Past Papers Higher Chemistry

2019 Marking Scheme

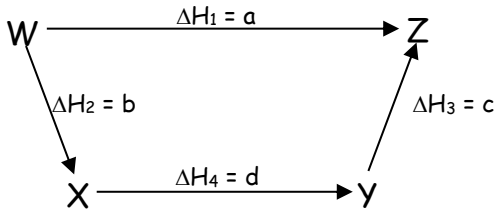
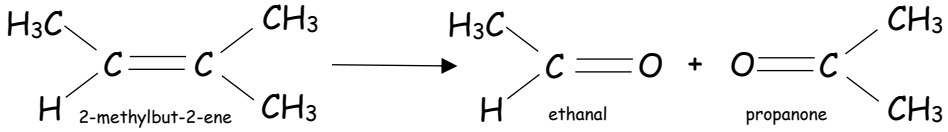
Grade Awarded	Mark Required		% candidates achieving grade
	(/120)	%	
A	80+	66.6%	28.3%
B	67+	55.8%	25.3%
C	54+	45.0%	23.0%
D	47+	39.2%	9.5%
No award	<47	<39.2%	13.9%

Section:	Multiple Choice	Extended Answer	Assignment
Average Mark:	12.1 /20	42.9 /80	13.1 /20

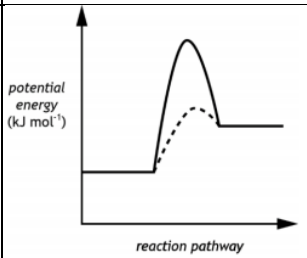
2019 Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	C		Hydrogen has electronegativity of 2.2 so the atom with electronegativity closest to 2.2 would be non-polar when joined to hydrogen.
2	B		☒A CCl_4 is non-polar due to 3D arrangement of Cl atoms around central C atom ☑B $NH_3$is a polar molecule due to the electronegativity difference between atoms ☒C CO_2 is non-polar due to linear arrangement of O atoms around central C atom ☒D CH_4 is non-polar as it is a hydrocarbon. All hydrocarbons are non-polar.
3	A		☑A CO reduces metal ores to metals. CO acting as Reducing Agent ☒B $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ is reduction ∴ MnO_4^- acting as oxidising agent ☒C $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ is reduction ∴ H_2O_2 acting as oxidising agent ☒D $Cr_2O_7^{2-}+14H^+ + 5e^- \rightarrow 2Cr^{3+} + 7H_2O$ is reduction ∴ $Cr_2O_7^{2-}$ acting as oxidising agent
4	C		❶ $NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$ ❷ $Zn \rightarrow Zn^{2+} + 2e^-$ ❶x2 $2NO_3^- + 8H^+ + \cancel{6e^-} \rightarrow 2NO + 4H_2O$ ❷x3 $3Zn \rightarrow 3Zn^{2+} + \cancel{6e^-}$ ❶'+❷' $2NO_3^- + 8H^+ + 3Zn \rightarrow 2NO + 3Zn^{2+}$ 2mol 3mol 1mol 1.5mol
5	B		☒A Primary Alcohol: 1 carbon directly attached to carbon with the -OH group ☑B Tertiary Alcohol: 3 carbons directly attached to carbon with the -OH group ☒C Secondary Alcohol: 2 carbons directly attached to carbon with the -OH group ☒D Secondary Alcohol: 2 carbons directly attached to carbon with the -OH group
6	A		☑A Amino acid with $-CH_3$ side group has been removed during partial hydrolysis ☒B $CH-CH_3$ group should be on left of $-CH_2-$ group in hydrolysis fragment ☒C $-CH_2-$ group has been removed but two groups are rejoined ☒D $CH-CH(CH_3)_2$ group should be on right of $-CH_2-$ group in hydrolysis fragment
7	D		☒A pentyl ethanoate has a total of 7 carbons ∴ cannot have formula $C_6H_{12}O_2$ ☒B hexan-2-one has formula $C_6H_{12}O$ so only has 1 oxygen atom not 2 oxygen atoms. ☒C 3-methylpentan-2-ol has formula $C_6H_{13}OH$ so only has 1 oxygen atom not 2. ☑D hexanoic acid has formula $C_6H_{12}O_2$
8	B		Primary Alcohols → (Hot copper(II) oxide, Acidified dichromate solution) Aldehydes → (Hot copper(II) oxide, Acidified dichromate solution) Carboxylic acids Secondary Alcohol → (Hot copper(II) oxide, Acidified dichromate solution, Benedict's or Fehling's solution, Tollen's Reagent) Ketone ☒A pentan-1-ol is a primary alcohol would oxidise with hot copper(II) oxide to pentanal which would further oxidise with Fehling's solution to form pentanoic acid ☑B pentan-2-ol is a secondary alcohol would oxidise with hot copper(II) oxide to form pentan-2-one which does not react with Fehling's solution. ☒C pentan-3-one is a ketone and does not oxidise with hot copper(II) oxide. ☒D pentanoic acid is a carboxylic acid and does not oxidise with hot copper(II) oxide.
9	D		☒A molecule has five carbons but not in one continuous chain of five carbons ☒B longest chain containing functional group has three carbons ∴ ends in propanoic acid ☒C two separate methyl $-CH_3$ groups attached to C_2 so is dimethyl not a ethyl $-C_2H_5$ group. ☑D 2x methyl $-CH_3$ groups attached to C_2 of three carbon main chain with $-COOH$ group

