JABchem

Past Papers Higher Chemistry

2016

Marking Scheme

Grade Awarded	Mark Required (/120)	%	% candidates achieving grade
A	86+	71.7%	29.6%
B	74+	61.7%	25.2%
C	62+	51.7%	21.3%
D	56+	46.7%	8.8%
No award	<56	<46.7%	15.1%

Section:	Multiple Choice	Extended Answer	Assignment
Average Mark:	13.0 /20	48.5 /80	13.2 /20

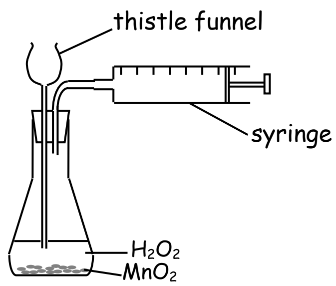
2016 Higher Chemistry Marking Scheme

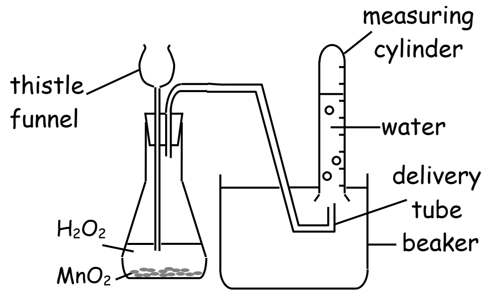
MC Qu	Answer	% Pupils Correct	Reasoning
1	D	55	☒A $(Na^+)_2S^{2-}$ electron arrangements: Na^+ 2,8 and S^{2-} 2,8,8 ☒B $Mg^{2+}(Cl^-)_2$ electron arrangements: Mg^{2+} 2,8 and Cl^- 2,8,8 ☒C K^+Br^- electron arrangements: K^+ 2,8,8 and Br^- 2,8,18,8 ☑D $Ca^{2+}(Cl^-)_2$ electron arrangements: Ca^{2+} 2,8,8 and Cl^- 2,8,8
2	A	80	☑A H has the $\delta+$ charge and Cl has the $\delta-$ charge as it has higher electronegativity ☒B Electrons will be closer to the more electronegative element (H 2.2 and Cl 3.0) ☒C Chlorine is the more electronegative element and has the $\delta-$ charge ☒D Electrons will be closer to the more electronegative element (H 2.2 and Cl 3.0)
3	A	83	☑A Electronegativity difference CsF_2 = 4.0-0.8 = 3.2 ∴ greatest ionic character ☒B Electronegativity difference CsI_2 = 2.6-0.8 = 1.8 ☒C Electronegativity difference NaF = 4.0-0.9 = 3.1 ☒D Electronegativity difference NaI = 2.6-0.9 = 1.7 ∴ least ionic character
4	B	81	Enthalpy change is the same for catalysed and uncatalysed reactions. Enthalpy change is measure from R to P = 50 – 100 = -50 kJ mol^{-1} Enthalpy change must be negative as diagram is exothermic type (downhill overall)
5	B	93	Formula of limonene molecule = $C_{10}H_{16}$ Each isoprene unit contains 5 carbons ∴ 2 isoprene units combined to make limonene
6	A	66	☑A molecules has a lack of polar groups so stays in food when boiled in polar water ☒B molecule has a polar –OH hydroxyl group and likely to enter boiling water ☒C molecule has a polar –OH hydroxyl group and likely to enter boiling water ☒D molecule has a polar –COOH carboxyl group and likely to enter boiling water
7	C	75	☒A Hydrolysis: vegetable oil would hydrolyses into glycerol and three fatty acids ☒B Condensation: vegetable oil made by condensation from glycerol & 3 fatty acids ☑C Hydrogenation: hydrogen added across C=C bonds making saturated chains ☒D Dehydrogenation: removing hydrogen would make more C=C bonds (stays oil)
8	D	71	☒A reaction rate falls at temperature above 37°C ☒B reaction rate rises not falls at temperatures from 0°C to 37°C ☒C reaction rate falls at temperature above 37°C ☑D Enzymes have an optimum temperature and decrease in activity as temp rises
9	C	81	☒A Fat is a solid triester molecule made from condensation of glycerol and 3 fatty acids ☒B Oil is a liquid triester molecule made from condensation of glycerol and 3 fatty acids ☑C Soap is made from neutralisation of a fatty acid with an alkali ☒D Glycerol (propane-1,2,3-triol) is a trihydric alcohol with three –OH groups
10	B	40	☒A the emulsifier produced and the edible oil are both esters to start with. ☑B glycerol reacts with edible oil by taking a fatty acid chain from the oil. ☒C fatty acids are produced in the reaction of making an emulsifier ☒D amino acids are the building blocks of making protein
11	B	61	☒A $Cu^{2+} + e^- \rightarrow Cu^+$ is the reduction reaction in Benedict's Solution ☑B $Ag^+ + e^- \rightarrow Ag^+$ is the reduction reaction in Tollen's Reagent ☒C $Cr_2O_7^{2-}+14H^++6e^-\rightarrow 2Cr^{3+}+7H_2O$ is the reduction reaction in acidified dichromate ☒D $MnO_4^-+8H^++5e^-\rightarrow Mn^{2+}+4H_2O$ is the reduction reaction in acidified permanganate
12	C	80	☒A numbering system used does not give functional group (C=O) the lowest number ☒B wrong functional group: -al is aldehyde group (-CHO) not a ketone group ☑C 5 carbon ketone with functional group on C_2 and methyl groups on C_3 and C_4 ☒D wrong functional group: -al is aldehyde group (-CHO) not a ketone group

