JABchem

Past Papers Higher Chemistry

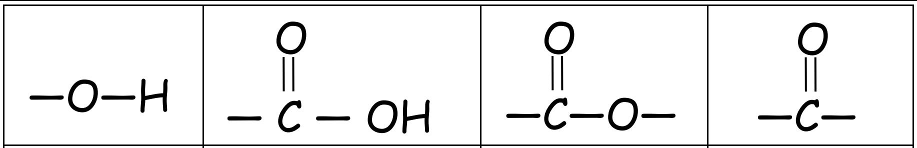
2018

Marking Scheme

Grade Awarded	Mark Required (/120)	Mark Required %	% candidates achieving grade
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

2018 Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	B	70	☒A Forward reaction has an activation energy of +40kJ mol^{-1} but always positive ☑B Enthalpy change is difference between P and R and downhill means exothermic ☒C This is enthalpy change for forward reaction from R to P (uphill = endothermic) ☒D This is the activation energy for the reverse reaction (P to top of hill)
2	A	91	$\text{Rate} = \frac{1}{t} \therefore t = \frac{1}{\text{rate}} = \frac{1}{100\ s} = 0.01\ s^{-1}$
3	D	70	☒A Decrease in temp decreases number of collisions with energy greater than E_a ☒B Activation Energy (E_a) is independent of temperature ☒C Activation Energy (E_a) is independent of temperature ☑D No change to activation energy & number of collisions decrease as temp decreases
4	C	57	❶ $Al^{+}(g) \rightarrow Al^{2+}(g) + e^{-}$ $\Delta H = 1817kJ$ ❷ $Al^{2+}(g) \rightarrow Al^{3+}(g) + e^{-}$ $\Delta H = 2745kJ$ Add ❶+❷ $Al^{+}(g) \rightarrow \cancel{Al^{2+}(g)} + e^{-}$ $\cancel{Al^{2+}(g)} \rightarrow Al^{3+}(g) + e^{-}$ $Al^{+}(g) \rightarrow Al^{3+}(g) + 2e^{-}$ $\Delta H = 4562kJ$
5	D	65	☒A Boron forms covalent network. No molecules to have London Dispersion Forces between ☒B Neon is a noble gas and contains no covalent bonds ☒C Sodium is an alkali metal and contains metallic bonds between atoms ☑D Sulphur has covalent bonds within its S_8 rings and LDF between molecules.
6	C	77	 hydroxyl group carboxyl group ester group carbonyl group
7	A	39	☑A main chain has 4 carbons, carboxyl functional group and methyls on C_2, C_2 and C_3 ☒B side groups incorrectly numbered as C_2 has two methyl groups attached. ☒C carbon side groups e.g. methyl groups never appear on carbon number 1 ☒D longest chain with functional group is four carbons ∴ ends in butanoic acid
8	D	64	☒A $CH_3H_2CH(OH)CH_2CH_3$ is pentan-3-ol so cannot be an isomer of pentan-3-ol ☒B Structure has formula $C_6H_{13}OH$ so has different formula and not an isomer ☒C Structure has formula C_5H_9OH so has different formula and not an isomer ☑D Structure is pentan-1-ol, has same formula and a different structure
9	A	69	4-methylpentan-2-ol $C_6H_{14}O$ → 4-methylpentan-2-one $C_6H_{12}O$ ∴ loss of 2xH atoms ☑A Loss of 2g per mole would be losing 2xH atoms from 1mol of $C_6H_{14}O$ ☒B Gain of 2g per mole would be gaining 2xH atoms on 1mol of $C_6H_{14}O$ ☒C Loss of 16g per mole would be losing 1xO atom from 1mol of $C_6H_{14}O$ ☒D Gain of 16g per mole would be gaining 1xO atom on 1mol of $C_6H_{14}O$
10	B	93	☒A All amino acids are necessary for building the different types of proteins ☑B Essential amino acids are the amino acids humans must acquire in their diet. ☒C Plants produce the essential amino acids that humans consume in their diet ☒D All types of amino acids are produced when a protein is hydrolysed
11	D	43	$n\,CO + (2n+1)\,H_2 \rightarrow n\,H_2O + C_nH_x$ $n\,CO + 2n\,H_2 + H_2 \rightarrow n\,H_2O + C_nH_x$ $n\,C\cancel{O} + n\,H_2 + n\,H_2 + H_2 \rightarrow n\,H_2\cancel{O} + C_nH_x$ $n\,C + n\,H_2 + \cancel{n\,H_2} + H_2 \rightarrow \cancel{n\,H_2} + C_nH_x$ $n\,C + 2n\,H + 2H \rightarrow + C_nH_x$ $n\,C + 2n{+}2\,H \rightarrow + C_nH_x$ n Carbon atoms has 2n+2 Hydrogen atoms available: general formula = C_nH_{2n+2}