10	D		☒A Molecule A has 10 carbons and is derived from two C_5 isoprene units joining together ☒B Molecule B has 10 carbons and is derived from two C_5 isoprene units joining together ☒C Molecule C has 10 carbons and is derived from two C_5 isoprene units joining together ☑D Molecule D has 9 carbons so cannot be made by two C_5 isoprene units joining together.
11	C		☒A methanol (primary alcohol) oxidises to methanoic acid (carboxylic acid) ☒B propanal (aldehyde) oxidises to propanoic acid (carboxylic acid) ☑C butan-2-one (ketone) reduces to become butan-2-ol (secondary alcohol) ☒D propan-2-ol (secondary alcohol) oxidises to propanone (ketone)
12	B		☒A Primary Amine: 1 carbon directly bonded to nitrogen atom ☑B Secondary Amine: 2 carbons directly bonded to nitrogen atom ☒C Tertiary Amine: 3 carbons directly bonded to nitrogen atom ☒D Primary Amine: 1 carbon directly bonded to nitrogen atom
13	D		Formula of Calcium Phosphate = $Ca_3(PO_4)_2$ 1mol of $Ca_3(PO_4)_2$ contains 3mol of Ca^{2+}ions and 2 mol of PO_4^{3-}ions.
14	A		**gfm** CH_4 = 16g ∴ **n**o. of mol = $^{mass}/_{gfm}$ = $^{4}/_{16}$ = 0.25mol ☑A **gfm** He = 4g ∴ **n**o. of mol = $^{mass}/_{gfm}$ = $^{1}/_{4}$ = 0.25mol ☒B **gfm** H_2 = 2g ∴ **n**o. of mol = $^{mass}/_{gfm}$ = $^{1}/_{2}$ = 0.5mol ☒C **gfm** N_2 = 28g ∴ **n**o. of mol = $^{mass}/_{gfm}$ = $^{3.5}/_{28}$ = 0.125mol ☒D **gfm** Cl_2 = 71g ∴ **n**o. of mol = $^{mass}/_{gfm}$ = $^{35.5}/_{71}$ = 0.5mol
15	C		$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$ 1mol 2mol 1mol 1mol 1mol 0.05mol 0.1mol 0.05mol 0.05mol 0.05mol Only 0.06mol of nitric acid available but 0.1mol nitric acid needed to react with all 0.05mol $MgCO_3$ ∴ Nitric acid HNO_3 is the limiting factor. 0.03mol 0.06mol 0.03mol 0.03mol 0.03mol ☒A 0.03mol of CO_2 gas produced ☒B 0.03mol of $MgCO_3$ produced ☑C 0.03mol of $MgCO_3$ reacted ∴ 0.02mol of $MgCO_3$ remaining ☒D nitric acid HNO_3 is the limiting factor so all 0.06mol are used up.
16	D		☒A O atom in C=O bonds have δ- charges so will not be attracted to each other ☒B C-H bond is non-polar due to similar electronegativity so no dipole ☒C C-H bonds are non-polar due to similar electronegativity so no dipoles ☑D C in C=O bond has δ+ charge and is attracted to δ- charge on other C=O bond
17	B		atom economy = $\frac{\text{mass of useful products}}{\text{total mass of reactants}} \times 100 = \frac{(4 \times 55.8)}{(2 \times 159.6)+(3 \times 12)} \times 100 = \frac{223.2}{319.2+36} \times 100 = 62.8\%$
18	B		$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ 1mol 5mol 3mol 4mol 1vol 5vol 3vol negligible volume 100cm³ 500cm³ 300cm³ - (+100cm³ O_2 leftover) Total Volume at end of reaction = 300cm³ CO_2 + 100cm³ leftover O_2 = 400cm³
19	B		Step 1: 60% of 100% = $\frac{60}{100}$ x 100% = 60% Step 2: 90% of 60% = $\frac{90}{100}$ x 60% = 54%
20	C		☒A Volume of gas must be reduced as volume of acid is reduced (zinc in excess) ☒B Initial Rate of reaction must be increased as lumps replaced by powder ☑C Initial rate must be greater and final volume of gas must be reduced ☒D Initial Rate of reaction must be increased as lumps replaced by powder

