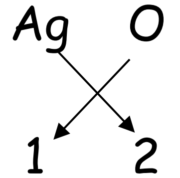
Past Papers
Int 2
Chemistry

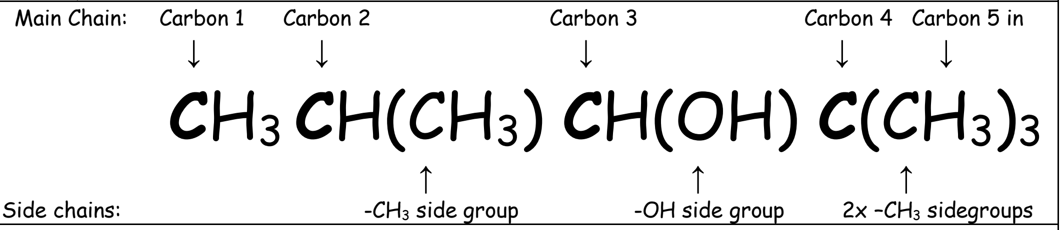
2009
Marking Scheme

Grade Awarded	Mark Required (/80)	%	% candidates achieving grade
A	55+	69%+	37.5%
B	47+	59%+	20.5%
C	40+	50%+	18.3%
D	36+	45%+	7.3%
No award	<36	<45%	16.4%

Section:	Multiple Choice	Extended Answer
Average Mark:	20.2 /30	29.5 /50

2009 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>A</td><td>95</td><td>☑A Argon is found in group 0 and is a noble gas
☒B Oxygen is found in group 6
☒C Fluorine is found in group 7 and is a halogen
☒D Nitrogen is found in group 5</td></tr>
<tr><td>2</td><td>C</td><td>69</td><td>Solute is the solid being dissolved.
• adding more solute will increase the concentration of the solution.
• Solvent is the liquid which is doing the dissolving
adding more solvent will decrease the concentration.</td></tr>
<tr><td>3</td><td>D</td><td>95</td><td>☒A zinc is below magnesium in the reactivity series so zinc reacts slower
☒B magnesium lumps react slower than magnesium powder due larger particle size
☒C zinc is below magnesium in the reactivity series so zinc reacts slower
☑D Fastest: most reactive metal + highest concentration + smallest particles size</td></tr>
<tr><td>4</td><td>B</td><td>89</td><td>☒A Isotopes have same number of protons but W=17 protons and X=11 protons
☑B Isotopes have same number of protons but different number of neutrons
☒C Isotopes have same number of protons but X=11 protons and Y=17 protons
☒D Isotopes have same number of protons but Y=17 protons and Z=18 protons</td></tr>
<tr><td>5</td><td>B</td><td>74</td><td>☒A Solutions of ions are written $Na^+(aq) + Cl^-(aq)$ not $Na^+(l) + Cl^-(l)$
☑B (s) = solid, (l) = liquid, (g) = gas and (aq) = aqueous
☒C water is written as $H_2O(l)$ as water is the solvent not the solute
☒D NaCl is a solid before it is dissolved in the solvent water.</td></tr>
<tr><td>6</td><td>A</td><td>70</td><td>☑A Metallic Bonding: positive ions with delocalised electrons
☒B Metallic bonding has positive ions (the nucleus and the inner electron shells)
☒C Ionic bonding: negative ion and positive ions attracted to each other
☒D Covalent bonding: a shared pair of electrons between two nuclei</td></tr>
<tr><td>7</td><td>D</td><td>81</td><td>The most polar bond has biggest difference in the attraction for electrons (C-F)
The least polar bond has smallest difference in the attraction for electrons (C-I)</td></tr>
<tr><td>8</td><td>C</td><td>43</td><td>☒A diagram shows a mixture of elements
☒B diagram shows a diatomic (two-atom) element
☑C diagram shows a diatomic (two-atom) compound
☒D diagram shows a triatomic (three-atom) compound</td></tr>
<tr><td>9</td><td>B</td><td>48</td><td>☒A diagram shows a covalent network (sodium chloride is ionic)
☑B diagram shows a ionic lattice and sodium chloride is ionic
☒C diagram shows a covalent molecules (sodium chloride is ionic)
☒D diagram shows a metallic substance (sodium chloride is ionic)</td></tr>
<tr><td>10</td><td>D</td><td>48</td><td>☒A copper ions gain electrons to become copper atoms: $Cu^{2+} + 2e^- \rightarrow Cu$
☒B bromide ions lose electrons to become bromine molecules: $2Br^- \rightarrow Br_2 + 2e^-$
☒C bromide ions lose electrons to become bromine molecules: $2Br^- \rightarrow Br_2 + 2e^-$
☑D copper ions gain electrons to become copper atoms: $Cu^{2+} + 2e^- \rightarrow Cu$</td></tr>
<tr><td>11</td><td>A</td><td>44</td><td><table><tr><th>Write down Formulae</th><th>Write Down Reverse of Cross Over Rule</th><th>Follow arrows to get formula</th></tr><tr><td>Ag_2O</td><td> </td><td>Valency of Ag=1
Valency of O=2</td></tr></table></td></tr>
</table>

