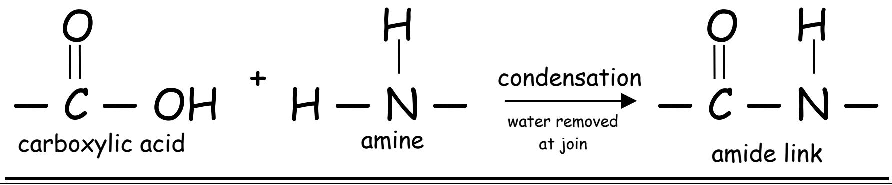
JABchem

Past Papers Int 2 Chemistry

2001

Marking Scheme

2001 Int2 Chemistry Marking Scheme

<table>
<tr><th>MC Qu</th><th>Answer</th><th>% Pupils Correct</th><th>Reasoning</th></tr>
<tr><td>1</td><td>D</td><td>72</td><td>
<table>
<tr><td>Name</td><td>Alkali Metals</td><td>Halogens</td><td>Noble gases</td><td>Transition Metals</td></tr>
<tr><td>Location</td><td>Group 1</td><td>Group 7</td><td>Group 0</td><td>Between Group 2 + 3</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>A</td><td>90</td><td>☑A Sodium is in group 1 and has an electron arrangement of 2,8,1
☒B Phosphorus is in group 5 has an electron arrangement of 2,8,5
☒C Chlorine is in group 7 has an electron arrangement of 2,8,7
☒D Argon is in group 0 has an electron arrangement of 2,8,8</td></tr>
<tr><td>3</td><td>A</td><td>29</td><td>Metallic bonding has positive ions (the nucleus and the inner electron shells) attracted to the delocalised electrons in the outer shell.</td></tr>
<tr><td>4</td><td>C</td><td>51</td><td>
</td></tr>
<tr><td>5</td><td>B</td><td>79</td><td>
<table>
<tr><td>Rate</td><td>Particle Size</td><td>Concentration</td></tr>
<tr><td>Faster</td><td>Powder</td><td>4mol l^{-1}</td></tr>
<tr><td>Slower</td><td>Ribbon</td><td>2mol l^{-1}</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>B</td><td>30</td><td>
<table>
<tr><td>Write down formula</td><td>Reverse cross-over rule</td><td>Lift valency from each ion</td><td>Write Ionic Formula</td></tr>
<tr><td>$Fe_2(SO_4)_3$</td><td>Fe SO_4
X
3 2</td><td><table><tr><td>Ion</td><td>Valency</td></tr><tr><td>Fe</td><td>3</td></tr><tr><td>SO_4</td><td>2</td></tr></table></td><td>$(Fe^{3+})_2(SO_4^{2-})_3$</td></tr>
</table>
</td></tr>
<tr><td>7</td><td>D</td><td>59</td><td>$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{60 - 0}{20 - 0} = \frac{60}{20} = 3\ cm^3\ s^{-1}$</td></tr>
<tr><td>8</td><td>A</td><td>49</td><td>gfm Na_2CO_3 = (2x23) + (1x12) + (3x16) = 46 + 12 + 48 = 106g
$\text{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{5.3}{106} = 0.05\text{mol}$</td></tr>
<tr><td>9</td><td>A</td><td>49</td><td>
<table>
<tr><td>Property</td><td>Petroleum Gas</td><td>Gasoline</td><td>Kerosene</td><td>Light gas Oil</td><td>Heavy Gas Oil</td><td>Residue</td></tr>
<tr><td>Viscosity</td><td>Low</td><td colspan="4">←→</td><td>High</td></tr>
<tr><td>Evaporation</td><td>Quickly</td><td colspan="4">←→</td><td>Slowly</td></tr>
<tr><td>Flammability</td><td>High</td><td colspan="4">←→</td><td>Low</td></tr>
<tr><td>Boiling Point</td><td>Low</td><td colspan="4">←→</td><td>High</td></tr>
</table>
</td></tr>
<tr><td>10</td><td>B</td><td>56</td><td>☒A C_5H_{12} is most likely to be found in the gasoline (naphtha) fraction
☑B $C_{12}H_{26}$ is most likely to be found in the kerosene fraction
☒C $C_{19}H_{40}$ is most likely to be found in the light gas oil fraction
☒D $C_{26}H_{54}$ is most likely to be found in the heavy gas oil fraction</td></tr>
<tr><td>11</td><td>B</td><td>89</td><td>☒A pent-2-ene C_5H_{10} cannot be an isomer of 2,2-dimethylpropane C_5H_{12}
☑B 2-methylbutane C_5H_{12} is an isomer of 2,2-dimethylpropane C_5H_{12}
☒C cyclopentane C_5H_{10} cannot be an isomer of 2,2-dimethylpropane C_5H_{12}
☒D 2,2-dimethylbutane C_6H_{14} cannot be an isomer of 2,2-dimethylpropane C_5H_{12}</td></tr>
<tr><td>12</td><td>C</td><td>45</td><td>
<table>
<tr><td>Product</td><td>Carbon dioxide</td><td>Sulphur Dioxide</td><td>Water</td></tr>
<tr><td>Element in Reactant</td><td>carbon</td><td>sulphur</td><td>hydrogen</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>13</td><td>B</td><td>42</td><td>☒A Condensation: small molecules join together with water removed at the join
☑B Hydration: addition reaction with water added across C=C double bond
☒C Hydrolysis: molecule splits into smaller molecules with water added across break
☒D Oxidation: Loss of electrons by adding oxygen or removing hydrogen from molecule</td></tr>
<tr><td>14</td><td>B</td><td>56</td><td>☒A Biopol is a synthetic polymer