21	A		$\Delta H_1 = \Delta H_2 + \Delta H_3 + \Delta H_4$ $\Delta H_2 = \Delta H_1 - \Delta H_3 - \Delta H_4$ $b = a - c - d$ 
22	D		☒A Higher Activation Energy will make a successful collision less likely to happen. ☒B The higher the kinetic energy of reactants the more like the collision will have sufficient energy to react. ☒C Higher the concentration the higher the likelihood of a successful collision ☑D Whether a reaction is exothermic or endothermic has no bearing on the reaction rate.
23	C		☒A no change in pressure from reactants to products ∴ lowering pressure has no effect ☒B lowering pressure favours pressure increasing reaction (reverse reaction) ☑C lowering pressure favours pressure increasing reaction (forward reaction) ☒D lowering pressure favours pressure increasing reaction (reverse reaction)
24	A		☑A Increasing the temperature moves the curve to the right. ☒B Increasing the temperature moves the curve to the right not the left. ☒C E_a does not change when temperature is changed ☒D Area under curve should be same as same number of particles.
25	D		

2019 Higher Chemistry Marking Scheme

Long Qu	Answer	Reasoning
1a(i)	Answer showing:	$Na_2S_2O_3 + 2HCl \longrightarrow S + SO_2 + 2NaCl + H_2O$
1a(ii) Part A	A 0 B 10 C 20 D 30 E 40	For the concentration of thiosulphate to be varied, the total volume of the solution must be kept constant. The total volume of sodium thiosulphate solution and water is 50 cm^3 in each experiment.
1a(ii) Part B	35.1	Rate = $\frac{1}{\text{Time}}$ $\therefore$ time = $\frac{1}{\text{Rate}} = \frac{1}{0.0285} = 35.1s$
1a(iii)	12±1	For doubling of rate from $0.02s^{-1}$ to $0.04s^{-1}$ Temperature at $0.02s^{-1}$ = 44°C Temperature at $0.04s^{-1}$ = 56°C Change in temperature = 12°C
1b	Sufficient Energy to React And Correct Geometry	1st Mark: sufficient or enough energy / energy equal to or greater than the activation energy / minimum/ enough energy to form an activated complex 2nd Mark: (Collision must occur with) suitable/correct/geometry/orientation
1c(i)	X at peak on curve	The top of the hill (peak on the curve) is the activated complex where the bonds of the reactants are half broken and the bonds of the products are half formed.
1c(ii)		A catalyst lowers the activation energy without changing the position of the reactants or products. This means that the top of the hill is lowered. The enthalpy change is the same as the positions of the reactants and products are unchanged.
2a(i)	Increasing number of protons or increasing nuclear charge	Going across a period does not increase the size of an atom as it is the same outer shell which is being filled up. The increased positive charge in the nucleus attracts the outer shell into more as you go across a period.
2a(ii)	One answer from:	Increased screening/shielding / Covalent radius increases / Atom size increases / More shells so less attraction of nucleus for outer electron decreases
2b(i)	$N^+(g) \rightarrow N^{2+}(g) + e^-$	1st Ionisation Energy: The removal of one mole of electrons from one mole of atoms in the gaseous state. 2nd Ionisation Energy: The removal of one mole of electrons from one mole of 1+ ions in the gaseous state.
2b(ii)	Answer to Include:	1st Mark: The 6th ionisation energy involves removing an electron from the shell which is full/ stable/closer to the nucleus / or / the 6th electron is removed from the electron shell which is inner/full/ stable/closer to the nucleus 2nd Mark: The 6th electron is less shielded / or / the 6th electron is more strongly attracted to/pulled towards the nucleus.
2c	1st Mark: Al forms Al^{3+} ion P forms P^{3-} ion 2nd Mark: P^{3-} ion has one more electron shell than Al^{3+} ion	Phosphorus atoms have electron arrangement of 2,8,5 and form P^{3-} ions which have electron arrangement of 2,8,8 Aluminium atoms have electron arrangement of 2,8,3 and form Al^{3+} ions which have electron arrangement of 2,8 Phosphide P^{3-} ion has one more electron shell than aluminium Al^{3+} ion.
2d	Radius Ratio = 0.96 Caesium Chloride Structure	Radius ratio = $\frac{\text{Radius of positive ion}}{\text{Radius of negative ion}} = \frac{135}{140} = 0.96$