<table>
<tr><td>12</td><td>B</td><td>55</td><td>☒A Water is formed from the complete combustion of hydrogen in a fuel
☑B Soot is carbon formed by incomplete combustion of fuels like diesel
☒C Carbon dioxide is formed by complete combustion
☒D Nitrogen Dioxide is formed by sparking of air not from the combustion of fuels</td></tr>
<tr><td>13</td><td>C</td><td>51</td><td>☒A $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$: carbon dioxide formed would turn limewater milky
☒B $CO + \frac{1}{2}O_2 \rightarrow CO_2$: carbon dioxide formed would turn limewater milky
☑C $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$: Water formed would condense in cold test tube
☒D $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$: carbon dioxide formed would turn limewater milky</td></tr>
<tr><td>14</td><td>D</td><td>77</td><td>
<table>
<tr><th>Property</th><th>Petroleum Gas</th><th>Gasoline</th><th>Kerosene</th><th>Light gas Oil</th><th>Heavy Gas Oil</th><th>Residue</th></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>
<tr><td>Molecule Size</td><td>Small</td><td colspan="4">⟷</td><td>Large</td></tr>
</table>
</td></tr>
<tr><td>15</td><td>C</td><td>87</td><td>☒A Cycloalkanes have general formula C_nH_{2n}: C_7H_{10} has wrong number of H atoms
☒B Cycloalkanes have general formula C_nH_{2n}: C_7H_{12} has wrong number of H atoms
☑C Cycloalkanes have general formula C_nH_{2n}: C_7H_{14} is cycloheptane
☒D Cycloalkanes have general formula C_nH_{2n}: C_7H_{16} has wrong number of H atoms</td></tr>
<tr><td>16</td><td>A</td><td>85</td><td>