12	D	34	1mol Na^+Cl^- contains 1mol Cl^- ions ∴ 0.6mol Na^+Cl^- contains 0.6mol Cl^- ions 1mol Na^+Cl^- contains 1mol Na^+ ions ∴ 0.6mol Na^+Cl^- contains **0.6mol Na^+ ions** 1mol $(Na^+)_2SO_4^{2-}$ contains 1mol SO_4^{2-} ions ∴ 0.2mol $(Na^+)_2SO_4^{2-}$ contains 0.2mol SO_4^{2-} ions 1mol $(Na^+)_2SO_4^{2-}$ contains 2mol Na^+ ions ∴ 0.2mol $(Na^+)_2SO_4^{2-}$ contains **0.4mol Na^+ ions**
13	A	48	☑A 0.20g of H_2 ∴ **no.** of mol = $^{mass}/_{\mathbf{gfm}}$ = $^{0.20}/_{2}$ = 0.10mol ∴ largest volume ☒B 0.44g of CO_2 ∴ **no.** of mol = $^{mass}/_{\mathbf{gfm}}$ = $^{0.44}/_{44}$ = 0.01mol ∴ smallest volume ☒C 0.60g of Ne ∴ **no.** of mol = $^{mass}/_{\mathbf{gfm}}$ = $^{0.60}/_{20}$ = 0.03mol ☒D 0.80g of Ar ∴ **no.** of mol = $^{mass}/_{\mathbf{gfm}}$ = $^{0.80}/_{2}$ = 0.02mol
14	A	52	$3CuO_{(s)} + 2NH_{3(g)} \longrightarrow 2Cu_{(s)} + N_{2(g)} + 3H_2O_{(l)}$ 3mol, 2mol, 2mol, 1mol, 3mol negligible volume, 2vol, negligible volume, 1vol, negligible volume -, $100cm^3$, -, $50cm^3$., -
15	D	43	☒A Hydrogen gas (H_2) would have no effect as it is neither a reactant nor product ☒B $HCl_{(g)}$ would dissolve in water to form acid sending equilibrium to left to remove H^+ ions ☒C Cl^- ions added so equilibrium would move to left to remove extra Cl^- ions ☑D OH^- ions would neutralise H^+ ions sending equilibrium to right to replace H^+ ions.
16	C	67	**gfm** C_4H_9OH = 72 mass = 3.6g **no**. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{3.6}{72}$ = 0.05mol 0.05mol C_4H_9OH releases 124kJ 1mol C_4H_9OH releases 124kJ x $^1/_{0.05}$ = -2480kJ mol^{-1}
17	B	75	❶ $C(s) + O_2(g) \rightarrow CO_2$ ΔH=-394kJ ❷ $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$ ΔH=-283kJ ❶ $C(s) + O_2(g) \rightarrow CO_2$ ΔH=-394kJ ❷x-1 $CO_2(g) \rightarrow CO(g) + \frac{1}{2}O_2(g)$ ΔH=+283kJ Add ❶+❷′ $C(s) + \frac{1}{2}\cancel{1}O_2(g) \rightarrow \cancel{CO_2}$ $\cancel{CO_2(g)} \rightarrow CO(g) + \cancel{\frac{1}{2}O_2(g)}$ $C(s) + \frac{1}{2}O_2(g)$ $CO(g)$ ΔH=-111kJ
18	C	43	☒A $Cr^{3+} + 3e^- \rightarrow Cr$ is higher in the electrochemical series than the equation $SO_4^{2-} + 2H^+ + 2e^- \rightarrow SO_3^{2-} + H_2O$ is too low to turn Cr^{3+} into Cr ☒B $Al^{3+} + 3e^- \rightarrow Al$ is higher in the electrochemical series than the equation $SO_4^{2-} + 2H^+ + 2e^- \rightarrow SO_3^{2-} + H_2O$ is too low to turn Al^{3+} into Al. ☑C $Fe^{3+} + e^- \rightarrow Fe^{2+}$: Fe^{3+} ions will reduce to Fe^{2+} ions and is lower in electrochemical series than $SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-$ (reversed as it is higher in ECS) ☒D $Sn^{4+} + 2e^- \rightarrow Sn^{2+}$ is higher in electrochemical series than the equation $SO_4^{2-} + 2H^+ + 2e^- \rightarrow SO_3^{2-} + H_2O$ is too low to turn Sn^{4+} into Sn^{2+}.
19	B	49	<u>Step 1</u>: Write down main species in reaction $NO_3^- \rightarrow NO$ <u>Step 2</u>: Balance all atoms other than O or H $NO_3^- \rightarrow NO$ <u>Step 3</u>: Balance O atoms by adding H_2O to the other side $NO_3^- \rightarrow NO + 2H_2O$ <u>Step 4</u>: Balance H atoms by adding H^+ to the other side $NO_3^- + 4H^+ \rightarrow NO + 2H_2O$ <u>Step 5</u>: Balance charge by adding electrons to the most positive side $NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$
20	B	59	Increase in proportion of solid = Increase in rate of forward reaction ☒A decrease in pressure increases the rate of the pressure-reducing reverse reaction ☑B decrease in temp and increase in pressure both favour the forward reaction. ☒C increase in temperature increases the rate of the endothermic reverse reaction ☒D increase in temperature increases the rate of the endothermic reverse reaction

