JABchem

Past Papers Int 2 Chemistry

2015

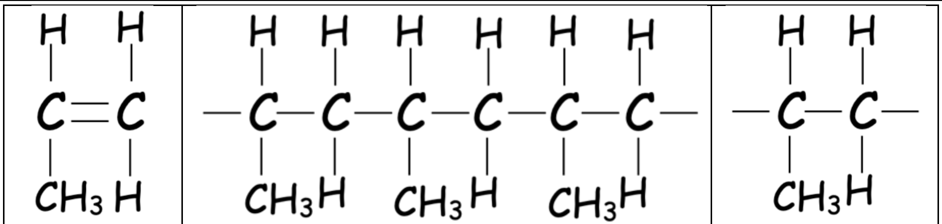
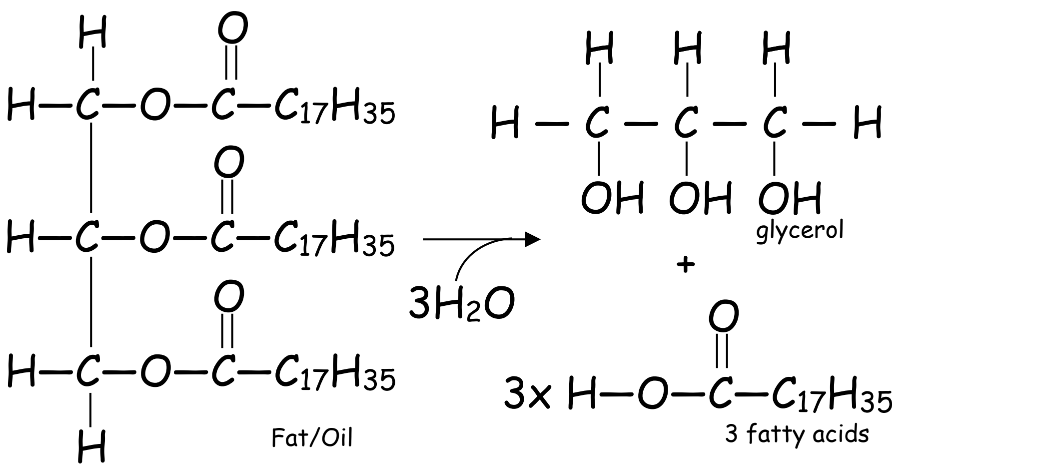
Marking Scheme

Grade Awarded	Mark Required (/80)	%	% candidates achieving grade
A	56+	70%+	46.1%
B	48+	60%+	19.8%
C	40+	50%+	15.7%
D	36+	%40+	5.0%
No award	<36	<40%	13.4%

Section:	Multiple Choice	Extended Answer
Average Mark:	22.5 /30	30.8 /50

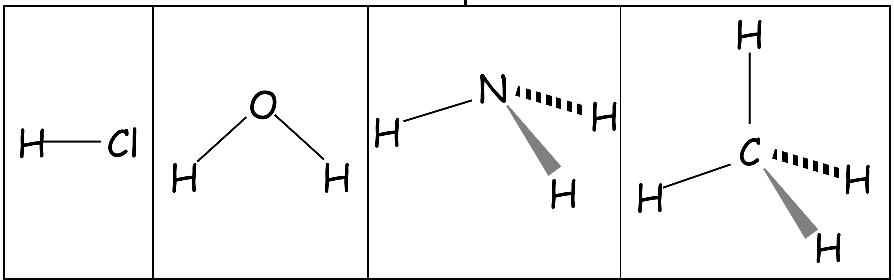
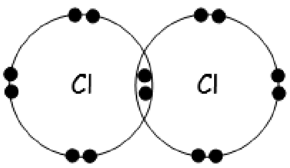
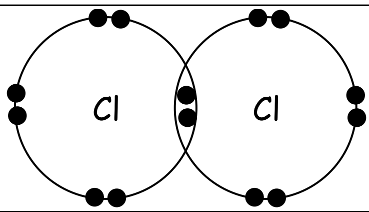
2015 Int2 Chemistry Marking Scheme