3

Open Question Answer to Include:

3 mark answer	2 mark answer	1 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.	Demonstrates a **reasonable understanding** of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.	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.

4a(i)

Biological catalyst

An enzyme is a protein which acts as a catalyst for the chemical reactions inside living things.

4a(ii)

4.5

Mass of cider = $1.36 g/cm^3 \times 50 cm^3 = 68 g$

$$\%\text{mass of alcohol} = \frac{\text{Mass of alcohol}}{\text{Mass of cider}} \times 100 = \frac{3.05}{68} \times 100 = 4.48\%$$

4b(i)

Carbon dioxide

Malic acid → Lactic Acid + X

$C_4H_6O_5 \rightarrow C_3H_6O_3 + CO_2$

4b(ii) Part A

0.25

$$R_f = \frac{\text{Distance moved by substance}}{\text{Distance moved by solvent}} = \frac{4.1}{16.4} = 0.25$$

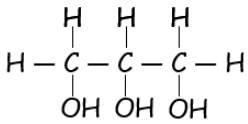
4b(ii) Part B

Sample 4 or Cider B

Problem Solving: Cider B/Sample 4 is the only cider that has no malic acid spot at 4.1 indicating all the malic acid has turned into lactic acid

4c

Propane-1,2,3-triol



glycerol

Propane-1,2,3-triol

3 carbons | Single bonds between carbons | Functional groups on Carbons 1,2,3 | 3 hydroxyl -OH groups

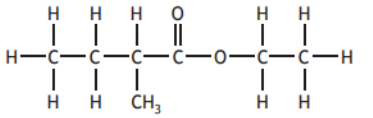
4d(i)

Answer to include:

1st Mark:	Molecule is polar due to hydroxyl groups	or	Can form hydrogen bonds due to hydroxyl groups
2nd Mark:	Solubility increases as more polar hydroxyl groups are added (and increases hydrogen bonding)		

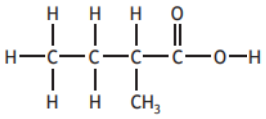
4d(ii)

2-methylbutanoic acid



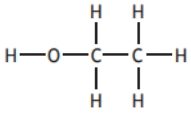
ethyl 2-methylbutanoate

+ H_2O



2-methylbutanoic acid

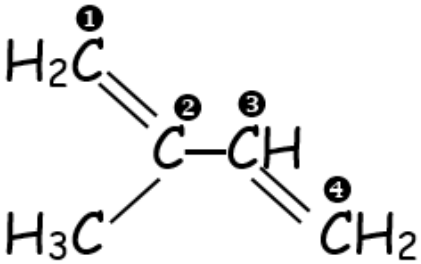
+



ethanol

4d(iii)

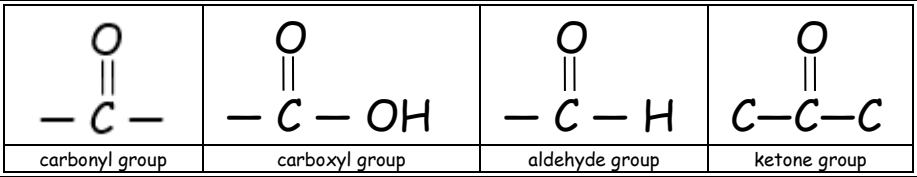
2-methylbuta-1,3-diene or isoprene



2-methylbuta-1,3-diene

4e(i)