☑B Biopol is a synthetic biodegradable polymer
☒C Biopol is a synthetic polymer
☒D Biopol is a biodegradable polymer</td></tr>
<tr><td>15</td><td>D</td><td>26</td><td>☒A the polymer is not a polyamide as it contains ester links
☒B the polymer is not a polyamide as it contains ester links
☒C the polymer is a polyamide but is not made by addition polymerisation
☑D the polymer is a polyester made by condensation of diacids and diols</td></tr>
<tr><td>16</td><td>B</td><td>71</td><td><table>
<tr><td>Carbohydrate</td><td>Glucose</td><td>Fructose</td><td>Maltose</td><td>Sucrose</td><td>Starch</td></tr>
<tr><td>Formula</td><td>$C_6H_{12}O_6$</td><td>$C_6H_{12}O_6$</td><td>$C_{12}H_{22}O_{11}$</td><td>$C_{12}H_{22}O_{11}$</td><td>$(C_6H_{10}O_5)_n$</td></tr>
<tr><td>Reaction with Benedict's Solution</td><td>blue → brick red</td><td>blue → brick red</td><td>blue → brick red</td><td>no change</td><td>no change</td></tr>
<tr><td>Reaction with Iodine Solution</td><td>no change</td><td>no change</td><td>no change</td><td>no change</td><td>turns blue/black</td></tr>
</table></td></tr>
<tr><td>17</td><td>C</td><td>71</td><td><table>
<tr><td>Food Type</td><td>Carbon</td><td>Hydrogen</td><td>Oxygen</td><td>Nitrogen</td></tr>
<tr><td>Carbohydrates</td><td>✓</td><td>✓</td><td>✓</td><td>×</td></tr>
<tr><td>Fats</td><td>✓</td><td>✓</td><td>✓</td><td>×</td></tr>
<tr><td>Proteins</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table></td></tr>
<tr><td>18</td><td>D</td><td>66</td><td>Ammonia is an alkali:<table>
<tr><td>Acidic</td><td>Neutral</td><td>Alkaline</td></tr>
<tr><td>pH < 7</td><td>pH=7</td><td>pH>7</td></tr>
</table></td></tr>
<tr><td>19</td><td>C</td><td>69</td><td>☒A acids contain more H^+ ions than OH^- ions (some OH^- ions present)
☒B neutral solutions contain equal numbers of H^+ and OH^- ions
☑C acids contain more H^+ ions than OH^- ion
☒D acids contain more H^+ ions than OH^- ion</td></tr>
<tr><td>20</td><td>C</td><td>24</td><td>☒A Condensation: small molecules join together with water removed at the join
☒B Dehydration: Water is removed from a molecule forming a C=C double bond
☑C Neutralisation: H^+ ions reacting to form water
☒D Precipitation: An insoluble solid is formed when two ions come together</td></tr>
<tr><td>21</td><td>C</td><td>29</td><td>☒A Rate of forward reaction equals the rate of the reverse reaction
☒B Only a few molecules have dissociated as ethanoic acid is a weak acid
☑C The concentration of ethanoate ions and hydrogen ions is constant not equal
☒D There are very few ethanoate ions compared to ethanoic acid molecules</td></tr>
<tr><td>22</td><td>A</td><td>26</td><td>☑A Iron atoms are oxidised into iron ions: $Fe \longrightarrow Fe^{3+} + 3e^-$
☒B Rust from corrosion of iron is a compound called iron (III) oxide Fe_2O_3
☒C Fe^{2+} ions oxidise (loss of electrons) to become Fe^{3+} ions: $Fe^{2+} \longrightarrow Fe^{3+} + e^-$
☒D Fe atoms oxidise (loss of electrons) to become Fe^{2+} ions: $Fe \longrightarrow Fe^{2+} + 2e^-$</td></tr>
<tr><td>23</td><td>D</td><td>47</td><td>☒A nail rusts as iron sacrificially protects the less reactive copper
☒B nail rusts as iron sacrificially protects the less reactive tin
☒C Positive terminal of battery speeds up the rusting if the nail
☑D Negative terminal of battery protects the nail from rusting (cathodic protection)</td></tr>
<tr><td>24</td><td>C</td><td>54</td><td><u>Displacement Reactions</u>
Higher up metals will displace lower down metal ions from solution.
magnesium + zinc chloride → magnesium chloride + zinc<table>
<tr><td>Order of Reactivity</td></tr>
<tr><td>Potassium</td></tr>
<tr><td>Sodium</td></tr>
<tr><td>Magnesium</td></tr>
<tr><td>Zinc</td></tr>
</table></td></tr>
<tr><td>25</td><td>A</td><td>67</td><td><u>Electrochemical Series</u>
The bigger the difference in the metals on the electrochemical series, the bigger the voltage is.<table>
<tr><td>Order in Electrochemical Series</td></tr>
<tr><td>Magnesium</td></tr>
<tr><td>Zinc</td></tr>
<tr><td>Tin</td></tr>
<tr><td>Copper</td></tr>
</table></td></tr>
</table>