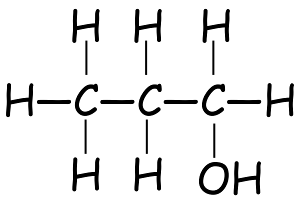
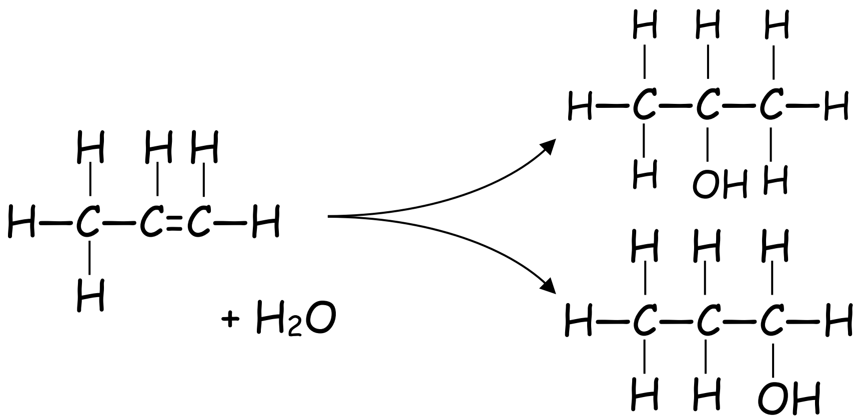
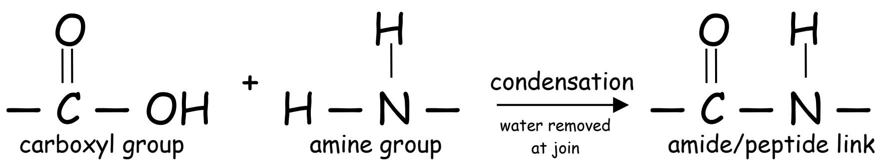
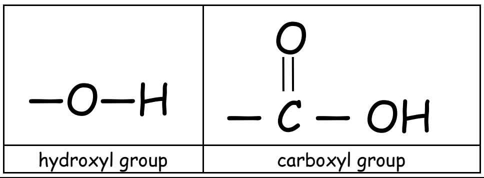
<table>
<tr><th>MC Qu</th><th>Answer</th><th>% Pupils Correct</th><th>Reasoning</th></tr>
<tr><td>1</td><td>C</td><td>94</td><td>☒A water is a compound of hydrogen and oxygen with formula H_2O
☒B methane is a compound of carbon and hydrogen with formula CH_4
☑C fluorine is a diatomic element with formula F_2
☒D ammonia is a compound of nitrogen and hydrogen with formula NH_3</td></tr>
<tr><td>2</td><td>C</td><td>93</td><td>☒A zinc is a transition metal ∴ different chemical properties to group 0 argon
☒B potassium is in group 1 ∴ different chemical properties to group 0 argon
☑C krypton and argon have same chemical properties as they are both in group 0
☒D chlorine is in group 7 ∴ different chemical properties to group 0 argon</td></tr>
<tr><td>3</td><td>A</td><td>86</td><td><table><tr><td>Gas in Air</td><td>Nitrogen</td><td>Oxygen</td><td>Carbon Dioxide</td><td>Noble Gases</td></tr><tr><td>% in Air</td><td>78%</td><td>21%</td><td>0.03%</td><td>1%</td></tr></table></td></tr>
<tr><td>4</td><td>B</td><td>83</td><td>☒A Solute: the substance which is dissolved
☑B Solvent: the liquid which does the dissolving
☒C Solution: the mixture formed when solute dissolves in solvent
☒D Saturated: a solution where no more solute can dissolve in the solvent</td></tr>
<tr><td>5</td><td>C</td><td>60</td><td>$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{1.00 - 0.25}{25 - 0} = \frac{0.75}{25} = 0.03\text{mol l}^{-1}\text{ s}^{-1}$</td></tr>
<tr><td>6</td><td>D</td><td>89</td><td>☒A magnesium powder is faster than magnesium ribbon
☒B magnesium powder is faster than magnesium ribbon
☒C 4mol l^{-1} hydrochloric acid is faster than 2mol l^{-1} hydrochloric acid
☑D 2mol l^{-1} hydrochloric acid and magnesium ribbon would be the slowest reaction</td></tr>
<tr><td>7</td><td>D</td><td>84</td><td>☒A the number of protons + neutrons is the mass number (not the atomic number)
☒B the number of neutrons is independent of the number of protons and electrons
☒C the number of neutrons is independent of the number of protons and electrons
☑D atoms are neutral as number of protons = number of electrons</td></tr>
<tr><td>8</td><td>B</td><td>95</td><td>☒A halogens are in group 7 and have 7 outer electrons
☑B noble gases are in group 0 and have 8 outer electrons (except helium with 2)
☒C alkali metals are in group 1 and have 1 outer electron
☒D transition metals have a variety of outer electrons, usually 2</td></tr>
<tr><td>9</td><td>B</td><td>68</td><td><table><tr><td>Iron nitrate has the formula</td><td>Nitrate ions have the formula</td><td>3 nitrate ions per iron nitrate</td><td>iron ion must have 3+ charge to balance charge</td></tr><tr><td>$Fe(NO_3)_3$</td><td>NO_3^-</td><td>$Fe^{n+}(NO_3^-)_3$</td><td>$Fe^{3+}(NO_3^-)_3$</td></tr></table></td></tr>
<tr><td>10</td><td>A</td><td>87</td><td>☑A gfm SO_2 = (1x32)+(2x16) = 32+32 =64g ∴ mass = n x gfm = 0.2 x 64 = 12.8g
☒B 1mol CO = (1x12)+(1x16) = 12+16 =28g ∴ mass = n x gfm = 0.2 x 28 = 5.6g
☒C 1mol CO_2 = (1x12)+(2x16) = 12+32 =44g ∴ mass = n x gfm = 0.2 x 44 = 8.8g
☒D 1mol NH_3 = (1x14)+(3x1) = 14+1 =17g ∴ mass = n x gfm = 0.2 x 17 = 3.4g</td></tr>
<tr><td>11</td><td>C</td><td>49</td><td>$2Al + CuSO_4 \longrightarrow 3Cu + Al_2(SO_4)_3$
2mol → 3mol
1mol → 1.5mol</td></tr>
<tr><td>12</td><td>A</td><td>48</td><td>☑A nitrogen dioxide is formed by the sparking of air to join nitrogen and oxygen
☒B carbon monoxide is formed by the incomplete combustion of fuel
☒C carbon (soot) is formed by the incomplete combustion of fuel
☒D unburnt hydrocarbons is formed by the incomplete combustion of fuel</td></tr>
<tr><td>13</td><td>B</td><td>38</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>Flammability</td><td>High</td><td colspan="4">←→</td><td>Low</td></tr><tr><td>Evaporation</td><td>Easy</td><td colspan="4">←→</td><td>Hard</td></tr></table></td></tr>
</table>