Carbonyl



carbonyl group	carboxyl group	aldehyde group	ketone group

4e(ii) — Ethanoic acid

Primary Alcohol	→	Aldehyde	→	Carboxylic acid
Ethanol	→	Ethanal	→	Ethanoic acid

5a(i) — -694

Bond Breaking Steps		Bond Forming Steps	
4x*C*-H bonds	4x 412kJ = 1648kJ	2x*C*=O bonds	2x 743kJ = 1486kJ
2x*O*=O bond	2x 498kJ = 996kJ	4x*O*-H bonds	4x 463kJ = 1852kJ
Total bond breaking	= 2644kJ	Total bond Forming	= 3338kJ

Enthalpy change = +2644 - 3338 = -694kJ mol^{-1}

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

ΔH = 2644 - 3338

ΔH = -694 kJ mol^{-1}

5a(ii) — Answer to include:

Mean bond enthalpy is an average energy from a number of compounds. Bond enthalpy relates to only one particular compound or molecule.

5a(iii) — 0.367

$$\text{no. of moles} = \frac{\text{Volume}}{\text{Molar Volume}} = \frac{0.200\text{litres}}{24\text{ litres mol}^{-1}} = 0.00833\text{mol}$$

$$\underset{1\text{mol}}{CH_{4(g)}} + \underset{2\text{mol}}{2O_{2(g)}} \longrightarrow \underset{1\text{mol}}{CO_{2(g)}} + \underset{2\text{mol}}{2H_2O_{(l)}}$$

0.00833mol 0.00833mol

mass = **no.** of mol x **gfm** = 0.00833 x 44 = 0.367g

5b(i) — Record the mass of burner before and after heating

The before and after masses of the spirit burner (including lid) are needed to calculate the change in mass of the spirit burner and this change in mass is the mass of heptane burned.

5b(ii) — -3496

Heat Energy = Specific Heat Capacity x Mass x Change In Temperature

E_h = c x m x ΔT

E_h = 4.18 kJ kg^{-1} $^oC^{-1}$ x 0.4kg x 23^oC

E_h = 38.456 kJ

gfm Heptane C_7H_{16} = (7x12) + (16x1) = 84 + 16 = 100g

1.1g heptane ⟷ 38.456kJ

1mol heptane = 100g heptane ⟷ 38.456kJ x $^{100}/_{1.1}$

= -3496kJ mol^{-1}

5b(iii) — One answer from:

Loss of heat to surroundings	Incomplete combustion	Loss by evaporation
Absorption of heat by glass/beaker/can	No stirring	No lid on container

6a(i) Part A — Same number of electrons or Same strength of LDF

Both molecules have identical number of electrons (34) so have the same ability to form London Dispersion Forces between molecules (due to formation of temporary dipoles in their electron clouds). The difference between the molecules mist be caused by other intermolecular forces.

6a(i) Part B — Answer to include:

1st mark:	Propan-1-ol has stronger intermolecular forces than ethanethiol	Intermolecular forces in propan-1-ol take more energy to break than those in ethanethiol
2nd mark:	Intermolecular bonds in propan-1-ol are hydrogen bonds and intermolecular bonds in ethanethiol are permanent dipole to permanent dipole attractions	

6a(ii) — methanethiol

Alkane:	Methane CH_4	Ethane C_2H_6	Propane C_3H_8
Thiol:	Mathanethiol CH_3SH	Ethanethiol C_2H_5SH	Propanethiol C_3H_7SH

