorbate is alkaline. Alkaline salts contain a weak acid when the salt is made (potassium hydroxide reacting with sorbic acid)
14c	1.78	**gfm** Na^+ = 23g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.7}{23}$ = 0.0304mol 1mol of Na^+ ↔ 1 mol of NaCl 0.0304mol 0.0304mol **gfm** NaCl = (1x23) + (1x35.5) + 23 + 35.5 = 58.5g **mass** = **n**o. of mol x **gfm** = 0.0304mol x 58.5 g mol^{-1} = 1.78g
15a	$H_2O_2 + 2H^+ + 2I^-$ ↓ $2H_2O + I_2$	❶ $H_2O_2 + 2H^+ + 2e^- \longrightarrow 2H_2O$ ❷ $2I^- \longrightarrow I_2 + 2e^-$ Add ❶+❷ $H_2O_2 + 2H^+ + 2I^- \longrightarrow 2H_2O + I_2$
15b	0.00945	**n**o. of mol $S_2O_3^{2-}$ = **v**olume x **c**oncentration = 0.005litres x 0.0149mol l^{-1} = 7.45 x 10^{-5} mol $2Na_2S_2O_3 + I_2 \longrightarrow 2NaI + Na_2S_4O_6$ 2mol 1mol 7.45×10^{-5} mol 3.725×10^{-5} mol **gfm** I_2 = (2x1276.9) = 253.8g **mass** = **n**o. of mol x **gfm** = 3.725×10^{-5}mol x 253.8g mol^{-1} = 0.00945g