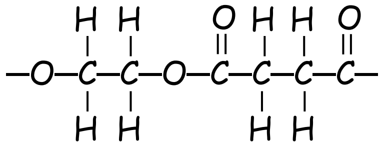
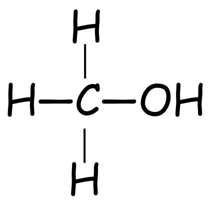
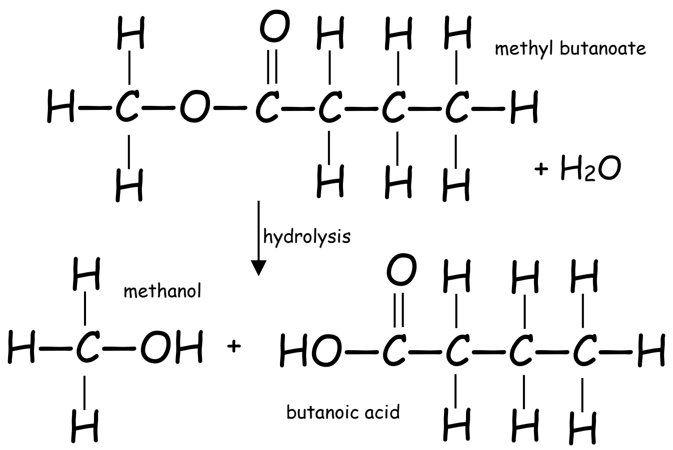
<table>
<tr><td>14</td><td>A</td><td>85</td><td>
<table>
<tr><th>General Formula</th><th>if n=4</th><th>if n=5</th><th>if n=6</th></tr>
<tr><td>C_nH_{2n-2}</td><td>$C_4H_{(2x4)-2} = C_4H_6$</td><td>$C_5H_{(2x5)-2} = C_5H_8$</td><td>$C_6H_{(2x6)-2} = C_6H_{10}$</td></tr>
<tr><td>C_nH_{2n-4}</td><td>$C_4H_{(2x4)-4} = C_4H_4$</td><td>$C_5H_{(2x5)-4} = C_5H_6$</td><td>$C_6H_{(2x6)-4} = C_6H_8$</td></tr>
<tr><td>C_nH_{2n}</td><td>$C_4H_{(2x4)} = C_4H_8$</td><td>$C_5H_{(2x5)} = C_5H_{10}$</td><td>$C_6H_{(2x6)} = C_6H_{12}$</td></tr>
<tr><td>C_nH_{2n+2}</td><td>$C_4H_{(2x4)+2} = C_4H_{10}$</td><td>$C_5H_{(2x5)+2} = C_5H_{12}$</td><td>$C_6H_{(2x6)+2} = C_6H_{14}$</td></tr>
</table>
</td></tr>
<tr><td>15</td><td>C</td><td>51</td><td>☒A longest chain is this structure is 4 carbons ∴ name ends in butane
☒B longest chain is this structure is 4 carbons ∴ name ends in butane
☑C longest chain of 4 carbons and 1 carbon sidegroup on C_2 ∴ 2-methylbutane
☒D numbering system must give the methyl the lowest number possible (i.e. 2)</td></tr>
<tr><td>16</td><td>B</td><td>82</td><td>☒A structure drawn a molecular formula of C_6H_{14} but heptane has formula C_7H_{16}
☑B structure drawn has formula C_7H_{16} and a different structure from heptane
☒C structure drawn a molecular formula of C_7H_{14} but heptane has formula C_7H_{16}
☒D structure drawn a molecular formula of C_6H_{12} but heptane has formula C_7H_{16}</td></tr>
<tr><td>17</td><td>D</td><td>75</td><td>☒A cyclopentane C_5H_{10} does not decolourise bromine solution as it has no C=C bond
☒B cyclopentene C_5H_8 does not fit the general formula C_nH_{2n}
☒C pentane C_5H_{12} does not decolourise bromine solution as it has no C=C bond
☑D pentene C_5H_{10} decolourises bromine solution and fits general formula C_nH_{2n}</td></tr>
<tr><td>18</td><td>B</td><td>94</td><td>$C_{22}H_{46} \longrightarrow C_{10}H_{22} + C_8H_{16} + C_4H_8$</td></tr>
<tr><td>19</td><td>A</td><td>61</td><td>☑A Fermentation: glucose broken down into ethanol and CO_2 in anaerobic conditions
☒B Combustion: substance burns and elements join with oxygen
☒C Condensation: two molecules join together with water removed at the join
☒D Photosynthesis: carbon dioxide and water join to form glucose and oxygen</td></tr>
<tr><td>20</td><td>C</td><td>90</td><td>☒A Polystyrene is an addition polymer used in corner packaging
☒B Nylon is a polyamide used in used in durable plastics e.g. toothbrush bristles
☑C poly(ethenol) is a water-soluble polymer used in hospital laundry bags
☒D Kevlar is a very strong polymer used in bullet-proof vests</td></tr>
<tr><td>21</td><td>A</td><td>76</td><td>
Monomer | Polymer | Repeating Unit</td></tr>
<tr><td>22</td><td>D</td><td>83</td><td>☒A C_6H_6O is not a carbohydrate as the ratio of H:O is not 2:1 (as in water)
☒B $C_6H_6O_6$ is not a carbohydrate as the ratio of H:O is not 2:1 (as in water)
☒C $C_6H_8O_6$ is not a carbohydrate as the ratio of H:O is not 2:1 (as in water)
☑D $C_6H_6O_6$ is a carbohydrate where the ratio of H:O is 2:1 (as in water)</td></tr>
<tr><td>23</td><td>C</td><td>79</td><td>
</td></tr>
</table>