6a(iii) — 11.853mg

1cm^3 air ⟷ $2.7x10^{-7}$mg

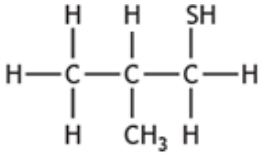
1 litre air ⟷ $2.7x10^{-4}$mg

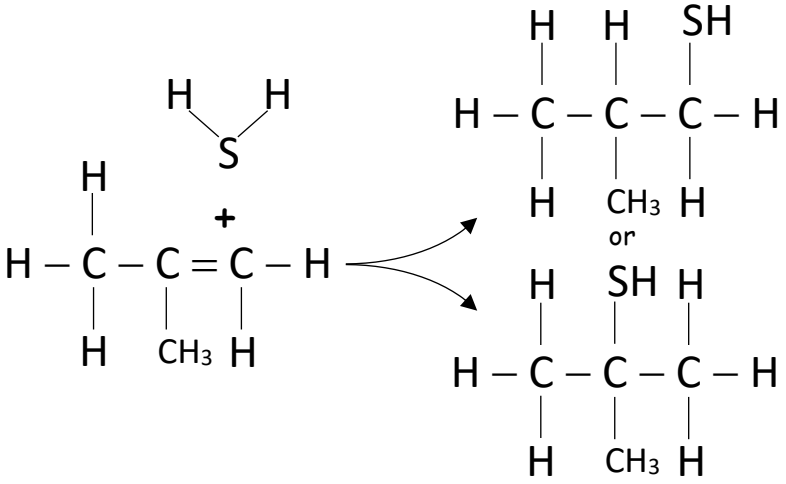
43900 litres air ⟷ $2.7x10^{-4}$mg x $^{43900}/_1$ = 11.853mg or 0.0118g

6b(i) — -SH group is attached to carbon which is attached to 3 other carbons

Primary Thiol	Secondary Thiol	Tertiary Thiol
-SH group attached to carbon which is attached to 0 or 1 other carbons atoms	-SH group attached to carbon which is attached to 2 other carbon atoms.	-SH group attached to carbon which is attached to 3 other carbon atoms.
-SH group attached to carbon which is attached to 2 hydrogen atoms.	-SH group attached to carbon which is attached to 1 hydrogen atom.	-SH group attached to carbon which is attached to no hydrogen atoms.

6b(ii) Part A





6b(ii) Part B

41.2

2-methylpropene + hydrogen sulphide → 2-methyl-2-propanethiol

1mol 1mol

56.0g 90.1g

30.5g 90.1g x $^{30.5}/_{56.0}$

= 49.07g

$\%Yield = \frac{Actual}{Theoretical} \times 100 \quad \therefore Actual = \frac{\%\ Yield \times Theoretical}{100} = \frac{84 \times 49.07}{100} = 41.2g$

7a(i) Propagation

Step	Reactants (before Arrow) → Products (after Arrow)
Initiation	No free radicals on Reactant Side → Free radicals on Product Side
Propagation	Free Radicals found on both sides of arrow
Termination	Free radicals on Reactant Side → No free radicals on Product Side

7a(ii) uv/ultraviolet

Ultraviolet light can cause the formation of free radicals as energy in the uv light can cause bonds to split and the two electrons in the bond separate one to each side. This means there are unpaired electrons which are called free radical. This breaks the plastic down in to smaller chunks that can be digested by bacteria.

7a(iii) Anti-oxidant or Free Radical Scavenger

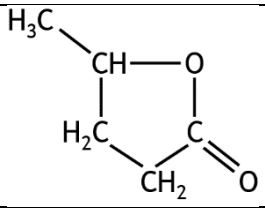
Free Radical Scavengers and anti-oxidants quickly react with any free radical particles going and prevent future propagation steps which would prolong the breakdown of the plastics.

7b(i) Water/H_2O

5-hydroxypentanoic acid = $C_5H_{10}O_3$

lactone = $C_5H_8O_2$ Difference = H_2O

7b(ii)