Questions 26, 27 and 28 are Grid Questions. • This style of question was dropped after the 2002 Int2 exam. • The style of question is no longer used but the content of the question can still be asked in future exams.		
26	C+D (both for 1 mark)	☒A Fluorine atoms have electron arrangement of 2,7 ∴ F^- ions are 2,8. Argon atoms are 2,8,8 ☒B Oxygen atoms have electron arrangement of 2,6 ∴ O^{2-} ions are 2,8. Argon atoms are 2,8,8 ☑C Potassium atoms have electron arrangement of 2,8,8,1 ∴ K^+ ions are 2,8,8. Argon atoms are 2,8,8 ☑D Sulphur atoms have electron arrangement of 2,8,6 ∴ S^{2-} ions are 2,8,8. Argon atoms are 2,8,8
27	C,E (1 mark each)	☒A Caesium valency = 1 & Fluorine valency = 1 ∴ Formula of Caesium Fluoride = CsF ☒B Caesium is a metal & Fluorine is a non-metal ∴ Caesium Fluoride has ionic bonding ☑C Caesium Fluoride has ionic bonding ∴ Caesium Fluoride conducts when molten ☒D Caesium Fluoride has ionic bonding ∴ Caesium Fluoride does not conducts when solid ☑E Caesium Fluuride has ionic bonding ∴ all ionic compounds have m.pt above room temp
28a	A+C (both for 1 mark)	☑A Molecular formula of this compound is C_3H_8S ☒B Molecular formula of this compound is $C_4H_{10}S$ ☑C Molecular formula of this compound is C_3H_8S ☒D Molecular formula of this compound is C_4H_8S
28b	D	☒A Molecular formula of this compound is C_3H_8S ∴ general formula = $C_nH_{2n+2}S$ ☒B Molecular formula of this compound is $C_4H_{10}S$ ∴ general formula = $C_nH_{2n+2}S$ ☒ Molecular formula of this compound is C_3H_8S ∴ general formula = $C_nH_{2n+2}S$ ☑D Molecular formula of this compound is C_4H_8S ∴ general formula = $C_nH_{2n}S$

