JABchem

Past Papers Higher Chemistry

2017

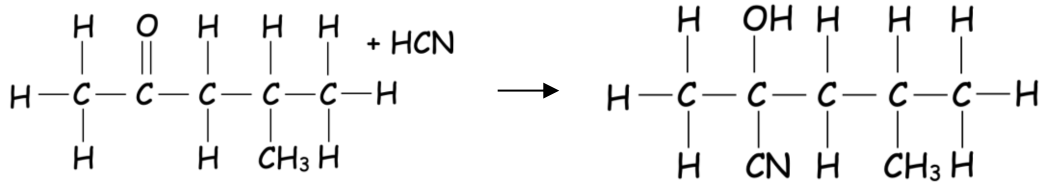
Marking Scheme

Grade Awarded	Mark Required (/120)	%	% candidates achieving grade
A	90+	75.0%	30.3%
B	79+	65.8%	24.2%
C	68+	56.7%	21.3%
D	62+	51.7%	8.4%
No award	<62	<51.7%	15.8%

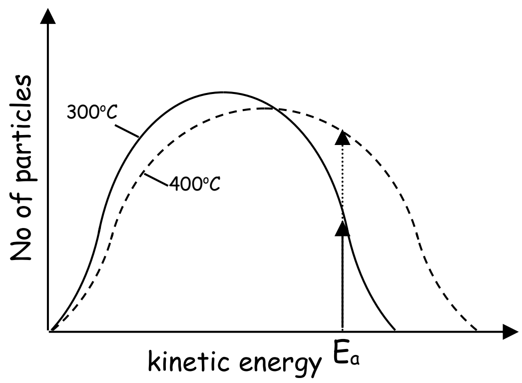
Section:	Multiple Choice	Extended Answer	Assignment
Average Mark:	16.2 /20	49.1 /80	13.9 /20

2017 Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	A	81	☑A Electronegativity difference C–I = 2.6-2.5 = 0.1 ∴ least polar bond ☒B Electronegativity difference C–I = 4.0-2.5 = 1.5 ∴ most polar bond ☒C Electronegativity difference C–I = 3.0-2.5 = 0.5 ☒D Electronegativity difference C–I = 2.8-2.5 = 0.3
2	D	86	☒A non-polar hydrocarbon ∴ molecule is non-polar ∴ molecule is insoluble in water ☒B one –OH groups ∴ molecule is polar ∴ molecule is soluble in water ☒C aldehyde group ∴ molecule is *slightly* polar ∴ molecule is slightly soluble in water ☑D three –OH groups ∴ molecule is polar ∴ molecule is very soluble in water
3	C	76	☒A Electronegativity of sulphur = 2.5 ☒B Electronegativity of silicon = 1.9 ∴ least attraction for electrons ☑C Electronegativity of nitrogen = 3.0 ∴ greatest attraction for electrons ☒D Electronegativity of hydrogen = 2.2
4	B	86	☒A Covalent networks have high melting points e.g. B, C (diamond), C (graphite), Si ☑B Phosphorus P_4 is a covalent molecular substance also S_8 and C_{60} (fullerene) ☒C monatomic substances are found in group 0 e.g. He, Ne, Ar ☒D metallic lattices are founds in metal elements e.g. Li, Be, Na, Mg, Al, K, Ca
5	D	82	☒A water H_2O contains polar –OH groups which are attracted to charged rod ☒B propanone contains polar C=O group which is attracted to charged rod ☒C propanol C_3H_7OH contains polar –OH group which is attracted to charged rod ☑D hexane C_6H_{14} is non-polar which is not attracted to charged rod
6	C	94	$2P_2H_4 + 7O_2 \longrightarrow P_4O_{10} + 4H_2O$
7	B	95	☒A longest chain containing –OH functional group is three carbons long ☑B longest chain = 3, -OH on C_1 and 2x –CH_3 methyl groups on C_2 ☒C functional group located on C_1 to give functional group lowest numbering system ☒D longest chain containing –OH function group is three carbons not five carbons
8	C	65	☒A $C_{15}H_{29}COOH$ is unsaturated ∴ $C_{15}H_{29}COOH$ contains one C=C double bond ☒B $C_{15}H_{31}COOH$ is saturated ∴ $C_{15}H_{31}COOH$ contains no C=C double bonds ☑C $C_{17}H_{31}COOH$ is unsaturated ∴ $C_{17}H_{31}COOH$ contains two C=C double bonds ☒D $C_{17}H_{35}COOH$ is saturated ∴ $C_{17}H_{35}COOH$ contains no C=C double bonds
9	A	98	☑A Activation is not a step in a free radical chain reaction mechanism. ☒B Initiation: Free-radicals are produced e.g. $Cl_2 \rightarrow 2Cl^\bullet$ ☒C Propagation: Free-radicals on both sides of arrow e.g. $CH_4 + Cl^\bullet \rightarrow CH_3^\bullet + HCl$ ☒D Termination: Free-radicals join together e.g. $CH_3^\bullet + Cl^\bullet \rightarrow CH_3Cl$
10	C	68	☒A methylpropanoate $C_3H_6O_2$ is not an isomer of ethyl propanoate $C_5H_{10}O_2$ ☒B pentan-2-one $C_5H_{10}O$ is not an isomer of ethyl propanoate $C_5H_{10}O_2$ ☑C pentanoic acid $C_5H_{10}O_2$ is an isomer of ethyl propanoate $C_5H_{10}O_2$ ☒D pentane-1,2-diol $C_5H_{12}O_2$ is not an isomer of ethyl propanoate $C_5H_{10}O_2$
11	B	61	☒A essential oils are volatile compounds to allow release of aroma ☑B essential oils are volatile compounds which do not dissolve in water. ☒C essential oils are non-water soluble ☒D essential oils are non-water soluble
12	C	85	☒A no. of moles of water formed dependent on formula of hydrocarbon ☒B no. of moles of carbon dioxide formed dependent on formula of hydrocarbon ☑C one mole of hydrocarbon burned completely in plentiful supply of oxygen ☒D enthalpy of combustion has a plentiful supply of oxygen