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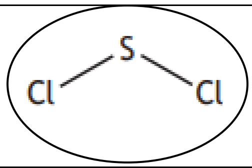
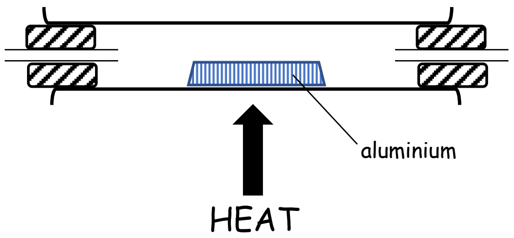
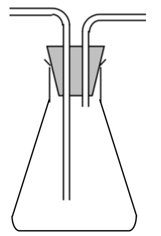
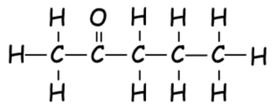
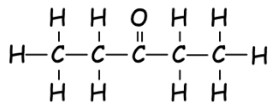
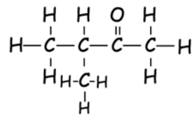
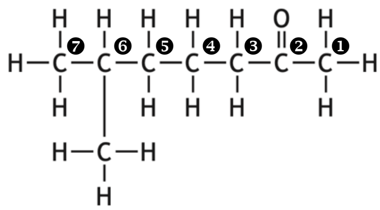
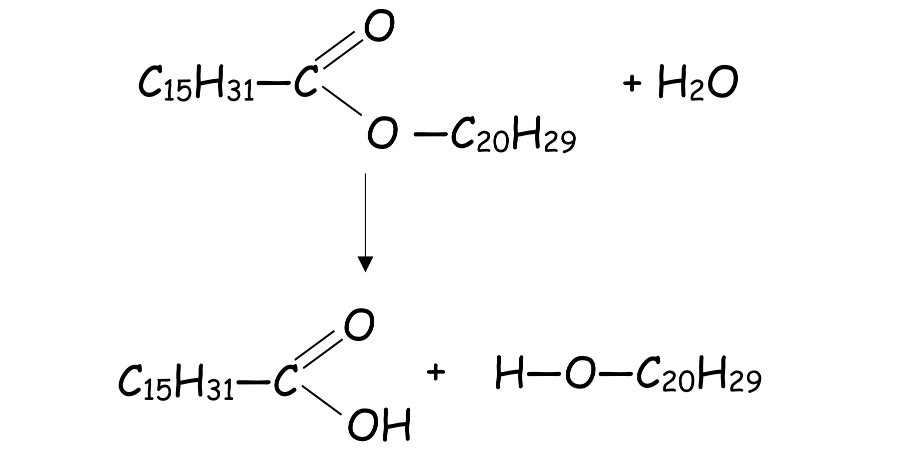
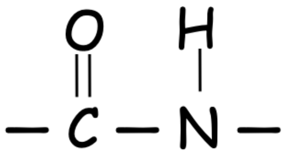
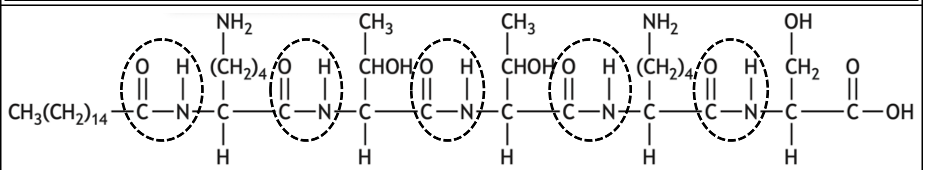
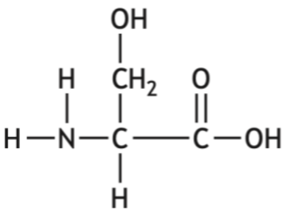
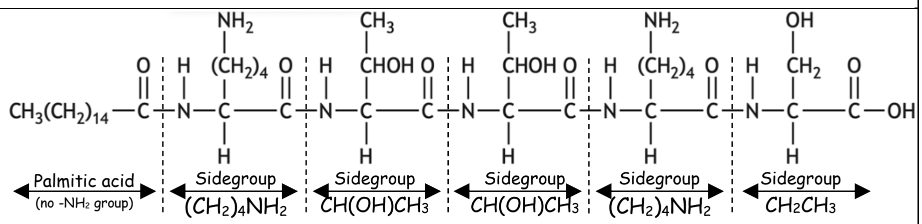
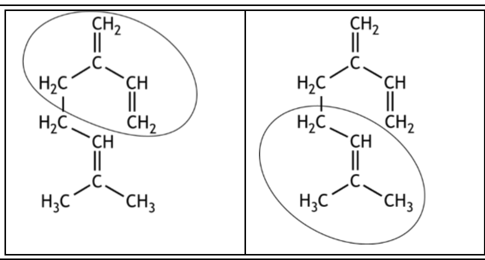
Long Qu	Answer	Reasoning
1a(i)	The attraction an atom/nucleus has for the electrons in a bond/shared electrons	Electronegativity is a measure of the attraction for the electrons in a bond by the nuclei at either end of that bond. Non-metals tend to have higher values of electronegativity and have a higher attraction for the electrons in a bond.
1a(ii)	One answer from:	Increased shielding/ more shielding (from additional shells) | Covalent radius increases/atom size increases/more shells so attraction of the nucleus/protons for the (outer/shared) electrons decreases
1b	Answer to include:	<u>1 mark</u> (Intermolecular) forces/bonds increase (going down the group) | <u>1 mark</u> London Dispersion Forces are the forces (broken) between the molecules | <u>1 mark</u> The more electrons the stronger the London Dispersion Forces
2a	Increasing number of protons or increasing nuclear charge	Across a period the same outer shell is being filled by electrons. The number of protons in the nucleus is increasing as is the positive charge in the nucleus. The outer shell of electrons is pulled in closer to the nucleus due to electrostatic attraction making the atom size decrease.
2b(i)		Electronegativity: Si=1.9 | P=2.2 | S=2.5 Chlorine: Cl=3.0 | Cl=3.0 | Cl=3.0 Difference: 1.1 | 0.8 | 0.5 Commentary: Most polar bonds | - | Least polar bonds
2b(ii)	Answer to include:	1 mark: Silicon tetrachloride and hexane are both non-polar 1 mark: Silicon tetrachloride is non-polar due to its tetrahedral shape (where polarities over molecule cancel out)
2c(i)	Answer to include:	1 mark: Silicon nitride is a covalent network 1 mark: Covalent bonds need to be broken before it will melt
2c(ii)	17.9	atom economy = $\frac{140.3}{(3\times170.1)+(16\times17.0)}\times100 = \frac{140.3}{510.3+272.0}\times100 = 17.9\%$
2d(i)	Answer to include:	1 mark  1 mark 
2d(ii)	To supply activation energy	Although the reaction is exothermic, sufficient energy to form the activated complex initially must be supplied for the activation energy barrier to be overcome. Once the reaction gets going the exothermic reaction will provide the heat energy to maintain the reaction.
3a	water bath or heating mantle or hot plate	A flame-based method of heating should not be used as the reactants and products are volatile and flammable.
3b	To condense any escaping gases	The reactants and products in the formation of esters can have low enough boiling points to evaporate and escape from the test tube. A cold surface like a small test tube filled with cold water will give a surface for the escaping gases to condense on. (Be careful, condensing gases give off heat which will rapidly heat up the water in the cold test tube)
3c(i)	water	benzoic Acid + methanol → methyl benzoate + water $C_6H_5COOH + CH_3OH \rightarrow C_6H_5COOCH_3 + H_2O$