13	C	31	Available nitric acid: **n**o. of mol = **v**olume x **c**oncentration = 0.2litres x 0.1mol l^{-1} = 0.02mol $CaCO_3 + 2HNO_2 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$ 1mol 2mol 1mol 1mol 1mol 0.01mol 0.02mol 0.01mol 0.01mol 0.01mol **gfm** $CaCO_3$ = (1x40.1)+(1x12)+(3x16) = 40.1+12+48 = 100.1g ∴ **n**o. of mol= $^{mass}/_{gfm}$ = $^{2}/_{100.1}$ = 0.020mol **gfm** $Ca(NO_3)_2$ = (1x40.1)+(2x14)+(6x16) = 40.1+28+96 = 164.1g ☒A $CaCO_3$ is in excess as 0.01mol reacts and more $CaCO_3$ is available than 0.01mol. ☒B All nitric acid is used up in the reaction as nitric acid is the limiting reactant ☑C 0.01mol $Ca(NO_3)_2$ produced ∴ **m**ass = **n**o. of mol x **gfm** = 0.01 x 164.1 = 1.64g ☒D **V**olume = **n**o. of mol x **M**olar **V**olume = 0.01mol x 24 litres mol^{-1} = 0.24litres = $240cm^3$
14	B	51	☒A carbon must be in the gaseous state in this reaction ☑B 4mol C-F bonds are broken ∴ total enthalpy change = 4x+484 = +1936kJ mol^{-1} ☒C 4mol C-F bonds broken but 2mol F-F bonds formed ☒D carbon must be in the gaseous state in this reaction
15	C	66	☒A At equilibrium, rate of forward reaction = rate of reverse reaction ☒B At equilibrium, concentration of reactants are constant (but not equal) ☑C At equilibrium, concentration of reactants are constant ☒D Activation Energies for forward and reverse reactions are never equal
16	A	75	☑A enthalpy for the complete combustion of 1mol of a substance ☒B Enthalpy of combustion must be complete combustion (no carbon monoxide is formed) ☒C Enthalpy of combustion must be complete combustion (water not hydrogen is formed) ☒D Enthalpy of combustion must be complete combustion (no carbon monoxide is formed)
17	C	68	☒A oxidising agent is reduced itself not oxidised ☒B oxidising agent is reduced itself not oxidised ☑C oxidising agent is reduced itself ∴ oxidising agent gains electrons ☒D oxidising agent is reduced itself ∴ oxidising agent gains electrons
18	D	49	<u>Step 1</u>: Write down main species in reaction $ClO_3^- \rightarrow Cl_2$ <u>Step 2</u>: Balance all atoms other than O or H $2ClO_3^- \rightarrow Cl_2$ <u>Step 3</u>: Balance O atoms by adding H_2O to the other side $2ClO_3^- \rightarrow Cl_2 + 6H_2O$ <u>Step 4</u>: Balance H atoms by adding H^+ to the other side $2ClO_3^- + 12H^+ \rightarrow Cl_2 + 6H_2O$ <u>Step 5</u>: Balance charge by adding electrons to the most positive side $2ClO_3^- + 12H^+ + 10e^- \rightarrow Cl_2 + 6H_2O$
19	D	41	$2I^- \rightarrow I_2 + 2e^-$ is an oxidation reaction (reverse of reduction reaction in data booklet) Reduction reaction must be below this reaction in the data booklet to proceed ☒A $SO_4^{2-} + 2H^+ + 2e^- \rightarrow SO_3^{2-} + H_2O$ (reduction reaction is above iodine in data booklet) ☒B $SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-$ (not a reduction reaction) ☒C $2Cr^{3+} + 7H_2O \rightarrow Cr_2O_7^{2-} + 14H^+ + 6e^-$ (not a reduction reaction) ☑D $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ (reduction reaction & below iodine in data booklet)
20	A	54	☑A white tile underneath helps to precisely determine the colour change at the end-point ☒B using bottom of meniscus improves the reading of volume in burette at end-point. ☒C repeating titrations improves reliability but not ability to precisely determine end-point ☒D carrying out rough titration allows the region of the end-point to be worked out