13	B	67	☒A Fluorine is a strong oxidising agent as it is located on bottom left of ECS ☑B Lithium is a strong reducing agent as it is located on top right of ECS ☒C Calcium is a reducing agent as it is located towards top right of ECS ☒D Iodine is a oxidising agent as it is located towards bottom left of ECS
14	B	79	$\text{atom economy} = \frac{\text{mass of useful products}}{\text{total mass of reactants}} \times 100 = \frac{47.9}{189.9 + (2\times24.3)} \times 100$
15	C	84	The most reproducible set of results are Student C as they have three results within $\pm0.2cm^3$.
16	A	83	
17	D	89	☒A All reactions have an enthalpy change as bonds break and new bonds are formed ☒B concentrations of reactants and products are not equal at equilibrium ☒C activation energy of forward/reverse reactions only equal If $\Delta H=0$ ☑D at equilibrium, rate of forward reaction equals rate of reverse reaction
18	A	76	<u>Bond Breaking Steps</u> 1x H-H = 1x436kJ = 436kJ 1x Br-Br = 1x194kJ = 194kJ Total = 630kJ <u>Bond Forming Steps</u> 2x H-Br = 2x366kJ = 732kJ Total = 732kJ ΔH = ΣBond enthalpies for bonds broken - ΣBond enthalpies for bonds formed ΔH = 630 - 732 ΔH = $-102\ kJ\ mol^{-1}$
19	D	93	☒A glycerol has three –OH hydroxyl groups ☒B glycerol has three carbon atoms in compound ☒C glycerol has three –OH hydroxyl groups but no –COOH carboxyl group ☑D glycerol has three carbons and three –OH hydroxyl groups
20	B	70	☒A catalyst increases rate of the forward reaction (and the reverse reaction too) ☑B catalyst increases rate of forward reaction but no change in position of equilibrium ☒C catalysts do no change position of equilibrium but equilibrium is achieved faster ☒D catalysts do no change position of equilibrium but equilibrium is achieved faster