$CH_3\ CH(CH_3)\ CH(OH)\ C(CH_3)_3$</td></tr>
<tr><td>17</td><td>D</td><td>73</td><td>☒A hydration would not produce 2-methylbutan-2-ol (-OH group on wrong carbon)
☒B hydration would not produce 2-methylbutan-2-ol(-OH group on wrong carbon)
☒C no C=C double bond for water to be added across (hydration)
☑D hydration reaction would produce 2-methylbutan-2-ol</td></tr>
<tr><td>18</td><td>A</td><td>37</td><td>☑A 2 carbon monomer (ethene) and 3 carbon monomer (propene)
☒B Largest monomer in plastic has 3 carbons (-CH_3 group off main chain)
☒C Largest monomer in plastic has 3 carbons (-CH_3 group off main chain)
☒D Largest monomer in plastic has 3 carbons (-CH_3 group off main chain)</td></tr>
<tr><td>19</td><td>D</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 Sol</td><td>Blue→Brick Red</td><td>Blue→Brick Red</td><td>Blue→Brick Red</td><td>No reaction</td><td>No reaction</td></tr>
</table>
</td></tr>
<tr><td>20</td><td>A</td><td>70</td><td>☑A Hydrolysis of fat: fat → glycerol + 3 fatty acids
☒B Esterification: alcohol + carboxylic acid → ester + water
☒C Condensation: small molecules join together with water removed at the join
☒D Neutralisation: acids reacting to form water</td></tr>
<tr><td>21</td><td>D</td><td>81</td><td>☒A metal oxides e.g. calcium oxide dissolve in water to form alkalis
☒B non-metal oxides e.g. carbon dioxide dissolve in water to form acids
☒C non-metal oxides e.g. sulphur dioxide dissolve in water to form acids
☑D zinc oxide is insoluble in water (p8 of data booklet) so pH is unchanged</td></tr>
<tr><td>22</td><td>B</td><td>86</td><td>
<table>
<tr><td>Test</td><td>Test 1</td><td>Test 2</td></tr>
<tr><td>Result</td><td>Lime water turns milky</td><td>Blue-green flame colour</td></tr>
<tr><td>Conclusion</td><td>Compound X is a carbonate</td><td>Compound X contains copper ions</td></tr>
</table>
</td></tr>
<tr><td>23</td><td>A</td><td>53</td><td>
<table>
<tr><th>Acid</th><th>pH</th><th>Conductivity</th><th>Rate of Reaction</th></tr>
<tr><td>0.1 mol l^{-1} hydrochloric acid</td><td>lower</td><td>higher</td><td>faster</td></tr>
<tr><td>0.1 mol l^{-1} ethanoic acid</td><td>higher</td><td>lower</td><td>slower</td></tr>
</table>
</td></tr>
</table>

24	D	46	☒A both forward and reverse reaction proceed at equal rates ☒B water is mainly molecules with few ions ☒C water is mainly molecules with few ions ☑D rate of forward reaction = rate of reverse reaction ∴ concentrations remain constant
25	C	57	☒A No C=C double bonds to add a molecule across ☒B No acid (H^+ ions) present to be reacted into water. ☑C Precipitation: insoluble solid product formed during reaction ☒D No gain or loss of electrons so not a redox reaction
26	C	65	☒A no gas passes through water so soluble gas is not removed ☒B gas does not pass through water and gas cannot escape on other side ☑C Gas passes through water, soluble gas is removed and remaining gas passes out ☒D gas cannot escape on other side
27	A	80	☑A Highest voltage and electrons flow from X (magnesium) to Y (copper) ☒B Electron flow is from Y to X as Y (magnesium) is more reactive than X (copper) ☒C Not highest voltage as zinc/tin is not as far apart magnesium/copper ☒D Electron flow is from Y to X as Y (zinc) is more reactive than X (tin)
28	C	53	☒A Electrons are gained in reduction and appear before the arrow in an equation ☒B Electrons are gained in reduction and appear before the arrow in an equation ☑C Titanium atoms are oxidised as electrons are lost (electrons after the arrow) ☒D Titanium ions are products and are the products of the oxidation
29	A	73	☑A S is most reactive, R is least reactive and P is more reactive than Q ☒B S is more reactive than P as electrons flow from S to P ☒C R is least reactive metal as it is obtained by heating ore alone ☒D P is more reactive than Q as P displaces Q from solution
30	B	67	☒A Ferroxyl indicator turns pink in the presence of OH^- ions ☑B Ferroxyl indicator turns blue in the presence of Fe^{2+} ions ☒C Fe^{3+} ions have no effect on ferroxyl indicator ☒D Cu^{2+} ions have no effect on ferroxyl indicator