One less carbon between Carboxyl -COOH group and Hydroxyl group

∴ One less carbon in lactone ring i.e. ring has 4 carbons plus 1 oxygen in ring

Carbon with hydroxyl -OH group has methyl -CH_3 group sticking off it

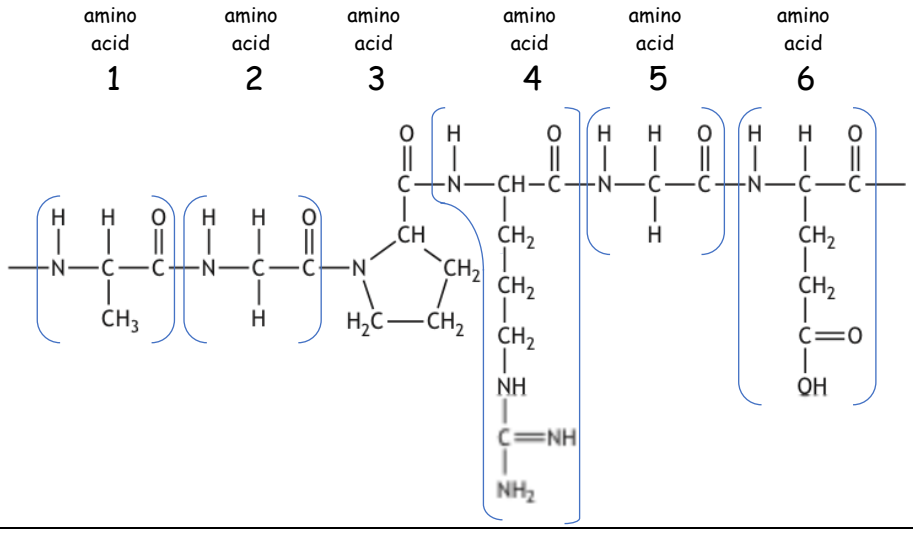
∴ Methyl -CH_3 group sticking off C on other side of -O-C=O ester group

7b(iii) 3-hydroxybutanoic acid

3-hydroxybutanoic acid

-OH on C_3 | -OH side group | Four carbon main chain | Carboxyl -COOH functional group

8a(i) — 6



8a(ii) — London Dispersion Forces

There are three forms of van der Waals' Attraction. London Dispersion forces are found in all substances but are the weakest form of intermolecular attraction. Permanent dipole to permanent dipole attractions are stronger than London Dispersion Forces and Hydrogen Bonding is the strongest form of van der Waals' attraction.

8b(i) — Answer to include:

1st Mark:	Dissolve gelatin (in small volume of deionised water)
2nd Mark:	Transfer quantitatively/with rinsings/with washings
3rd Mark:	Fill to the mark/line (on volumetric/standard flask)

8b(ii) — 11.0

Concentration (%)	2.0	4.0	6.0	8.0	10.0
Viscosity (units)	1.0	2.0	4.0	7.0	(-)
Difference		1.0	2.0	3.0	(4.0)
Prediction (units)	(-)	(-)	(-)	(-)	11.0

8c(i) — Enzyme Changes shape or denatured

Enzymes are specifically shaped globular proteins which denature when heated. Denaturing is caused by the 3D structure of the protein in the enzyme changing. This 3D structure is held by various types of bonding e.g. hydrogen bonding. Once the enzyme has changed shape, the substrate molecule no longer fits the enzyme active sire and the enzyme no longer catalyses the reaction.

8c(ii) — 37.88

13.2mg bromelain ⟷ 1g pineapple

500mg bromelain ⟷ 1g x $^{500}/_{13.2}$

= 37.88g

9a(i) — +220±2

Activation Energy (forward reaction) is measure from:

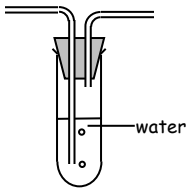
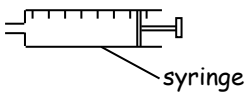
R to Activated Complex = 220 – 0 - +220kJ mol^{-1}

NB: Activation energy are always endothermic with a positive value.

9a(ii) — One Answer from:

Favours the endothermic/ reverse reaction	(Forward) reaction is exothermic	Reverse reaction is endothermic

9b — Diagram showing:

workable method for removal of HCl but allowing Cl_2 to pass through water (1mark)	workable method to collect gas (1mark)
	

9c — -391

❶ $C + 2H_2 \rightarrow CH_4$ ΔH=-75 kJ mol^{-1}

❷ $C + 2Cl_2 \rightarrow CCl_4$ ΔH=-98 kJ mol^{-1}

❸ $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl$ ΔH=-92 kJ mol^{-1}

❶x-1 $CH_4 \rightarrow C + 2H_2$ ΔH=+75 kJ mol^{-1}

❷ $C + 2Cl_2 \rightarrow CCl_4$ ΔH=-98 kJ mol^{-1}

❸x4 $2H_2 + 2Cl_2 \rightarrow 4HCl$ ΔH=-368 kJ mol^{-1}

Add ❶'+❷+❸' $CH_4 + 4Cl_2 \rightarrow CCl_4 + 4HCl$ ΔH=-391 kJ mol^{-1}

10a

Tap water contains metal ions/salts which are not found in deionised water

The tap water used might contained chloride ions or magnesium ions which would alter the concentration of either ions in the final solution. Deionised water or distilled water are free from ions.