2017 Higher Chemistry Marking Scheme

<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1a</td><td>Si</td><td><table><tr><td>Na</td><td>Mg</td><td>Al</td><td>Si</td><td>P_4</td><td>S_8</td><td>Cl_2</td><td>Ar</td></tr><tr><td>metallic bonding</td><td>metallic bonding</td><td>metallic bonding</td><td>covalent network</td><td>covalent molecular</td><td>covalent molecular</td><td>covalent molecular</td><td>monatomic</td></tr></table></td></tr>
<tr><td>1b(i)</td><td>Electrons closer to nucleus across period</td><td>Atoms decrease in size across period due to increased nuclear charge.
Electrons are harder to remove if they are closer to the nucleus</td></tr>
<tr><td>1b(ii)</td><td>$Mg^{+}(g) \rightarrow Mg^{2+}(g) + e^{-}$</td><td><u>1st Ionisation Energy</u>: $Mg(g) \rightarrow Mg^{+}(g) + e^{-}$
1 mole of electrons removed from one mole of atoms in the gaseous state
<u>2nd Ionisation Energy</u>: $Mg^{+}(g) \rightarrow Mg^{2+}(g) + e^{-}$
1 mole of electrons removed from one mole of 1+ ions in the gaseous state</td></tr>
<tr><td>1b(iii)</td><td>3rd ionisation is low as full outer shell is created. 4th Ionisation is higher as it breaks full outer shell</td><td>Third ionisation energy creates a full outer shell. $Al^{2+}(g) \rightarrow Al^{3+}(g) + e^{-}$
2,8,1   2,8
Fourth ionisation energy breaks into a full outer shell. $Al^{3+}(g) \rightarrow Al^{4+}(g) + e^{-}$
2,8   2,7</td></tr>
<tr><td>1c</td><td>Answer to include:</td><td>Argon is a monatomic gas in Group 0 which has only single atoms in its structure. The only type of Van der Waals forces between atoms of argon are London dispersion forces. London dispersion forces are the weakest form of intermolecular forces and this results in a low boiling point. Chlorine is a diatomic molecule but is non-polar due to both atoms having the same electronegativity. The only type of intermolecular forces between chlorine atoms are London dispersion forces. Chlorine has a higher melting point than argon because as it is diatomic and this increases the number of electrons in chlorine molecules compared to argon atoms. The increased number of electrons make a temporary dipole more likely and increases the strength of London dispersion forces, bringing molecules of Cl_2 closer together than atoms of Ar and raises the boiling point of Cl_2 higher than Ar.</td></tr>
<tr><td>2a(i)</td><td>Answer to include:</td><td>436kJ of energy required to break one mole of H-H bonds
151 kJ of energy required to break one mole of I-I bonds
I-I bonds much more likely to break than H-H bonds</td></tr>
<tr><td>2a(ii)</td><td>Diagram showing:</td><td>
</td></tr>
<tr><td>2a(iii)
Part A</td><td>Equilibrium shifts to left</td><td>In increase in temperature would favour the endothermic reaction
The endothermic reaction is the reverse reaction so equilibrium shifts to left as products are turned into reactants.</td></tr>
<tr><td>2a(iii)
Part B</td><td>Equal number of moles of gas on each side of equation</td><td>$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
1mol   1mol   2mol
2mol   2mol</td></tr>
</table>