2016 Higher Chemistry Marking Scheme

<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1a</td><td>Increased successful collisions at higher temp</td><td>At a higher temperature, the average kinetic energy of particles increases. Number of collisions will increase and the number of collisions with energy greater than the activation energy will increase, increasing the reaction rate.</td></tr>
<tr><td>1b(i)</td><td>Answer to include one of:</td><td>





</td></tr>
<tr><td>1b(ii)</td><td>3.7</td><td>

volume of oxygen produced = volume strength x volume of hydrogen peroxide solution

$74cm^3$ = volume strength x $20cm^3$

$$\text{volume strength} = \frac{\text{volume of oxygen produced}}{\text{volume of hydrogen peroxide}} = \frac{74cm^3}{20cm^3} = 3.7$$

</td></tr>
<tr><td>1c</td><td>80s</td><td>

From graph: when concentration = $0.6 mol\ l^{-1}$ the relative rate = $0.0125\ s^{-1}$

$$\text{time} = \frac{1}{\text{relative rate}} = \frac{1}{0.0125s^{-1}} = 80s$$

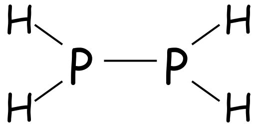
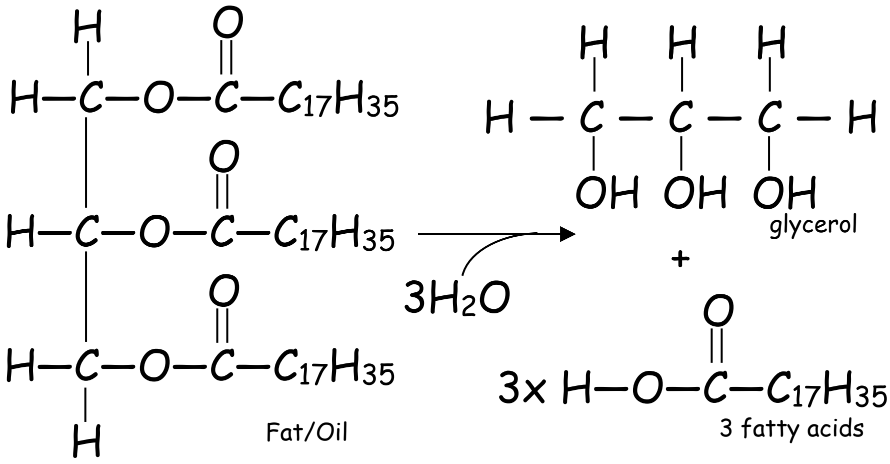
</td></tr>
<tr><td>2a(i)</td><td>Nuclear charge increases <u>or</u> number of protons in nucleus increases</td><td>As the nuclear charge increases (due to additional protons in the nucleus) the same outer shell of electrons undergoes a greater pull from the nucleus which causes the covalent radius/atomic size to decrease.</td></tr>
<tr><td>2a(ii)</td><td>Answer to include:</td><td><u>1st Mark</u>: sodium atom loses electron to become sodium ion
<u>2nd Mark</u>: sodium ion has two electron shells (2,8) but sodium atom has three electron shells (2,8,1)</td></tr>
<tr><td>2b(i)</td><td>One answer from:</td><td>Outer electrons less strongly attracted to nucleus
Outer electrons more shielded from nuclear pull as atom increases in size</td></tr>
<tr><td>2b(ii)</td><td>Answer to include:</td><td><u>1st Mark</u>: electron removed is being removed from a full outer shell or from an electron shell which is closer to nucleus
<u>2nd Mark</u>: electron being removed by 2nd ionisation energy is more strongly attracted to nucleus (or less shielded)</td></tr>
<tr><td>2c(i)</td><td>Any value between 720-770</td><td>