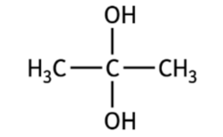
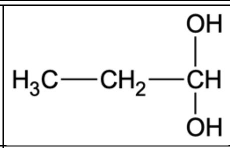
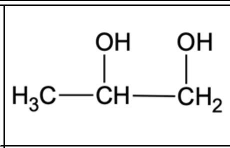
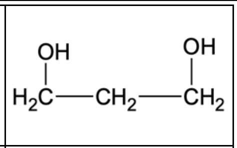
<table>
<tr><td>3c(ii)</td><td>Answer showing:</td><td>
no. of mol $C_6H_5COOH = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{5.0}{122} = 0.0410mol$
no. of mol $CH_3OH = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{2.5}{32} = 0.0781mol$
$C_6H_5COOH + CH_3OH \rightarrow C_6H_5COOCH_3 + H_2O$
1mol (0.0410mol Available)   1mol (0.0410mol Required)
0.0410mol CH_3OH required and 0.0781 mol CH_3OH available
$\therefore$ CH_3OH in excess and C_6H_5COOH is limiting factor as a result.
</td></tr>
<tr><td>3c(iii)</td><td>12.84</td><td>
500g Benzoic Acid. $\longrightarrow$ £39.80
5g Benzoic acid. $\longrightarrow$ £39.80 x $^5/_{500.}$ = £0.3980
$\therefore$ 3.1g methyl benzoate $\longrightarrow$ £0.3980
100g methyl benzoate $\longrightarrow$ £0.3980 x $^{100}/_{3.1}$
= £12.84
</td></tr>
<tr><td>4a</td><td>One diagram from:</td><td>
<table><tr>
<td>
pentan-2-one</td>
<td>
pentan-3-one</td>
<td>
3-methylbutan-2-one</td>
</tr></table>
</td></tr>
<tr><td>4b</td><td>One oxidising agent from:</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 Solution</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>4c</td><td>Permanent dipole to permanent dipole</td><td>3-methylbutanal contains a carbonyl C=O bond. There is an electronegativity difference of 1.0 within the bond making the bond polar.
The δ+ and δ- charges across the bond are attractive to neighbouring molecules also with a carbonyl C=O group.</td></tr>
<tr><td>4d</td><td>It will oxidise</td><td>Aldehydes will oxidise to carboxylic acids which gives food an unpleasant taste known as rancid.</td></tr>
<tr><td>4e(i)</td><td>Two molecules join together with the loss of water/small molecule</td><td>
<table>
<tr><td>Condensation</td><td>Two small molecules join together to form a larger molecule with the loss of a small molecules (usually water)</td></tr>
<tr><td>Hydrolysis</td><td>A larger molecule splits into two smaller molecules with a small molecule (usually water) added across the break point</td></tr>
</table>
</td></tr>
<tr><td>4e(ii)</td><td>6-methylheptan-2-one</td><td>
<table><tr>
<td></td>
<td>C=O Carbonyl group between two carbons
$\therefore$ -one
C=O Carbonyl group on C_2
$\therefore$ -2-one
Seven carbons on main chain with functional group
$\therefore$ heptan-2-one
$-CH_3$ methyl group on C_6
$\therefore$ 6-methylheptan-2-one</td>
</tr></table>
</td></tr>
<tr><td>5</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>
</table>