<table>
<tr><td>2a(iv)
Part A</td><td>Activated Complex</td><td>Activated Complex is the unstable arrangement of atoms when the reactants bonds are half broken and the product bonds are half formed.</td></tr>
<tr><td>2a(iv)
Part B</td><td>-9.6</td><td>Enthalpy change = 173.2kJ – 182.8kJ = -9.6kJ mol^{-1}</td></tr>
<tr><td>2a(iv)
Part C</td><td>Deceases activation energy</td><td>Catalysts decrease the activation energy of both the forward and reverse reactions</td></tr>
<tr><td>2b(i)</td><td>To prevent dilution of reactants</td><td>If any water remains in the beaker prior to transfer of reactants the reactant concentration would decrease.</td></tr>
<tr><td>2b(ii)</td><td>122.1</td><td>$\text{rate} = \frac{1}{\text{time}} \therefore \text{time} = \frac{1}{\text{rate}} = \frac{1}{0.00819\ s^{-1}} = 122.1\ s$</td></tr>
<tr><td>2b(iii)</td><td>Decreases number of collisions at lower concentration</td><td>Lower concentration of Iodide I^- ions results in less collisions between I^- ions and the persulphate $S_2O_8^{2-}$ ions. Successful collisions which leads to products being formed requires both the correct collision geometry and collision energy to occur.</td></tr>
<tr><td>3</td><td>Open Question Answer to Include:</td><td><table>
<tr><th>3 mark answer</th><th>2 mark answer</th><th>1 mark answer</th></tr>
<tr><td>Demonstrates a <u>good</u> understanding of the chemistry involved. A good comprehension of the chemistry has provided in a logically correct, including a statement of the principles involved and the application of these to respond to the problem.</td><td>Demonstrates a <u>reasonable</u> understanding of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.</td><td>Demonstrates a <u>limited</u> understanding of the chemistry involved. The candidate has made some statement(s) which are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.</td></tr>
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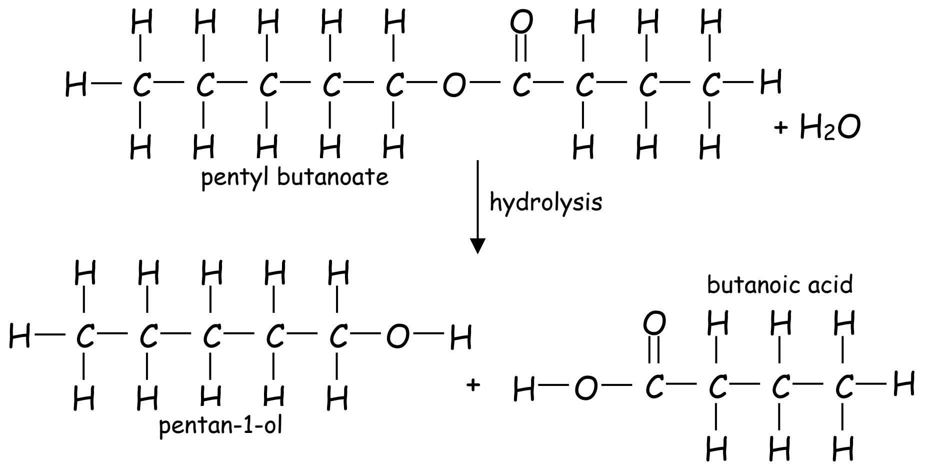
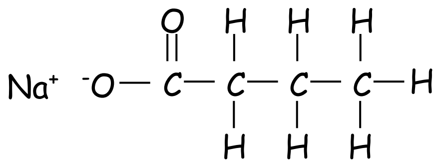
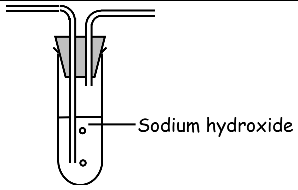
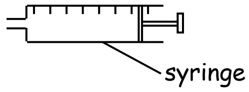
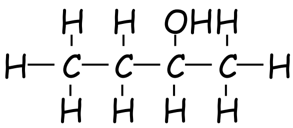
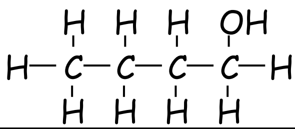
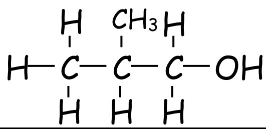
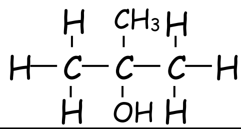
<tr><td>4a(i)</td><td>pentan-1-ol</td><td>
</td></tr>
<tr><td>4a(ii)</td><td>Diagram showing:</td><td>Sodium hydroxide reacts with butanoic acid to form sodium butanoate
</td></tr>
<tr><td>4b(i)</td><td>esters</td><td>Fats and oils are esters formed by the condensation reactions between glycerol and three fatty acids</td></tr>
<tr><td>4b(ii)</td><td>Soaps</td><td>Salts of fatty acids from the hydrolysis of fats/oils have and polar head and a non-polar tail which allows use as a soap.</td></tr>
<tr><td>4b(iii)</td><td>394.3 kJ</td><td><table><tr><td>$C_{17}H_{35}COOH + 26O_2 \rightarrow 18CO_2 + 18H_2O$
1mol 18mol
1mol × $^1/_{18}$ 1mol
= 0.0556mol
mass = no. of mol x gfm
= 0.0556mol x 284 g mol^{-1}
= 15.8g</td><td>15.8g stearic acid ⟷ 623kJ
10g stearic acid ⟷ 623kJ x $^{10}/_{15.8}$
= 394.3kJ</td></tr></table></td></tr>
</table>