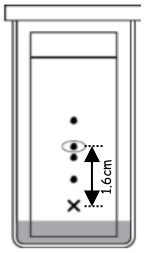
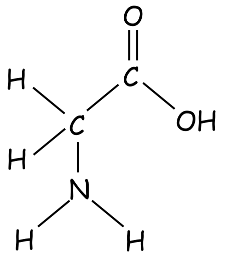
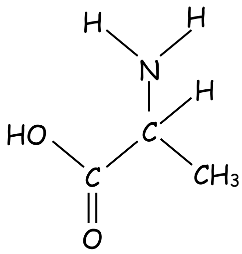
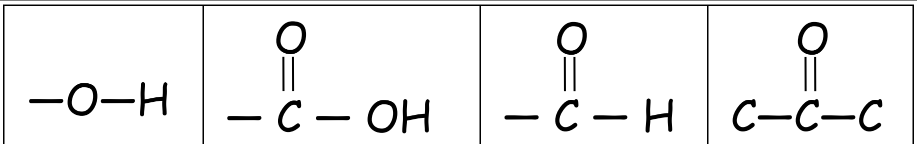
<table>
<tr><td>Ion in Chloride</td><td>Li^+</td><td>Na^+</td><td>K^+</td><td>Rb^+</td></tr>
<tr><td>Lattice Enthalpy</td><td>834</td><td>769</td><td>701</td><td>658</td></tr>
<tr><td>Difference</td><td></td><td>65</td><td>68</td><td>43</td></tr>
</table>

$K^+ \rightarrow Rb^+$ difference is less than previous differences

<table>
<tr><td>Ion in Fluoride</td><td>Li^+</td><td>Na^+</td><td>K^+</td><td>Rb^+</td></tr>
<tr><td>Lattice Enthalpy</td><td>1030</td><td>910</td><td>808</td><td>-</td></tr>
<tr><td>Difference</td><td></td><td>120</td><td>102</td><td>65</td></tr>
<tr><td>Prediction</td><td>-</td><td>-</td><td>-</td><td>743</td></tr>
</table>

</td></tr>
<tr><td>2c(ii)</td><td>As ionic radii increases the lattice enthalpy decreases</td><td>Going down group 1 ($Li^+ \rightarrow Na^+ \rightarrow K^+ \rightarrow Rb^+$) ionic radius increases and for both fluorides and chloride the lattice enthalpy decreases.
The corresponding lattice enthalpies for each chloride and fluoride show that the chloride has a lower lattice enthalpy than the fluoride for the same metal ion.</td></tr>
</table>