24	B	83	☒A carbon dioxide is a non-metal oxide which dissolves in water to form an acid ☑B copper oxide is not soluble in water and would not change the pH of water ☒C sodium oxide is a metal oxide which dissolves in water to form an alkali ☒D sulphur dioxide is a non-metal oxide which dissolves in water to form an acid
25	B	55	☒A sodium carbonate + hydrochloric acid ⟶ sodium chloride + water + carbon dioxide ☑B sodium chloride does not react with hydrochloric acid as it is not a base ☒C sodium hydroxide + hydrochloric acid ⟶ sodium chloride + water ☒D sodium oxide + hydrochloric acid ⟶ sodium chloride + water
26	C	55	☒A copper metal does not react with dilute acid as copper is below hydrogen in ECS ☒B copper oxide + hydrochloric acid ⟶ copper chloride + water ☑C copper carbonate + hydrochloric acid ⟶ copper chloride + water + carbon dioxide ☒D copper hydroxide + hydrochloric acid ⟶ copper chloride + water
27	A	97	☑A hydrogen burns with a pop ☒B oxygen relights a glowing splint ☒C hydrogen chloride and sulphur dioxide turn damp pH paper red ☒D carbon dioxide turns limewater milky
28	D	73	☒A ammonium nitrate NH_4NO_3 contains the element nitrogen ☒B ammonium sulphate $(NH_4)_2SO_4$ contains the element nitrogen ☒C potassium nitrate KNO_3 contains the element nitrogen ☑D potassium sulphate K_2SO_4 cannot be used as a fertiliser as it lacks nitrogen
29	C	79	☒A addition: a molecule adds across a C=C double bond ☒B neutralisation: acid (H^+ ions) react with a base to form water (H_2O) ☑C precipitation: an insoluble of solid is formed during reaction ☒D redox: a reaction where transfer of electrons takes place during reaction
30	A	58	☑A calcium forms as a solid on the surface due to density and melting point. ☒B calcium is a solid as it melts at 842°C and the temperature used is 800°C ☒C Calcium formed on surface as it has a lower density than calcium chloride ☒D Calcium formed on surface as it has a lower density than calcium chloride