5a(i)	Answer to include:	 e.g. bubbling gases through sodium hydroxide solution  e.g. syringe to collect gas or downwards displacement of air
5a(ii)	Answer showing:	no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.40g}{126.1\ g\ mol^{-1}}$ = 0.00317mol $Na_2SO_3 + 2HCl \longrightarrow H_2O + 2NaCl + SO_2$ 1mol 2mol 0.00317mol 0.00634mol (needed) **n** HCl = **v** x **c** = 0.05litres x 1.0 mol l^{-1} = 0.05mol (available) There is more HCl available for the reaction than is needed to completely react with all Na_2SO_3 ∴ Na_2SO_3 is the limiting reactant.
5b	-1075	❶ $C + O_2 \rightarrow CO_2$ ΔH= -393.5 kJ mol^{-1} ❷ $S + O_2 \rightarrow SO_2$ ΔH= -296.8 kJ mol^{-1} ❸ $C + 2S \rightarrow CS_2$ ΔH= +87.9 kJ mol^{-1} ❶ $C + O_2 \rightarrow CO_2$ ΔH= -393.5 kJ ❷x2 $2S + 2O_2 \rightarrow 2SO_2$ ΔH= -593.6 kJ ❸x-1 $CS_2 \rightarrow C + 2S$ ΔH= -87.9 kJ Add ❶+❷'+❸' $CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$ ΔH= -1075 kJ mol^{-1}
5c(i)	165 g l^{-1}	Join line of best fit ignoring the rogue result. Extrapolate up from 10°C to line and read solubility from graph
5c(ii)	Answer to include:	CO_2 is a non-polar molecular due to the linear shape of CO_2 molecule which cancels out the polarity of the molecule. SO_2 has an angular shape and is a polar molecule due to the electronegativity difference between the two elements in the molecule. The more polar the molecule the higher the solubility in polar solvents like water is likely to be.
6a(i)		Butan-2-ol is a secondary alcohol as it has 2 carbons directly attached to the carbon with the –OH group. There are three alcohol isomers of butan-2-ol: butan-1-ol  <u>Primary Alcohol</u> 1 carbon directly attached to the carbon with the –OH group 2-methylpropan-1-ol  <u>Primary Alcohol</u> 1 carbon directly attached to the carbon with the –OH group 2-methylpropan-2-ol  <u>Tertiary Alcohol</u> 3 carbons directly attached to the carbon with the –OH group
6a(ii) Part A	Alcohols are flammable	A water bath should be used to heat the reactants instead of a Bunsen burner due to the flammability of the chemicals being heated.
6a(ii) Part B	orange ⟶ green	**Oxidising Agent** / **Start Colour** / **End Colour** Acidified Dichromate / Orange / Green Benedict's/Fehling's / Blue / Brick Red (orange) Hot copper (II) oxide / Black / Brown Tollen's Reagent / (Colourless) / Silver mirror produced
6a(ii) Part C	Tertiary alcohol	Oxidation of Alcohols: Primary alcohol ⟶ Aldehyde ⟶ Carboxylic acid Secondary alcohol ⟶ Ketone ⟶✗ [No oxidation] Tertiary alcohol ⟶✗ [No oxidation]
6a(iii) Part A	butanoic acid (or 2-methylpropanoic acid)	For wet pH paper to turn red an acid would have to dissolve in the water in the pH paper. As copper(II) oxide is an oxidising agent, only a primary alcohol will oxidise to form the carboxylic acid which would turn wet pH paper red. butan-1-ol (C_4H_9OH) would oxidise to butanoic acid. 2-methylpropan-1-ol (C_4H_9OH) would oxidise to 2-methylpropanoic acid.