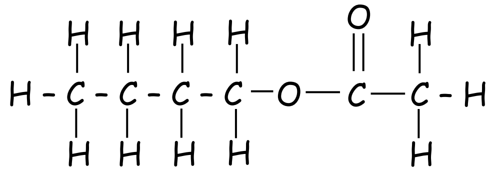
<table>
<tr><td>3a</td><td>Covalent molecular</td><td>Phosphine PH_3 contains only non-metal atoms in the compound and will have covalent bonding as a result. PH_3 will have a molecular structure as it is a gas at room temperature.</td></tr>
<tr><td>3b</td><td>1200</td><td>1mol AlP = (1x27)+(1x31) = 27+31 = 58g
$\text{no. of mol} = \frac{\text{mass}}{\text{gfm}} = \frac{2900g}{58\ g\ mol^{-1}} = 50mol$
$AlP + 3H_2O \longrightarrow PH_3 + Al(OH)_3$
1mol → 1mol
50mol → 50mol
Volume = no. of mol x Molar Volume = 50mol x 24 litres mol^{-1} = 1200 litres</td></tr>
<tr><td>3c</td><td></td><td>Phosphorus is in group 5, has a valency of 3 and makes three bonds.
Hydrogen is in group 1, has a valency of 1 and makes one bond.</td></tr>
<tr><td>4</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>
</table></td></tr>
<tr><td>5a</td><td>glycerol
or
propane-1,2,3-triol</td><td>
</td></tr>
<tr><td>5b(i)</td><td>polyunsaturated</td><td>general formula of saturated fatty acids = $C_nH_{2n+1}COOH$
∴ saturated 18 carbon fatty acid will have formula $C_{17}H_{35}COOH$<table>
<tr><td>No C=C bonds</td><td>1x C=C bond</td><td>2x C=C bond</td><td>3x C=C bond</td></tr>
<tr><td>$C_{17}H_{35}COOH$</td><td>$C_{17}H_{33}COOH$</td><td>$C_{17}H_{31}COOH$</td><td>$C_{17}H_{29}COOH$</td></tr>
<tr><td>Saturated</td><td>Monosaturated</td><td>Polyunsaturated</td><td>Polysaturated</td></tr>
</table></td></tr>
<tr><td>5b(ii)</td><td>Octanoic acid</td><td>Caprylic acid contains 8 carbons, a carboxyl –COOH group and no C=C double bonds.</td></tr>
<tr><td>5c(i)</td><td>Answer to include:</td><td><table>
<tr><td><u>1st Mark</u>: Bromine solution is added to both until the bromine is no longer decolourised. (or reddish-brown colour remains)</td></tr>
<tr><td><u>2nd Mark</u>: more bromine would be added to olive oil as it is more unsaturated than coconut oil</td></tr>
</table></td></tr>
<tr><td>5c(ii)</td><td>Hexane is non-polar or water is polar</td><td>As oils are non-polar substances which do not dissolve in water
∴water (a polar solvent) is of no use as a solvent for oil.
Hexane is a hydrocarbon, is non-polar and will dissolve oil</td></tr>
<tr><td>5c(iii)</td><td>Answer to include:</td><td><table>
<tr><td><u>1st Mark</u>: Coconut oil has more straight chains due to fewer double bonds while olive oil has more kinked chains due to more double bonds</td></tr>
<tr><td><u>2nd Mark</u>: London dispersion forces between coconut oil are stronger than in olive oil</td></tr>
</table></td></tr>
</table>