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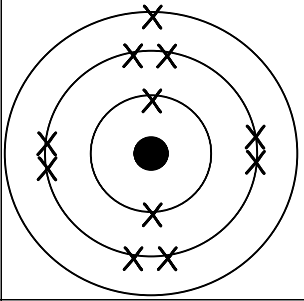
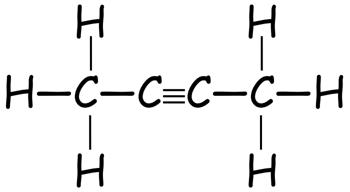
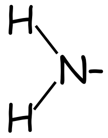
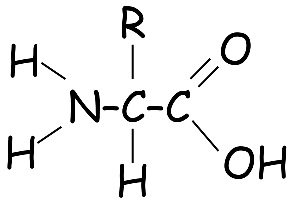
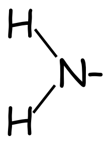
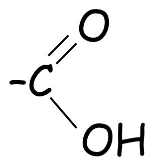
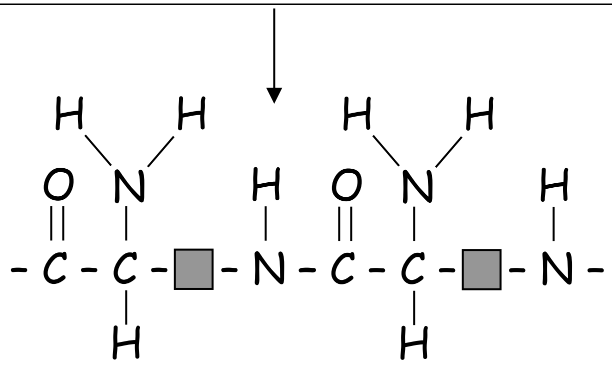
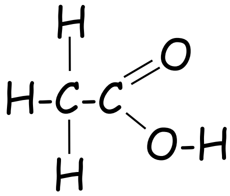
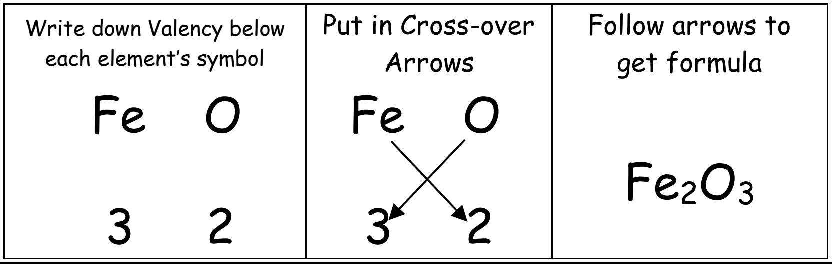
<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1a</td><td>11
13</td><td>No. of protons = atomic number = 11 = 11
No. of neutrons = mass number – atomic number = 24 – 11 = 13
No of electrons = atomic number - charge = 11 – 0 = 11</td></tr>
<tr><td>1b(i)</td><td></td><td>Sodium has an electron arrangement of 2,8,1 (p6 data booklet)
• inner shell holds a maximum of 2 electrons
• next shell holds a maximum of 8 electrons
• next shell has one electron (but can hold a maximum of 8)</td></tr>
<tr><td>1b(ii)</td><td>Positive nucleus attracts electrons</td><td>The positively charge nucleus is attracted to the negatively charges electrons spinning around the nucleus.</td></tr>
<tr><td>2a</td><td><table><tr><th>Equipment</th><th>Label</th></tr><tr><td>Flask</td><td>Potassium permanganate + hydrochloric acid</td></tr><tr><td>Test Tube 1</td><td>Water</td></tr><tr><td>Test Tube 2</td><td>concentrated sulphuric acid</td></tr></table></td><td>Problem Solving: information transfer from written passage to diagram</td></tr>
<tr><td>2b(i)</td><td>Higher the atomic no, the higher the melting point</td><td>Problem Solving: Interpretation of graph & conclusion formation</td></tr>
<tr><td>2b(ii)</td><td>450°C ±20°C</td><td>Problem Solving: Prediction from a graph</td></tr>
<tr><td>3a</td><td>exothermic</td><td>Exothermic Reactions: Heat energy given out
Endothermic Reaction: Energy absorbed from the surroundings</td></tr>
<tr><td>3b(i)</td><td>Line graph showing:</td><td>½mark: labelling axes ½mark: correct scales ½mark: plotting points ½mark: drawing line</td></tr>
<tr><td>3b(ii)</td><td>13g</td><td>Problem Solving: estimation of point on graph</td></tr>
<tr><td>3c</td><td>Reduces heat loss to surroundings</td><td>Polystyrene is a poor conductor of heat and reduces heat loss during the experiment.</td></tr>
<tr><td>4a</td><td>$Fe_2O_3 + 3CO$
↓
$2Fe + 3CO_2$</td><td>$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$</td></tr>
<tr><td>4b</td><td>5600</td><td>gfm C = 12g
$\text{no of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1200000\text{g}}{12\text{ g mol}^{-1}} = 100000\text{ mol}$
$$CO_2 + \underset{\substack{1\text{mol}\\100000\text{mol}}}{C} \longrightarrow \underset{\substack{2\text{mol}\\200000\text{mol}}}{2CO}$$
Gfm Co = (1x12)+(1x16) = 12+16 = 28g
mass = **n**o. of mol x **gfm** = 200000 x 28 = 5600000g = 5600kg</td></tr>
</table>