<table>
<tr><td>6a(iii)
Part B</td><td>$C_4H_9OH + H_2O$
↓
$C_4H_8O_2 + 4H^+ + 4e^-$</td><td><table>
<tr><td>Write down the main species
$C_4H_9OH \longrightarrow C_4H_8O_2$</td></tr>
<tr><td>Balance all atoms other than O and H (not needed in this example)
$C_4H_9OH \longrightarrow C_4H_8O_2$</td></tr>
<tr><td>Balance O atoms by adding H_2O to one side
$C_4H_9OH + H_2O \longrightarrow C_4H_8O_2$</td></tr>
<tr><td>Balance H atoms by adding H^+ to one side
$C_4H_9OH + H_2O \longrightarrow C_4H_8O_2 + 4H^+$</td></tr>
<tr><td>Balance charge by adding e^- to the most positive side
$C_4H_9OH + H_2O \longrightarrow C_4H_8O_2 + 4H^+ + 4e^-$</td></tr>
</table></td></tr>
<tr><td>6b(i)</td><td>2-methylpentanal</td><td>2-methylpentanal
$-CH_3$ methyl group on C_2 of main chain; 5 carbons on main chain; -CHO aldehyde functional group</td></tr>
<tr><td>6b(ii)</td><td>171°C</td><td><table>
<tr><th>Aldehyde</th><th>Pentanal</th><th>Hexanal</th><th>Heptanal</th><th>Heptanal</th></tr>
<tr><td>Boiling Point (°C)</td><td>102</td><td>130</td><td>153</td><td>-</td></tr>
<tr><td>Difference</td><td></td><td>28°C</td><td>23°C</td><td>18°C</td></tr>
<tr><td>Prediction</td><td>-</td><td>-</td><td>-</td><td>171°C</td></tr>
</table></td></tr>
<tr><td>6b(iii)</td><td>One from:</td><td>The longer the carbon chain the higher the boiling point
The higher the number of side groups the lower the boiling point.</td></tr>
<tr><td>6b(iv)</td><td>Silver mirror formed</td><td><table>
<tr><th>Oxidising Agent</th><th>Start Colour</th><th>End Colour</th></tr>
<tr><td>Acidified Dichromate</td><td>Orange</td><td>Green</td></tr>
<tr><td>Benedict's/Fehling's</td><td>Blue</td><td>Brick Red (orange)</td></tr>
<tr><td>Hot copper (II) oxide</td><td>Black</td><td>Brown</td></tr>
<tr><td>Tollen's Reagent</td><td>(Colourless)</td><td>Silver mirror produced</td></tr>
</table></td></tr>
<tr><td>6c</td><td>Permanent dipole to permanent dipole attractions</td><td>The C=O bond is a polar bond due to the difference in electronegativity of the elements within the bond is large enough to form a polar covalent bond
These permanent dipoles within polar covalent molecules are attracted to each other are bring the molecules closer together and raise the boiling point.</td></tr>
<tr><td>7a</td><td>Answer to include:</td><td>Once the contents of the beaker have been poured through the filter funnel, the beaker is rinsed with deionised water to ensure every drop of the solution is washed into the standard flask. The filter funnel this then rinsed with deionised water (inside and out). The standard flask is then filled up the mark with the last few drops being added by dropper so that the bottom of the meniscus is on the line on the flask.</td></tr>
<tr><td>7b(i)</td><td>Permanganate is self-indicating</td><td>Permanganate MnO_4^- ions are purple and these ions react in the titration to become colourless Manganese Mn^{2+} ions.</td></tr>
<tr><td>7b(ii)</td><td>H^+ ions are reactants</td><td>Acid contains H^+ ions which are a reactant in the reaction, appearing before the arrow.</td></tr>
<tr><td>7b(iii)
Part A</td><td>Sample 1 is ignored as it is inaccurate</td><td>The 1st Titre is the rough titre which is not designed to be accurate but gives an idea of the rough volume at which the colour change takes place. Subsequent titrations are carried out with the majority of the volume added in one big addition and the remaining volume added drop by drop until the colour change is accurately determined.</td></tr>
<tr><td>7b(iii)
Part B</td><td>0.0502</td><td>no. of mol = volume x concentration = 0.01455litres x 0.02mol l-1 = 0.000291mol
$5Fe^{2+} + 8H^+ + MnO_4^- \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$
5mol ... 1mol
0.001255mol ... 0.000291mol
$\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.001255\text{mol}}{0.025\text{litres}} = 0.0502\text{mol l}^{-1}$</td></tr>
<tr><td>7b(iii)
Part C</td><td>Solution whose concentration is accurately known</td><td>Standard solutions have a very accurately known concentration which can then be used to work out the concentration or quantity of another substance.</td></tr>
<tr><td>7b(iii)
Part D</td><td>Pipette</td><td>Pipettes, when used with a pipette filler for safety reasons, is more accurate than using measuring cylinders and beakers for accurately measuring volumes of liquids.</td></tr>
<tr><td>7c</td><td>14.1</td><td>5 tablets = 0.00126mol Fe ∴ 1 tablet = 0.000252mol Fe
1 mole of Fe = 55.8g
mass = no. of mol x gfm = 0.000252mol x 55.8g mol^{-1} = 0.0141g = 14.1mg</td></tr>
</table>