6a	hexapeptide	Prefix: Mono- 1; di- 2; Tri- 3; Tetra- 4; Penta- 5; Hexa- 6; Poly- many
6b	Answer showing:	isoleucine, leucine, glycine, valine, serine Overlapping fragments: isoleucine – leucine leucine – glycine – valine glycine – valine – serine
6c	essential	Amino acids which must be obtained by the body through the diet are known as essential amino acids.
6d(i)	One answer from:	Peptide only contained four different amino acids / An amino acid is repeated in the sequence / Two amino acids had the same R_f value (for that solvent) / Two different amino acids moved the same distance
6d(ii)	2^{nd} Spot from Top circled	Measured from the diagram: solvent front moved: 4cm From the Question: R_f value of methionine: 0.40 $R_f = \frac{\text{Distance moved by the substance}}{\text{Maximum distance moved by the solvent}}$ ∴ Distance moved by the Substance = R_f × Maximum distance moved by the solvent = 0.40 × 4cm = 1.6cm 
6e(i)	One from:	
6e(ii)	30g	1kg adult ⟷ 100mg lethal dose alpha-amanitin for humans 75kg adult ⟷ 100mg lethal dose alpha-amanitin for humans × $^{75}/_{1}$ = 7500mg alpha-amanitin 250mg alpha-amanitin ⟷ 1.0g death cap mushroom 7500mg alpha-amanitin ⟷ 1.0g death cap mushroom × $^{7500}/_{250}$ = 30g death cap mushroom
7a	One answer from:	UV light is damaging/harmful to skin / Sunblocks contain free-radical scavengers / UV light damages collagen / UV light can break bonds/molecules in skin / UV light can cause skin cancer / UV light ages skin / UV light creates free radicals or initiates free-radical chain reactions / UV light causes photo ageing / UV light causes sunburn
7b(i)	Atom/molecule with unpaired electron	Free radical are species (atoms or molecules) which have an unpaired electron in the structure. This electron is very reactive and will react with a variety of other chemicals to pair up this unpaired electron.
7b(ii)	Initiation	Step: Reactants (before Arrow) → Products (after Arrow) Initiation: No free radicals on Left Hand Side → Free radicals on Right Hand Side Propagation: Free Radicals found on both sides of arrow Termination: Free radicals on Left Hand Side → No free radicals on Right Hand Side
7b(iii)	Carboxyl group	hydroxyl group / carboxyl group / aldehyde group / ketone group

7b(iv) — 2 carbons attached to the Carbon with the –OH group

Alcohol	Description
Primary	1 carbon directly attached to the carbon with the –OH group
Secondary	2 carbons directly attached to the carbon with the –OH group
Tertiary	3 carbons directly attached to the carbon with the –OH group

7c(i) — Diagram showing:



7c(ii) — To condense vapours which would evaporate

Both the reactants and the products in an esterification reaction are volatile and evaporate when in a hot water bath. The wet paper towel attached by an elastic band provides a cool glass surface in the inside of the test tube which will condense the vapours back to liquids and prevent their escape. These vapours are flammable.

7c(iii) — 60.7%

1mol ethanol C_2H_5OH = 46g 1mol ethyl ethanoate $C_2H_5COCH_3$ = 88g

$$\text{no. of mol ethanol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{2.5g}{46g\ mol^{-1}} = 0.0543mol$$

$$\text{ethanol + ethanoic acid} \rightleftharpoons \text{ethyl ethanoate + water}$$

ethanol	ethyl ethanoate
1mol	1mol
0.0543mol	0.0543mol

ethyl ethanoate **m**ass = **n**o. of mol x **gfm** = 0.0543mol x 88g = 4.78g (Theoretical)

$$\% \text{ Yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100 = \frac{2.9g}{4.78g} \times 100 = 60.7\%$$

7c(iv) — Condensation or esterification

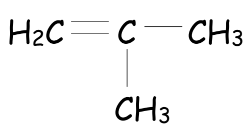
Condensation reactions involve two molecules joining together to make a larger molecule with a small molecule (usually H_2O) removed as they join. Esterification reactions are specific condensations where esters are made.

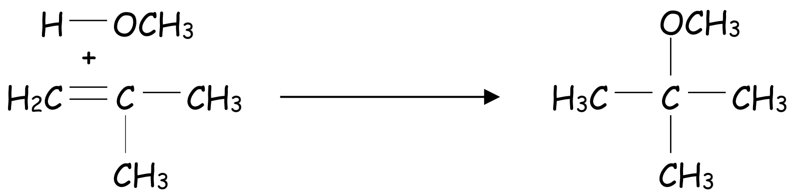
8a

	Temperature	Pressure
Step1	High	Low
Step1	Low	high

Step 1	Forward Reaction is endothermic which decreases the temperature ∴ an increase in temperature will favour the forward reaction which increases the yield
	Forward Reaction increases the pressure (2mol of gas → 4mol of gas) ∴ a decrease in pressure will favour the forward reaction which increases the yield
Step 2	Forward Reaction is exothermic which increases the temperature ∴ an decrease in temperature will favour the forward reaction which increases the yield
	Forward Reaction decreases the pressure (3mol of gas → 1mol of gas) ∴ an increase in pressure will favour the forward reaction which increases the yield

8b(i) — 2-methylpropene or





8b(ii) — One answer from:

The proportion of the total mass of all starting materials converted into the desired product is 100%	All the atoms in the reactants are converted into the product you want or Mass of product equal to mass of reactants	No by-products/no waste products/only one product is formed.