10b(i)

	Pipette
	Measuring cylinder

Pipettes are the most accurate method of transferring accurate volumes of solutions. Measuring cylinders do not provide an accurate measurement of volume, only approximate volumes.

10b(ii)

E	C	B	D	A
1st Step	2nd Step	3rd Step	4th Step	5th Step

E	Weigh the filter paper
C	Filter the precipitate
B	Wash the precipitate with water to remove any impurities
D	Dry the precipitate in an oven
A	Weigh the precipitate and the filter paper

10b(iii)

0.463

$$\text{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1.393}{143.3} = 0.00972\text{mol}$$

$$MgCl_{2(aq)} + 2AgNO_{3(aq)} \longrightarrow 2AgCl_{(s)} + Mg(NO_3)_{2(aq)}$$

1mol : 2mol

0.00486mol : 0.00972mol

mass = **n**o. of mol x **gfm** = 0.00486 x 95.3 = 0.463g

10c

96.0

$$\%\ \text{purity} = \frac{\text{mass of pure sample}}{\text{mass of impure sample}} \times 100 = \frac{2.403}{2.503} \times 100 = 96.0\%$$

11

Open Question Answer to Include:

3 mark answer	2 mark answer	1 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.	Demonstrates a **reasonable understanding** of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.	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.

12a(i)

Ionic	Positively charged

Compound A has polar bonds which have permanent dipoles to allow interaction with water molecules. Compounds B+C have ionic charges which allow these compounds to interact with water.

12a(ii) Part A

Alkaline hydrolysis or saponification

Alkali will hydrolyse fats/oils into glycerol and three fatty acids. The alkali will then neutralise the fatty acids to form salts which act as soaps.

12a(ii) Part B

Answer to Include:

1st Mark	ionic/hydrophilic part **and** a non-polar/hydrophobic part to molecule	
2nd Mark	Head/COO^- part of the molecules dissolves in water (hydrophilic) Tail/hydrocarbon chain part of molecule dissolves in oil (hydrophobic)	
3rd Mark	One from:	Agitation cause small oil droplets to form
		The (negatively-charged) ball-like structures repel each other
		Soap/compound C allow emulsions to form or break oil into micelles.

12a(iii)

React edible oil with glycerol

Edible oils can form an ester link with the hydroxyl -OH group on a glycerol (propane-1,2,3-triol). The emulsifier has a hydrophobic tail from the edible oil that has just joined on and has hydrophilic hydroxyl -OH groups.

12b(i)

One answer from:

Both nuclei have the same attraction for the bonding electrons	Both atoms have same electronegativity	Bonding electrons shared evenly

12b(ii)

One answer from:

To ensure all chlorine is used up/to prevent chlorine being released	NaOH is the cheaper/less expensive reactant	To ensure that the bleach cleaner contains sodium hydroxide	Excess NaOH would neutralise any acid added to cleaner	Excess NaOH helps break up oil/grease

12c

Answer to include:

1st Mark:	Adding acid increases in the number of H^+ ions
2nd Mark:	Rate of Forward Reaction increases (to reduce concentration of H^+ ions by turning them into products)

12d(i)

$OCl^- + 2H^+ + 2e^- \downarrow Cl^- + H_2O$

redox: $OCl^- + 2H^+ + 2I^- \longrightarrow I_2 + Cl^- + H_2O$

oxidation: $2I^- \longrightarrow I_2 + 2e^-$

reduction: $OCl^- + 2H^+ + 2e^- \longrightarrow Cl^- + H_2O$

12d(ii)	1.76×10^{-2} or 0.0176	**n**o. of mol = **v**olume x **c**oncentration = 0.0090litres x 0.098mol l^{-1} = 8.82×10^{-4} mol $I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_2O_6$ 1mol : 2mol 4.41×10^{-4}mol : 8.82×10^{-4}mol $OCl^- + 2I^- + 2H^+ \longrightarrow I_2 + Cl^- + H_2O$ 1mol : 1mol 4.41×10^{-4}mol : 4.41×10^{-4}mol concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{4.41\times10^{-4}\text{mol}}{0.025\text{ litres}} = 1.76\times10^{-2}$ mol l^{-1}