<table>
<tr><td>7d</td><td>24.3</td><td>100g breakfast cereal contains 12.0mg Fe
30g breakfast cereal contains 12.0mg Fe x $^{30}/_{100}$ = 3.6mg Fe
$\% \text{ Fe in 30g cereal} = \frac{\text{mass of Fe}}{\text{Recommended mass}} \times 100 = \frac{3.6\text{mg}}{14.8\text{mg}} \times 100 = 24.3\%$</td></tr>
<tr><td>8</td><td>Open Question Answer to Include:</td><td><table>
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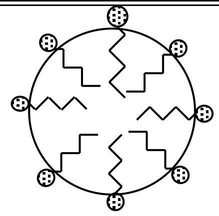
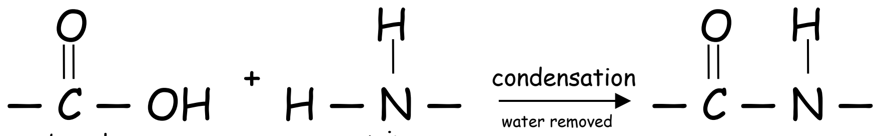
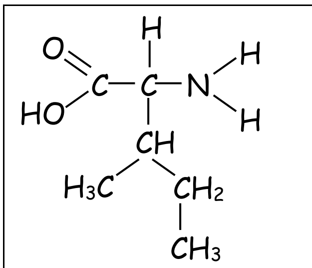
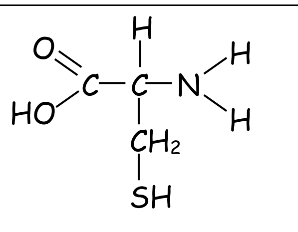
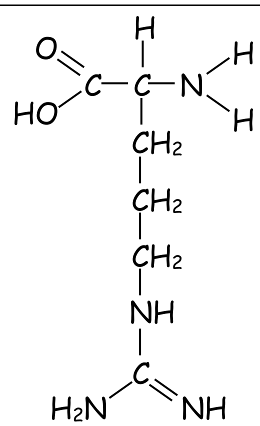
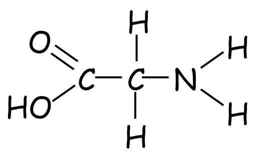
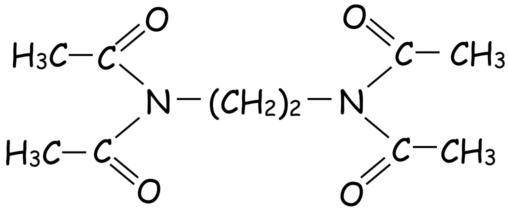
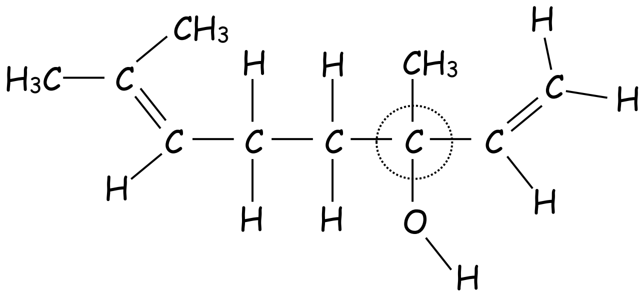
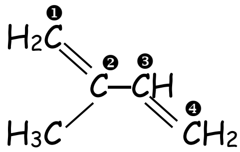
<tr><td>9a(i)</td><td>Diagram showing:</td><td></td></tr>
<tr><td>9a(ii)</td><td>hydrophobic</td><td><table>
<tr><th>Part of Soap</th><th>Water</th><th>Polarity</th><th>Mechanism</th></tr>
<tr><td>Head</td><td>Hydrophilic</td><td>Polar</td><td>Polar head stays outside non-polar grease droplet and surrounds droplet until droplet is able to dissolve in water</td></tr>
<tr><td>Tail</td><td>Hydrophobic</td><td>Non-polar</td><td>Non-polar tail enters non-polar grease droplet but head cannot enter droplet.</td></tr>
</table></td></tr>
<tr><td>9b(i)</td><td>Kills Bacteria</td><td>Oxidising agents can be used kill bacteria and fungi. Oxidising agents can inactive viruses.</td></tr>
<tr><td>9b(ii)</td><td>0.036litres
or
36cm^3</td><td>$\text{no. of mol} = \frac{\text{mass}}{\text{gfm}} = \frac{0.051\text{g}}{34\text{g mol}^{-1}} = 0.0015\text{mol}$
$2H_2O_2 \longrightarrow 2H_2O + O_2$
2mol → 1mol
0.0015mol → 0.00075mol
Volume = no. of mol x Molar Volume = 0.00075mol x 24 litres mol^{-1} = 0.036 litres</td></tr>
<tr><td>9c(i)</td><td>amino acids</td><td>Proteins are polymers made from amino acid monomers. The breakdown of protein into amino acids is a hydrolysis reaction.</td></tr>
<tr><td>9c(ii)
Part A</td><td>Amide Link
(or peptide link)</td><td></td></tr>
<tr><td>9c(ii)
Part B</td><td>One from:</td><td>   </td></tr>
<tr><td>9c(iii)
Part A</td><td>Denaturing</td><td>Enzymes are specifically-shaped proteins. Any change to the shape of an enzyme will prevent the enzyme from fitting the exact shape of the substrate molecule it catalyses the reaction for.</td></tr>
<tr><td>9c(iii)
Part B</td><td>Increase in temperature
or change in pH</td><td>Enzymes have optimum temperatures and pH conditions which they work best at. Raising the temperature above 37°C will denature the enzyme. Altering the conditions of pH will also change the shape of the enzyme.</td></tr>
</table>