4c	To provide oxygen in Zone 1	Oxygen is a reactant in the reaction in zone 1: $C + O_2 \rightarrow CO_2$
5a	Gases have different boiling points	Fractional distillation separates substances with different boiling points
5b	Liquid	200°C is below this temperature that Nitrogen boils (-196°C) ∴ nitrogen has yet to boil at this temperature and is still a liquid
5c	Neutralisation	Carbon dioxide is a non-metal oxide and dissolves in water to form an acid This acid reacts with the alkali sodium hydroxide by a neutralisation reaction
6a	A substance which burns to give out energy	Fuels are burned for the purpose of releasing energy which can then be used for a purpose.
6b(i)	Number between 0 → 19	Problem Solving: Estimation of octane number from table of information
6b(ii)	One from:	The longer the carbon chain the more efficient the fuel Branch chains increase the efficiency of the fuel
7a	Aluminium oxide	Cracking is the process where less useful, longer saturated chains are broken into more useful, shorter chains that can be unsaturated.
7b(i)	C_4H_8 or butene	$C_{12}H_{26} \longrightarrow C_8H_{18} + C_4H_8$
7b(ii)	Bromine solution decolourises	Bromine solution reacts with C=C double bonds and decolourises from brown to colourless as it reacts
8a	ethyne	Alkynes have a C≡C triple bond as a functional group: H - C ≡ C - H
8b(i)	Structure of but-2-yne	
8b(ii)	Bromine atoms must be on adjacent carbons	For this reaction, the bromine atoms must be on adjacent carbons (carbons next door to each other)
9a		 Amino Acid  Amine group  Carboxyl group
9b	Amino acids	
9c	Diagram showing:	
10a	starch + water → glucose	$\text{starch} + \text{water} \xrightarrow{\text{hydrolysis}} \text{glucose}$ $(C_6H_{10}O_5)_n + nH_2O \longrightarrow C_6H_{12}O_6$