<table>
<tr><td>6a(i)</td><td>Hydrolysis</td><td rowspan="2">
</td></tr>
<tr><td>6a(ii)</td><td>$C_{20}H_{29}OH$
or
$C_{20}H_{30}O$</td></tr>
<tr><td>6b(i)</td><td>Bond breaking by u.v. light</td><td>The initiation step forms free radicals by breaking covalent bonds and free radical particles are formed with unpaired electrons
e.g. $Cl{-}Cl \rightarrow Cl^{\bullet} + Cl^{\bullet}$</td></tr>
<tr><td>6b(ii)</td><td>Propagation</td><td><table>
<tr><td>Step</td><td>Reactants
(before Arrow)</td><td>→</td><td>Products
(after Arrow)</td></tr>
<tr><td>Initiation</td><td>No free radicals on Reactant Side</td><td>→</td><td>Free radicals on Product Side</td></tr>
<tr><td>Propagation</td><td colspan="3">Free Radicals found on both sides of arrow</td></tr>
<tr><td>Termination</td><td>Free radicals on Reactant Side</td><td>→</td><td>No free radicals on Product Side</td></tr>
</table></td></tr>
<tr><td>6b(iii)</td><td>One answer from:</td><td><table><tr><td>Can react with free radicals to form stable molecules</td><td>Donates electrons</td><td>Acts as a reducing agent</td><td>Provides electrons to pair with an unpaired electron</td></tr></table></td></tr>
<tr><td>6c(i)</td><td></td><td></td></tr>
<tr><td>6c(ii)</td><td></td><td>
</td></tr>
<tr><td>7a(i)</td><td>One answer from:</td><td></td></tr>
<tr><td>7a(ii)</td><td>Sesquiterpene</td><td>Isoprene (2-methylbuta-1,3-diene) has the formula C_5H_8. Humulene has formula $C_{15}H_{24}$ and is formed when three C_5H_8 units join together.</td></tr>
<tr><td>7b(i)</td><td>5.345</td><td>1 flu vaccine ⟷ 10.69 mg squalene
500000 flu vaccines ⟷ 10.69 mg squalene x $^{500000}/_{1}$
= 5345000 mg squalene
= 5345g squalene
= 5.345 kg squalene</td></tr>
<tr><td>7b(ii)</td><td>6</td><td>1 mol of H_2 will add across 1 mol C=C double bonds
6 mol of H_2 will add across 6 mol C=C double bonds
1 mol of Squalene contains 6 mol C=C double bonds
∴1 mol of squalene will react with 6 mol of H_2</td></tr>
</table>