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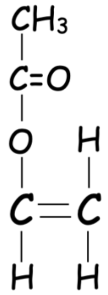
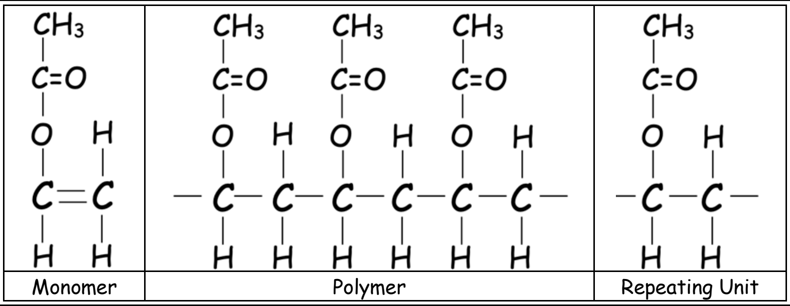
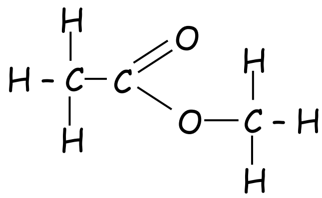
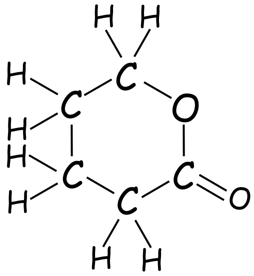
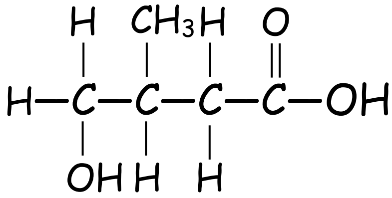
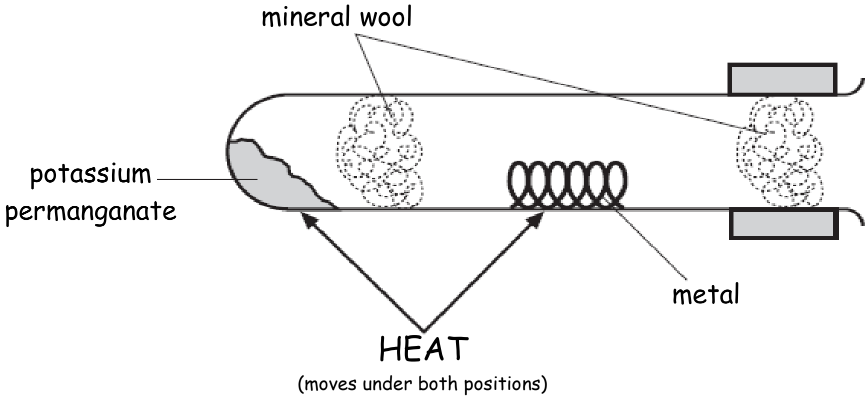
Long Qu	Answer	Reasoning
1a	19 20 19	No. of protons = atomic number = 19 No. of neutrons = mass number – atomic number = 39-19 = 20 No. of electrons = atomic number - charge = 19 – 0 = 19
1b	Same no. of protons but different no. of neutrons	Isotopes: Same atomic number but different mass number Same number of protons but different number of neutrons
2a	Carbon dioxide and water	Alkynes are hydrocarbons. Hydrocarbons burn in a plentiful supply of air to produce carbon dioxide and water.
2b	propyne C_4H_6	Prefix for 3 carbons is *prop-* ∴ alkyne with 3 carbons is called propyne From C_2H_2 and C_3H_4 formula - alkynes have general formula: C_nH_{2n-2} ∴ when n=4, butyne is molecular formula of C_4H_6
3a		
3b(i)	Soluble in water	Poly(ethenol) is a synthetic polymer which is soluble in water
3b(ii)	Diagram showing:	
4a	$Cu(NO_3)_2$	Write down Formulae of ions: Cu NO_3^- Write down Valency below each ion: Cu NO_3^- / 2 1 Put in Cross-over Arrows: Cu NO_3 / 2 1 Follow arrows and cancel down to get formula: $Cu(NO_3)_2$
4b	0.05	**n**o. of mol = **v**olume x **c**oncentration = 0.25litres x 0.2mol l^{-1} = 0.05mol
5a	Heat catalyst then heat paraffin	PPA Technique Question: The catalyst must be at a high temperature before it will work efficiently. The Bunsen burner initially heats only the catalyst and when it is hot the Bunsen burner is then moved under the paraffin with the heating shared between the paraffin and the catalyst to keep both warm.
5b(i)	Gases produced are unsaturated	The products of cracking contain unsaturated compounds with C=C double bonds.
5b(ii)	Remove test tube from delivery tube before stopping heating	PPA Technique Question. Suck back is caused by the expansion of gases in the heated test tube during the heating phase. When the heating is stopped, the gases contract to its original size and cold liquid in the cold test tube will be sucked up the delivery tube unless the cold test tube is removed from the delivery tube first.
5c	Catalyst in different state to reactants	**Type of Catalyst** / **Definition** Homogeneous: Catalyst in same state as reactants Heterogeneous: Catalyst in different state from reactants