<table>
<tr><td>10b</td><td>fermentation</td><td>glucose $\xrightarrow[\text{(no air)}]{\text{enzymes}}$ ethanol + carbon dioxide
$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$</td></tr>
<tr><td>10c</td><td></td><td>Ethanoic acid has two carbons and a carboxyl -COOH functional group</td></tr>
<tr><td>10d</td><td>Methyl ethanoate</td><td>alcohol + carboxylic acid ⟶ ester + water
<i>meth</i>anol + ethanoic acid ⟶ <i>methyl</i> ethanoate + water
NB: <i>Alcohol</i> name comes first in ester, carboxylic acid name comes second</td></tr>
<tr><td>11a</td><td>biological catalyst</td><td>Enzymes are biological catalysts made of protein. They catalyse the chemical reactions in living organisms at body temperatures.</td></tr>
<tr><td>11b(i)</td><td>Partial ionisation or dissociation of ions</td><td>Strong Alkalis: full dissociation (ionisation) of ions
Weak Alkali: partial dissociation (ionisation) of molecules into ions</td></tr>
<tr><td>11b(ii)</td><td>Titration</td><td>The technique where acids and alkalis are accurately measured from a burette is called titration.</td></tr>
<tr><td>12a</td><td>167</td><td>$\text{Time} = \frac{1}{\text{rate}} = \frac{1}{0.006} = 166.7\text{s}$</td></tr>
<tr><td>12b</td><td>Increased surface area so more success collisions to take place</td><td><table>
<tr><th>Factor</th><th>Increase in Rate by</th><th>Collision Theory</th></tr>
<tr><td>Concentration</td><td>Increased concentration</td><td>High concentration increase the number of collisions which increases the number of successful collisions</td></tr>
<tr><td>Temperature</td><td>Increased temperature</td><td>Higher temperature increases the number of collisions and the energy of the collisions which increases the number of successful collisions</td></tr>
<tr><td>Surface Area</td><td>Decreased particle size</td><td>Smaller particle size means more particles to collide with each other and increases the number of successful collisions</td></tr>
</table></td></tr>
<tr><td>12c(i)</td><td>0.1</td><td>no. of moles = volume x concentration = 0.1litres x 1.0mol l^{-1} = 0.1mol</td></tr>
<tr><td>12c(ii)</td><td>0.25</td><td>$2MnO_4^- + 5C_2H_2O_4 + 6H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
2mol 5mol
0.1mol 5mol x $^{0.1}/_2$
= 0.25mol</td></tr>
<tr><td>13a</td><td>No more solid reacts with acid</td><td>The solid will continue to react with the acid, giving off a gas, until the acid is all reacted. The unreacted solid will lie on the bottom of the beaker as it is insoluble.</td></tr>
<tr><td>13b</td><td>To ensure all the acid has reacted</td><td>It is important that no acid remains and is all reacted. Using an insoluble solid means that all the acid can be reacted and the excess solid removed by filtration.</td></tr>
<tr><td>13c</td><td>$H_2SO_4 + MgCO_3$
↓
$MgSO_4 + \mathbf{H_2O} + \mathbf{CO_2}$</td><td>acid + metal carbonate ⟶ salt + water + carbon dioxide
sulphuric acid + magnesium carbonate ⟶ magnesium sulphate + water + carbon dioxide
$H_2SO_4 + MgCO_3 \longrightarrow MgSO_4 + H_2O + CO_2$</td></tr>
<tr><td>14a</td><td>Fe_2O_3</td><td>
<table>
<tr><td>Write down Valency below each element's symbol
Fe O
3 2</td><td>Put in Cross-over Arrows
Fe O
3 2</td><td>Follow arrows to get formula
Fe_2O_3</td></tr>
</table></td></tr>
<tr><td>14b</td><td>$Fe^{2+} \rightarrow Fe^{3+} + e^-$</td><td>$Fe^{2+} \rightarrow Fe^{3+} + e^-$</td></tr>
<tr><td>14c</td><td>Iron sacrificially protects lower down lead</td><td>Lead is protected by the iron by sacrificial protection. Iron provides the lead with electrons to stop the lead corroding.</td></tr>
</table>

<table>
<tr><td>15a</td><td>$OH^- + H^+ \rightarrow H_2O$</td><td>$2Na^+ + 2OH^- + 2H^+ + SO_4^{2-} \rightarrow 2Na^+ + SO_4^{2-} + 2H_2O$
Cancel out any spectator ions which appear on both sides
$\cancel{2Na^+} + 2OH^- + 2H^+ + \cancel{SO_4^{2-}} \rightarrow \cancel{2Na^+} + \cancel{SO_4^{2-}} + 2H_2O$
Re-write equation omitting spectator ions
$2OH^- + 2H^+ \rightarrow 2H_2O$</td></tr>
<tr><td>15b(i)</td><td>Barium hydroxide has higher concentration of OH^- ions</td><td><table>
<tr><td>Compound</td><td>Sodium Hydroxide</td><td>Barium Hydroxide</td></tr>
<tr><td>Formula</td><td>$NaOH$</td><td>$Ba(OH)_2$</td></tr>
<tr><td>OH^- ions concentration</td><td>1 OH^- ion per formula unit</td><td>2 OH^- ions per formula unit</td></tr>
</table></td></tr>
<tr><td>15b(ii)</td><td>There are no free ions in the solution</td><td>$Ba^{2+} + 2OH^- + 2H^+ + SO_4^{2-} \longrightarrow BaSO_{4(s)} + 2H_2O_{(l)}$
Insoluble solid formed and no ions on product side to complete the circuit</td></tr>
</table>