8c — 56

Bond Breaking Steps		Bond Forming Steps (exothermic)	
3xC-H bonds	3x 412kJ = 1236kJ	2xC-H bonds	2x 412kJ = 824kJ
1xC-O bond	1x 360kJ = 360kJ	1xH-H bonds	1x 436kJ = 436kJ
1x O-H bonds	1x 463kJ = 463kJ	1xC=O bonds	1x 798kJ = 743kJ
Total bond breaking	= 2059kJ	Total bond Forming	= 2003kJ

ΔH = ΣBond enthalpies for bonds broken - ΣBond enthalpies for bonds formed

ΔH = 2059 - 2003

ΔH = +56 kJ mol^{-1}

9a(i) — 4.92

Starting Temperature = 18.8°C (from graph)	ΔT = 30.6-18.8 = 11.8°C
Final Temperature = 30.6°C (extrapolated from graph)	

$E_h = cm\Delta T$ = 4.18 x 0.10 x 11.8 = 4.93 kJ

9a(ii) — To prevent heat loss to surroundings

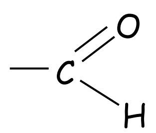
Polystyrene is a poor conductor of heat (an insulator) and will help slow down the rate of heat loss to the surroundings.

9a(iii) — 52.5

1mol KOH = (1x39.1)+(1x16)+(1x1) = 39.1+16+1 = 56.1g

5.61g KOH releases 5.25kJ

56.1g KOH releases 52.5kJ mol^{-1}

9b	-414	❶ $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ ΔH=-286 kJ mol^{-1} ❷ $Ca + O_2 + H_2 \rightarrow Ca(OH)_2$ ΔH=-986 kJ mol^{-1} ❶x-2 $2H_2O \rightarrow 2H_2 + O_2$ ΔH=+572 kJ mol^{-1} ❷ $Ca + O_2 + H_2 \rightarrow Ca(OH)_2$ ΔH=-986 kJ mol^{-1} Add ❶'+❷ $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ ΔH=-414 kJ mol^{-1}
10	Open Question Answer to Include:	**3 mark answer**: Demonstrates a **good 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. **2 mark answer**: Demonstrates a **reasonable understanding** of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood. **1 mark answer**: Demonstrates a **limited 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.
11a(i)	A diagram showing:	Flask with long narrow neck and a single gradation mark which goes completely across (or is labelled) on the narrow neck.
11a(ii)	Answer to include:	1st Mark: Accurate method for volume measurement e.g. uses a pipette or burette (syringe not accepted) 2nd Mark: Description of weighing by difference (or used Tare on a balance)
11a(iii)	Line graph to include:	1st Mark: All points plotted correctly (±½ box tolerance) 2nd Mark: Best Fit Line
11a(iv) Part A	Dissolved gas/bubbles will affect the density/mass/volume	The gas bubbles in the soft drink will alter the volume and the mass of the liquid being measured which will change the density.
11a(iv) Part B	3.43%	Density of sugar in g cm^{-3} = (0.0204 x %concentration of sugars in solution) + 1.00 1.07 = (0.0204 x %concentration of sugars in solution) + 1.00 1.07 – 1.00 = (0.0204 x %concentration of sugars in solution) 0.07 = 0.0204 x %concentration of sugars in solution $^{0.07}/_{0.0204}$ = %concentration of sugars in solution 3.43g cm^{-3} %concentration of sugars in solution
11a(v)	34.98g	100cm^3 contains 10.6g sugar 330cm^3 contains 10.6g x $^{330}/_{100}$ = 34.98g
11b(i)		—O—H: hydroxyl group O=C(—)—OH: carboxyl group O=C(—)—H: aldehyde group C—C(=O)—C: ketone group
11b(ii)	$C_6H_{12}O_6 + H_2O$ ↓ $C_6H_{12}O_7 + 2H^+ + 2e^-$	Redox $C_6H_{12}O_6 + 2Cu^{2+} + H_2O \rightarrow C_6H_{12}O_7 + 2Cu^+ + 2H^+$ Oxidation $C_6H_{12}O_6 + H_2O \rightarrow C_6H_{12}O_7 + 2e^- + 2H^+$ Reduction $2Cu^{2+} + 2e^- \rightarrow 2Cu^+$
11b(iii)	blue to orange/brick red	The final colours accepted: orange, red, brick red, brown, yellow or green
11b(iv)	0.0099	no. of mol Cu^{2+} = volume x concentration = 0.0198litres x 0.0250mol l^{-1} = 0.000495mol $C_6H_{12}O_6 + 2Cu^{2+} + H_2O \rightarrow C_6H_{12}O_7 + 2Cu^+ + 2H^+$ 1mol 2mol 0.0002475mol 0.000495mol concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.0002475\text{mol}}{0.025\text{litres}}$ = 0.0099 mol l^{-1}
12a(i)	Hydrogen Bonding	Hydrogen bonds form between molecules containing –OH: (see table below)