<table>
<tr><td>6a</td><td>Reduction</td><td>In the production of a metal, the metal ion gains electrons to become a an uncharged metal atom e.g. $Fe^{3+} + 3e^{-} \longrightarrow Fe$</td></tr>
<tr><td>6b</td><td>Mercury,
silver or gold</td><td>Only the least reactive metals in metal oxide will release the metal on heating alone</td></tr>
<tr><td>6c(i)</td><td>$C + CO_2 \rightarrow 2CO$</td><td>Carbon will react with carbon dioxide to form carbon monoxide</td></tr>
<tr><td>6c(ii)</td><td>$Fe_2O_3 + 3CO$
↓
$2Fe + 3CO_2$</td><td>$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$</td></tr>
<tr><td>7a</td><td>d.c. supply has steady + and – so ions move in one direction</td><td>D.C. (direct current) has constant positive and negative terminals and the oppositely charged ion is attracted to that terminal to be electrolysed back to the elements. A.C. (alternating current) has reversing positive and negative terminals and ions cannot move to the terminals to be electrolysed.</td></tr>
<tr><td>7b</td><td>Chlorine bleaches paper (turns white)</td><td>Chlorine has a bleaching effect on the pH paper or litmus paper and the paper turns white. Chlorine also has a distinctive smell (like the swimming baths)</td></tr>
<tr><td>8</td><td>Answer to include:</td><td>

Measure mass of evaporating basin
Use measuring cylinder to measure $100cm^3$ of $0.1mol\ l^{-1}$ sodium chloride solution
Transfer liquid to evaporating basin and heat the basin using tripod+Bunsen burner
Once all liquid has evaporated, let it cool and weigh the basin on a balance.
Clean the evaporating basin and repeat with $100cm^3$ of $0.2mol\ l^{-1}$ solution.
The mass of the salt in the basins (once the mass of the basin has been subtracted) should show that $100cm^3$ of $0.2mol\ l^{-1}$ solution contains twice as much sodium chloride than $100cm^3$ of $0.1mol\ l^{-1}$

</td></tr>
<tr><td>9a(i)</td><td>Oxygen relights a glowing splint</td><td>
<table>
<tr><td>Gas</td><td>Hydrogen</td><td>Oxygen</td><td>Carbon Dioxide</td></tr>
<tr><td>Gas Test</td><td>Burns with a pop</td><td>Relights glowing splint</td><td>Turns lime water milky</td></tr>
</table>
</td></tr>
<tr><td>9a(ii)</td><td>Not enough oxygen in air to relight the lowing splint</td><td>In 100% oxygen, the glowing splint glows so bright that it is hot enough to relight the splint. A glowing splint in air does not relight because air only contains 21% oxygen which is too low to relight the splint.</td></tr>
<tr><td>9b</td><td>600.9g</td><td>1mol $LiClO_4$ = (1x7) + (1x35.5) + (4x16) = 7 + 35.5 + 64 = 106.5g
$$\textbf{no}.\ \text{of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1000}{106.5} = 9.39\text{mol}$$
$$LiClO_4 \longrightarrow LiCl + 2O_2$$
1mol   2mol
9.39mol   18.78mol
1mol O_2 = (2x16) = 32g
mass = no. of mol x gfm = 18.78 x 32 = 600.9g</td></tr>
<tr><td>10a</td><td>Hydrolysis</td><td>Big molecules splitting into smaller molecules with water added across the break.
Starch + Water → Glucose
$(C_6H_{10}O_5)_n + nH_2O \rightarrow nC_6H_{12}O_6$</td></tr>
<tr><td>10b</td><td>Proteins</td><td>Enzymes are specially-shaped proteins that are catalysts in living organisms, which catalyse all the chemical reactions in the body.</td></tr>
<tr><td>10c</td><td>Activity of enzyme increases</td><td>When the pH increases from pH=5 to pH=6, the time taken to break starch down decreases. Decreasing time taken means that the enzyme is working faster so the activity of the enzyme is increasing.</td></tr>
<tr><td>10d</td><td>Enzymes denature at high temperature</td><td>Enzymes are specially shaped proteins but will lose their special shape when heated and no longer exactly fits the molecule it catalyses anymore.</td></tr>
<tr><td>10e</td><td>No change in colour
or iodine stays yellow</td><td>Iodine solution turns blue/back in the presence of starch. If all the starch has broken down then the iodine added will stay yellow and not turn blue/black</td></tr>
</table>