<table>
<tr><td>9d(i)</td><td>Condensation</td><td>Condensation reactions involve the joining together of two molecules with the removal of a small molecule (usually water).
When the acetic anhydride splits in half, one half joins to eh N atom in ethylene diamine and water is removed between the two molecules.</td></tr>
<tr><td>9d(ii)</td><td>Diagram showing:</td><td></td></tr>
<tr><td>10a(i)</td><td>40.2</td><td>$\text{Relative concentration} = \frac{\text{Component peak area}}{\text{Total Peak Area}} \times 100 = \frac{31909}{79310} \times 100 = 40.2\%$</td></tr>
<tr><td>10a(ii)</td><td>geranyl acetate</td><td><table>
<tr><td>Lavender Oil A Peak</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Component</td><td>1,8-cineole</td><td>Linalool</td><td>Camphor</td><td>linalyl acetate</td><td>geranyl acetate</td><td>farnesene</td></tr>
<tr><td>Retention Time (min)</td><td>17</td><td>18</td><td>19</td><td>20.75</td><td>21.25</td><td>24</td></tr>
<tr><td>Lavender Oil B Peak</td><td>1st</td><td>2nd</td><td>3rd</td><td>4th</td><td>No peak</td><td>5th</td></tr>
</table></td></tr>
<tr><td>10b</td><td>£0.0272
or
2.72p</td><td>$1 cm^3$ mouthwash contains 0.92mg 1,8-cineole
$500 cm^3$ mouthwash contains 0.92mg x $^{500}/_{1}$
= 460mg 1,8-cineole
= 0.46g 1,8-cineole
1000g 1,8-cineole costs £59.10
0.46g 1,8-cineole costs £59.10 x $^{0.46g}/_{1000g}$
= £0.0272 = 2.72p</td></tr>
<tr><td>10c(i)</td><td>Diagram showing:</td><td></td></tr>
<tr><td>10c(ii)</td><td>$C_{15}H_{24}$</td><td>One isoprene unit = C_5H_8
∴ three isoprene units = $C_{15}H_{24}$

2-methylbuta-1,3-diene</td></tr>
</table>