2015 Int2 Chemistry Marking Scheme

Long Qu	Answer	Reasoning
1a	126	no. of neutrons = mass number – atomic number = 210 – 84 = 126
1b	Answer from:	Same atomic number but different mass number Same number of protons but different number of neutrons
1c	225-235 days	Time when radioactivity = 100cpm is 0 days Time when radioactivity = 210cpm is 230 days ∴time for radioactivity to fall from 100cpm to 20cpm = 230 – 0 = 230 days
2a	tetrahedral	Chloroform $CHCl_3$ has the same shape as methane CH_4  linear | angular | trigonal pyramidal | tetrahedral
2b(i)	weak strong	The bonds inside molecules are covalent bonds which are strong bonds. The bonds between molecules are not covalent bonds and these bonds are much easier to overcome so they are weak bonds.
2b(ii)	One answer from:	Chlorine has stronger attraction for electrons Chlorine pulls electrons more Electrons not shared equally Hydrogen less attraction for electrons Hydrogen pull electrons less Different electronegativities Attraction for the (bonded) electrons is different
3a	Diagram completed as shown:	(concentrated) hydrochloric acid water (concentrated) sulphuric acid chlorine
3b	 	Each chlorine atom has 7 electrons of its own and shares an electron with another chlorine to achieve a stable full outer shell of 8 electrons. 
4a	(A substance which) burns to produce energy	A fuel is a substance which burns to produce energy. Oxygen gas is required for any substance to burn
4b(i)	sodium hydroxide or sodium oxide	$NaH + H_2O \longrightarrow H_2 + \mathbf{NaOH}$ or $2NaH + H_2O \longrightarrow 2H_2 + \mathbf{Na_2O}$
4b(ii)	Na^+H^-	Sodium is a group 1 metal so forms an sodium ion with formula Na^+ The negative ion to balance this is the hydride ion will formula H^-. The cross over rule would give the formula NaH as both ions have a valency of one.
5a	covalent or covalent molecular	Titanium chloride is a compound containing a metal and a non-metal. This would normally form an ionic compound. However, ionic compounds are all solids at room temperature with high melting points but titanium chloride is a liquid at room temperature. Metallic bonding can be ruled out as it is a compound so (molecular) covalent is left due to the low melting and boiling points.