11a	0.00001mol l^{-1} or 1×10^{-5}mol l^{-1}	pH: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 $[H^+]$ (mol l^{-1}): 10^{0}, 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8}, 10^{-9}, 10^{-10}, 10^{-11}, 10^{-12}, 10^{-13}, 10^{-14}
11b	Not all molecules dissociate into ions	Strong Acid: Full dissociation of molecules to release H^+ ions (lower pH) Weak Acid: Partial dissociation of molecules to release H^+ ions (higher pH)
11c	Answer to include:	Set up a reaction container with a gas collection system e.g. syringe or upside down measuring cylinder full of water with a delivery tube. • Use same volume of each acid • Use same temperature of acid • Use same concentration of acid • Use same mass of magnesium • Use same particle size of magnesium Measure the time taken to release a set volume of gas The lower the time to release set volume the faster the rate of reaction.
12a(i)	$Ba^{2+} + SO_4^{2-} \longrightarrow Ba^{2+}SO_4^{2-}$	$Ba^{2+} + 2Cl^- + 2Na^+ + SO_4^{2-} \longrightarrow Ba^{2+}SO_4^{2-} + 2Na^+ + 2Cl^-$ Cancel out any spectator ions which appear on both sides $Ba^{2+} + \cancel{2Cl^-} + \cancel{2Na^+} + SO_4^{2-} \longrightarrow Ba^{2+}SO_4^{2-} + \cancel{2Na^+} + \cancel{2Cl^-}$ Re-write equation omitting spectator ions $Ba^{2+} + SO_4^{2-} \longrightarrow Ba^{2+}SO_4^{2-}$
12a(ii)	Precipitation	Precipitation: Reaction where two ions come together to form an insoluble solid. The solid can be removed by filtration.
12b	0.008mol l^{-1}	KOH **n**o. of mol = **v**olume x **c**oncentration = 0.020litres x 0.1mol l^{-1} = 0.002mol $2KOH + H_2SO_4 \longrightarrow NaSO_4 + 2H_2O$ 2mol 1mol 0.002mol 0.001mol $\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.001 \text{ mol}}{0.0125 \text{ litres}} = 0.08 \text{ mol } l^{-1}$
13a	$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	From the question, $Fe^{3+} \longrightarrow Fe^{2+}$ (difference on charge of 1+) 1e^- is added to the most positive side: $Fe^{3+} + e^- \longrightarrow Fe^{2+}$
13b(i)	Line graph showing:	½mark: labelling axes ½mark: correct scales ½mark: plotting points ½mark: drawing line
13b(ii)	~ 4.8 mg l^{-1}	The figure you write down must be correct from the graph you have drawn.
14a	$O_2 + 2H_2 \rightarrow 2H_2O$	❶ $H_2 \rightarrow 2H^+ + 2e^-$ ❷ $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ ❶x2 $2H_2 \rightarrow 4H^+ + 4e^-$ ❷ $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ add $O_2 + 2H_2 \rightarrow 2H_2O$
14b	Completes the circuit	Electrolytes complete the circuit by balancing the movement of charged electrons by allowing ions to move too.
14c	increases rate of reaction	A catalyst speeds up a chemical reaction without being used up itself. The larger the surface area of the catalyst the more sites where the reaction can be catalysed exist and the faster the chemical reaction.

15a		In the example in the question, the main chain of the hydroxyl acid has 4 carbons and forms a lactone ring with 4 carbons and 1 oxygen in a ring of 5 This example has a hydroxyl acid has 5 carbons in main chain. This will then form a lactone ring with 5 carbons and 1 oxygen in a ring of 6.
15b	Diagram showing:	 • 4 carbons in main chain • -COOH on end • -OH on other end • $-CH_3$ group 2 carbons away from C=O bond
16a	Diagram showing:	
16b	One from:	• Burning magnesium should not be directly looked at when it is burning due to the bright light given off as it might damage your eyes. • Metal powders are not used as they would react too quickly (too violently)