7c(i)	Addition or Hydration	Addition Reactions have a molecule adding across a C=C double bond or a C≡C triple bond. If the molecule adding across the C=C double bond is water then the reaction can also be described as hydration.
7c(ii)	Terpineol is a tertiary alcohol	Hot copper (II) oxide oxidises primary alcohols into carboxylic acids and oxidises secondary alcohols into ketones. Tertiary alcohols do not oxidise.
8a	286	Bond Breaking Steps: 6xC-H bonds — 6x 412kJ = 2472kJ 1xC-C bond — 1x 348kJ = 348kJ Total bond breaking = 2820kJ Bond Forming Steps: 1xC≡C bonds — 1x 838kJ = 838kJ 2xC-H bonds — 2x 412kJ = 824kJ 2xH-H bonds — 2x 436kJ = 872kJ Total bond Forming = 2534kJ ΔH = ΣBond enthalpies for bonds broken - ΣBond enthalpies for bonds formed ΔH = 2820 - 2534 ΔH = +286 kJ mol^{-1}
8b	185	❶ $C + O_2 \rightarrow CO_2$ ΔH=-394 kJ mol^{-1} ❷ $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ ΔH=-286 kJ mol^{-1} ❸ $C_3H_4 + 4O_2 \rightarrow 3CO_2 + 2H_2O$ ΔH=-1939 kJ mol^{-1} ❶x3 $3C + \cancel{3O_2} \rightarrow \cancel{3CO_2}$ ΔH=-1182 kJ ❷x2 $2H_2 + \cancel{O_2} \rightarrow \cancel{2H_2O}$ ΔH=-572 kJ ❸x-1 $\cancel{3CO_2} + \cancel{2H_2O} \rightarrow C_3H_4 + \cancel{4O_2}$ ΔH=+1939 kJ Add ❶'+❷'+❸' $3C + 2H_2 \rightarrow C_3H_4$ ΔH=+185 kJ mol^{-1}
8c(i)	48475	**gfm** C_3H_4 = 40g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{1000g}{40}$ = 25 mol 1mol ⟷ -1939 kJ 25mol ⟷ -1939kJ x $^{25}/_{1}$ = 48475 kJ
8c(ii)	13.76	**gfm** C_3H_4 = 40g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{1g}{40g\ mol^{-1}}$ = 0.025 mol $C_3H_{4(g)} + 4O_{2(g)} \longrightarrow 3CO_{2(g)} + 2H_2O_{(l)}$ 1mol 4mol 0.025mol 0.1mol **gfm** O_2 = 32g **mass** = **no.** of mol x **gfm** = 0.1 x 32 = 3.2g mass of air = 4.3 x mass of oxygen mass of air = 4.3 x 3.2 mass of air = 13.76g
8c(iii)	Methanol and ethanol contain oxygen in their structure	Methanol and ethanol are alcohols which contain the -OH hydroxyl group. This oxygen inside the molecule means less oxygen is required from air to burn the structure fully. Ethane and propane are alkanes and these hydrocarbons have no oxygen in their structure.
9a(i)	Any two from:	recycle (waste) gases / use catalyst / low/reduce energy requirements / reactors are run at lower temperatures / inexpensive feedstocks / selling/using by-products
9a(ii)	Distillation	Distillation separates chemicals with different boiling points. Ethane-1,2-diol has a higher boiling point due to hydrogen bonding by its two hydroxyl -OH groups.
9b	Answer to include:	1st Mark: Propan-1-ol has one hydroxyl -OH group Ethane-1,2-diol has two hydroxyl -OH group 2nd Mark: Stronger/more hydrogen bonding in ethane-1,2-diol than propan-1-ol