<table>
<tr><td>5b(i)</td><td>$TiCl_4 + 4Na$
↓
$Ti + 4NaCl$</td><td>$TiCl_4 + 4Na \longrightarrow Ti + 4NaCl$</td></tr>
<tr><td>5b(ii)</td><td>Titanium is less reactive than sodium</td><td>More reactive metals will displace lower down metals from their ions/ compounds. Sodium is more reactive than titanium as the sodium metal becomes sodium ions and titanium in the compound is becoming the metal to accept the electrons released by the sodium as it become ions.</td></tr>
<tr><td>5b(iii)</td><td>Unreactive atmosphere or no oxygen to react</td><td>Sodium is a very reactive metal which must be kept away from oxygen or water so it would not react before the intended reaction. Argon is an unreactive gas and would prevent sodium from reacting.</td></tr>
<tr><td>6a</td><td>propan-2-ol</td><td>Propan -2- ol
3 carbons / -OH on C / -OH functional group</td></tr>
<tr><td>6b(i)</td><td></td><td></td></tr>
<tr><td>6b(ii)</td><td>addition
or hydration</td><td>Addition reactions happen when as small molecule adds directly across a carbon to carbon double bond.
Cl_2, F_2, Br_2, I_2, H_2, H_2O, HCl, HBr, HF and HI are all capable of adding across a double bond.</td></tr>
<tr><td>7a(i)</td><td>serine</td><td>The apple juice has separated into two spots on the chromatogram, one of the spots corresponds to serine.</td></tr>
<tr><td>7a(ii)</td><td>One
answer from:</td><td><table>
<tr><td>Not enough amino acids samples</td><td>Not one of amino acids tested for</td><td>Spots didn't match up/line up</td></tr>
<tr><td>Its higher than the known amino acids</td><td>It doesn't reach to known amino acids</td><td>Different amino acid</td></tr>
<tr><td colspan="3">Travelled different distance to known amino acids</td></tr>
</table></td></tr>
<tr><td>7b</td><td>amide link
or peptide link</td><td></td></tr>
<tr><td>8a</td><td>Carboxyl</td><td></td></tr>
<tr><td>8b(i)</td><td>Condensation
(polymerisation)</td><td><table>
<tr><th>Polymerisation</th><th>Description</th></tr>
<tr><td>Addition</td><td>Monomers with C=C double bonds open up the double bonds and join together to make a long polymer with single C-C bonds.</td></tr>
<tr><td>Condensation</td><td>Monomers with two functional groups (usually –OH, -COOH or –NH_2) join together to make a polymer with a small molecule like water removed at every join.</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>8b(ii)</td><td>Diagram showing:</td><td></td></tr>
<tr><td>9a</td><td>Supply energy</td><td><table><tr><th>Type of Food</th><th>Use in Body</th></tr><tr><td>Fats/Oil</td><td>for energy</td></tr><tr><td>Carbohydrates</td><td>for energy</td></tr><tr><td>Proteins</td><td>for growth and repair</td></tr></table></td></tr>
<tr><td>9b</td><td>Oils are more unsaturated or oils have more double bonds</td><td>Any answer from:<table><tr><td>Oils have greater unsaturation compared to fats</td><td>Fats have less carbon to carbon double bonds</td><td>Oils have more carbon to carbon double bonds</td></tr><tr><td>Oils are unsaturated</td><td>Oils have more unsaturation</td><td>Fats are saturated</td></tr><tr><td>Fats are greater saturation compared to oils</td><td>Fats have more saturation</td><td>Fats have less unsaturation</td></tr></table></td></tr>
<tr><td>9c</td><td>heterogenous</td><td><table><tr><th>Type of Catalyst</th><th>Definition</th></tr><tr><td>Homogeneous</td><td>Catalyst in same. state as reactants</td></tr><tr><td>Heterogeneous</td><td>Catalyst in different state from reactants</td></tr></table></td></tr>
<tr><td>10a</td><td>hydrolysis</td><td>Esters are made from an alcohol and a carboxylic acid by a condensation reaction where water is removed as they join.
Esters are broken down by a hydrolysis reaction where water is added back into the molecule as it splits to form an alcohol and a carboxylic acid.</td></tr>
<tr><td>10b</td><td></td><td></td></tr>
<tr><td>11a</td><td>Any answer from:</td><td><table><tr><td>(Same) volume
(of sodium chloride)</td><td>(Same) volume
(of sodium chloride)</td><td>(Same) concentration
(of sodium chloride)</td><td>Number of moles</td></tr><tr><td>$50cm^3$</td><td>$0.1\ mol\ l^{-1}$</td><td>(same) size of metals</td><td>temperature</td></tr><tr><td colspan="2">Depth of metals in solution</td><td colspan="2">(same) surface area of metals</td></tr></table></td></tr>
<tr><td>11b(i)</td><td>Any answer from:</td><td><table><tr><td>The greater the difference in reactivity (between the metals) the greater the voltage</td><td>The more reactive, the less the voltage</td></tr><tr><td>Metals close to Mg on the Electrochemical Series will produce lower voltage</td><td>The less reactive the metal, the greater the voltage</td></tr></table></td></tr>
<tr><td>11b(ii)</td><td>Value greater than 2.25</td><td>Magnesium and Lead produce a voltage of 2.25V. Magnesium and Copper will produce a bigger voltage because Copper is lower on the electrochemical series than Lead.
There is a greater voltage in a Magnesium/Copper cell than Magnesium/Lead cell.</td></tr>
<tr><td>11c</td><td>Complete the circuit or allow ions to move</td><td>The ionic solution of sodium chloride provide the ions needed to complete the circuit. Ions move to balance the charge in the cell caused by the movement of electrons through the wires from the magnesium electrode to the lead electrode.</td></tr>
<tr><td>12a</td><td>One from:</td><td><table><tr><td>Boil it</td><td>Heat it</td><td>Leave it overnight</td><td>on windowsill</td><td>Use a Bunsen</td></tr></table></td></tr>
</table>