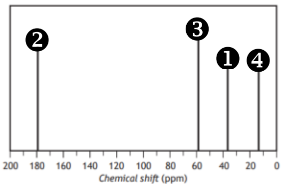
Isomer	1	2	3	4	5	6	7	8
Type	Carboxylic Acid	Carboxylic Acid	Carboxylic Acid	Ester	Ester	Ester	Ester	Ester
Hydrogen Bonding	yes	yes	yes	no	no	no	no	no

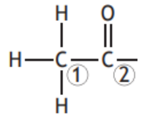
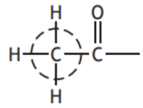
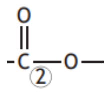
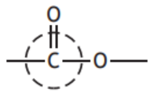
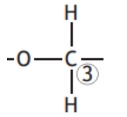
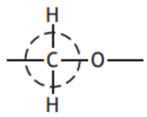
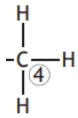
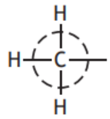
12a(ii)	Answer to include	1st Mark:	More branching lowers boiling point

2nd Mark:		
The shorter the alcohol, the lower the boiling point	The longer the carboxylic acid the lower the boiling point	The nearer the ester link is to the right hand end (of the molecule) the higher the boiling point.

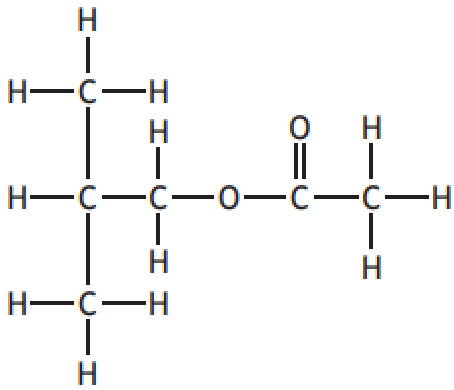
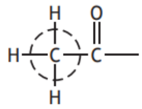
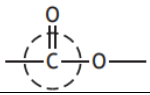
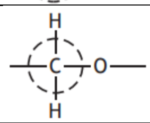
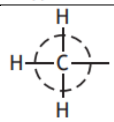
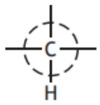
12a(iii)	Temperature between 99°C and 124°C	Structures 1, 2 and 3 show that increasing number of branches decreases the boiling point. Structures 4, 5 and 6 show that increasing number of branches decreases the boiling point. Both comparisons above show that more branches lowers the boiling point. Only structures 7 and 8 are compared with structure in question as they are isomers with same formula. Boiling point must be greater than 98°C as it has less branches than structure 8 and must be less than 126°C as it has more branches than structure 7.

12b(i)



Peak	Structure	Chemical Environment	Chemical Shift (ppm)
❶			20-50
❷			170-185
❸			50-90
❹			10-15

12b(ii) 5

Structure	Peak	Chemical Environment	Chemical Shift (ppm)
	❶		20-50
	❷		170-185
	❸		50-90
	2x❹		10-15
	❺		25-35