9c

One diagram from:

			
(propane-2,2-diol)	(propane-1,1-diol)	(propane-1,2-diol)	(propane-1,3-diol)

9d(i)

Answer to include:

1st Mark:	Use pipette to measure 20cm^3 of ethanol
2nd Mark:	Fill up 100cm^3 volumetric/standard flask up to mark with deionised water

9d(ii)

157.5

1kg animal ⟷ 5cm^3 ethanol solution

3.5kg animal ⟷ 5cm^3 x $^{3.5}/_1$ ethanol solution

= 17.5cm^3

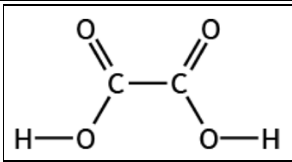
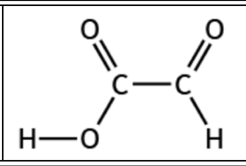
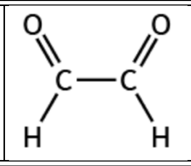
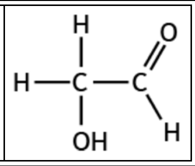
1 dose for 3.5kg animal ⟷ 17.5cm^3 ethanol solution

9 doses for 3.5kg animal ⟷ 17.5cm^3 x $^9/_1$

= 157.5cm^3

9d(iii) PART A

One answer from:

9d(iii) PART B

$HOCH_2COONa$ or $NaC_2H_3O_3$

$HOCH_2COOH + NaOH \longrightarrow HOCH_2COONa + H_2O$

10

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.