12b	0.2	1mol $CuSO_4$ = (1x63.5)+(1x32)+(4x16)=63.5+32+64 = 159.5g no of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{3.19}{159.5}$ = 0.02mol concentration = $\frac{\text{no of mol}}{\text{volume}} = \frac{0.02\text{mol}}{0.1\text{litres}}$ = 0.2mol l^{-1}
13a	Aluminium sacrificially protects steel <u>or</u> aluminium loses electrons to steel	If the aluminium layer comes into contact with the iron layer underneath, the Aluminium will corrode to protect the less reactive iron due to sacrificial protection. The electrons released by the corrosion of aluminium will travel to the iron to protect the iron from corroding.
13b	$Al \rightarrow Al^{3+} + 3e^-$	Electrons are always on the right of an equation to be a corrosion reaction. The data book always list equations as reduction reactions with electrons on the left of the equation. The equation is flipped to become an oxidation reaction.
13c	Stops oxygen or Stops water or Stops oxygen & water	Both oxygen and water are required for corrosion to take place. Any method which either oxygen or water (or both) getting to the metal will prevent corrosion from taking place.
14a(i)	Sulphuric acid	Acid + Metal ⟶ Salt + Hydrogen Sulphuric acid + Magnesium ⟶ magnesium sulphate + hydrogen
14a(ii)	No more bubbling	Any answer from: No more bubbles of gas | Solid left at bottom | Unreacted magnesium left | Magnesium stops reacting
14a(iii)	Remove (unreacted/excess) magnesium	Magnesium added to the sulphuric acid will continue to react until there is no sulphuric acid left. At this point, all the additional magnesium added will lie on the bottom of the beaker as it is insoluble in water. Filtration will removed the solid from the liquid.
14b	weak	The salt sodium ethanoate has pH=12 when dissolved in water. This is because it is a salt made from a strong alkali (sodium hydroxide) and a weak acid (ethanoic acid). The salt sodium citrate also has pH=12 when dissolved in water. We can conclude that the acid sodium citrate is made from (citric acid) is a weak acid.
15a	More hydrogen ions than hydroxide ions	**Acid**: concentration of H^+ ions greater than concentration of OH^- ions **Neutral**: concentration of H^+ ions equal to concentration of OH^- ions **Alkali**: concentration of H^+ ions less than concentration of OH^- ions
15b(i)	Starch	Starch solution turns blue/black in the presence of iodine. Starch solution is colourless when iodine is not present.
15b(ii)	16.0	Ignore the first (rough) titration as it is to work out where the colour change will take place. Ave titre = $\frac{15.9 + 16.1}{2} = \frac{32.0}{2}$ = 16.0 cm^3
15b(iii)	0.0032	Iodine n = v x c = 0.016litres x 0.005mol l^{-1} = 0.00008mol $C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2HI$ 1mol 1mol 0.00008mol 0.00008mol concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.00008\text{ mol}}{0.025\text{ litres}}$ = 0.0032mol l^{-1}
16a	pink	Ferroxyl indicator turns blue in the presence of Fe^{2+} ions Ferroxyl indicator turns pink in the presence of OH^- ions
16b	left to right (through wires)	Electrons formed in Beaker A (left): $4OH^- \longrightarrow 2H_2O + O_2 + 4e^-$ Electrons travel to Beaker B (right) to be gained by Fe^{3+}: $Fe^{3+} + e^- \longrightarrow Fe^{2+}$