11a

One from:

Weighing By Difference	Tare Method
Set the balance to zero, place weighing bottle on balance. Record empty mass. Add 50.0g of salt to weighing bottle on balance and record the new mass. The difference in masses is the mass of the substance in the bottle.	Place weighing boat/bottle on the balance. Press TARE button on balance. When reading is a zero, add 50.0g of salt and read the mass on the balance.

11b

$2I^- \rightarrow I_2 + 2e^-$

Redox equation: $2I^- + Br_2 \rightarrow I_2 + 2Br^-$

Reduction step: $Br_2 + 2e^- \rightarrow 2Br^-$

Oxidation step: $2I^- \rightarrow I_2 + 2e^-$

11c(i)

9.5

Average volume = $\frac{9.4 + 9.6}{2} = \frac{19.0}{2}$ = 9.5cm^3

11c(ii)

4.75x10^{-6} or 0.00000475

no. of mol = **v**olume x **c**oncentration = 0.0095$_{litres}$ x 0.0010$_{mol\ l^{-1}}$ = 9.5x10^{-6}mol

$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$

1mol 2mol

4.75x10^{-6}mol 9.5x10^{-6}mol

12a(i)

1st Mark

More chlorine atoms increases germ-killing power

2nd Mark

Longer carbon chain increases germ-killing power

Compound	Phenol	2-chlorophenol	2,4-dichlorophenol	2,4,6-trichlorophenol
No. of Chlorine atoms	0	1	2	3
Germ-killing Power	1.0	3.6	13.0	23.0

Conclusion: Increasing the number of chlorines increases the germ-killing power

Compound	Phenol	4-methylphenol	4-ethylphenol	4-propylphenol
Carbon Chain Length	0		2	3
Germ-killing Power	1.0	2.5	7.5	20.0

Conclusion: Increasing the carbon chain length increases the germ-killing power

12a(ii)

2-chloro-4,5-dimethylphenol

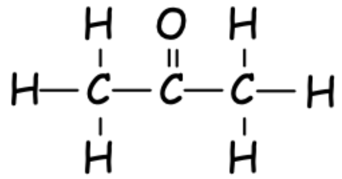
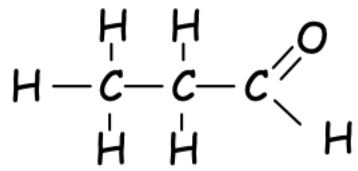
2-chloro-4,5-dimethylphenol

Chlorine on C_2 of ring (anti-clockwise numbering)

-CH_3 groups on C_4 & C_5 (anti-clockwise numbering)

6 carbon ring with -OH group on C_1

<table>
<tr>
<td>12b(i)</td>
<td>126.9</td>
<td>$C_6H_6 + H_2SO_4 + 2NaOH \longrightarrow C_6H_5OH + Na_2SO_3 + 2H_2O$
1mol   1mol
78g   94g
117g   94g x $^{117}/_{78}$
= 141g
117kg   141kg
$\%Yield = \frac{Actual}{Theoretical} \times 100 \quad \therefore\ Actual = \frac{\%\ Yield \times Theoretical}{100} = \frac{90 \times 141kg}{100} = 126.9kg$</td>
</tr>
<tr>
<td>12b(ii)</td>
<td>propanone</td>
<td>Cumene hydroperoxide $\longrightarrow$ Phenol + X
[ring]-$C_3H_7O_2$ $\longrightarrow$ [ring]-OH + C_3H_6O

C_3H_6O has two possible structures.
<table>
<tr><th>Propanone</th><th>propanal</th></tr>
<tr><td></td><td></td></tr>
</table>
The oxygen atoms in cumene hydroperoxide are attached to C_2 of three carbon chain
Conclusion: X must be propanone</td>
</tr>
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