# Past Papers Higher Chemistry

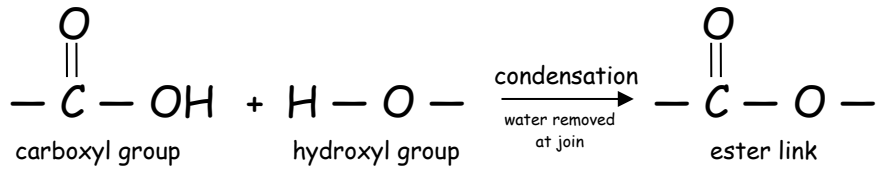
# REVISED 2013 Marking Scheme

| Grade Awarded | Mark Required (/100) | % candidates achieving grade |
|---|---|---|
| A | 72+ | 47.2% |
| B | 60+ | 22.2% |
| C | 49+ | 17.2% |
| D | 43+ | 5.5% |
| No award | <43 | 7.8% |

| Section: | Multiple Choice | Extended Answer |
|---|---|---|
| Average Mark: | 22.3 /30 | 45.8 /70 |

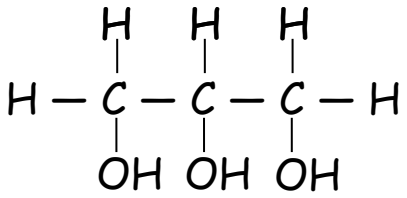
# 2013 Revised Higher Chemistry Marking Scheme

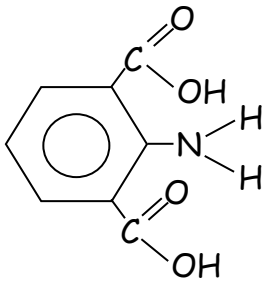
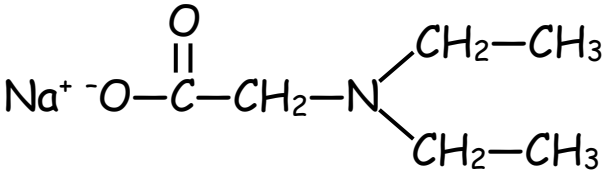
| MC Qu | Answer | % Pupils Correct | Reasoning |
|---|---|---|---|
| 1 | B | 88<br>OldH=74 | ☒A Electronegativity of lithium = 1.0<br>☑B Electronegativity of chlorine = 3.0 ∴ greatest attraction for bonding electrons<br>☒C Electronegativity of sodium = 0.9 ∴ smallest attraction for bonding electrons<br>☒D Electronegativity of bromine = 2.8 |
| 2 | D | 76<br>OldH=63 | ☒A boron has a melting point of 2300°C ∴ covalent network structure<br>☒B carbon (diamond) sublimes at 3642°C ∴ covalent network structure<br>☒C silicon has a melting point of 1410°C ∴ covalent network structure<br>☑D sulphur has a melting point of 113°C ∴ molecular covalent structure |
| 3 | C | 71<br>OldH=59 | ☒A potassium atom (2,8,8,1) is larger than potassium ion (2,8,8)<br>☒B Chloride ion (2,8,8) is not smaller than a chlorine atom (2,8,7)<br>☑C Sodium atom (2,8,1) is larger than a sodium ion (2,8)<br>☒D Oxygen atom (2,6) is not larger than an oxide ion (2,8) |
| 4 | C | 49<br>OldH=50 | ☒A Metal elements contain metallic bonding<br>☒B All elements contain London dispersion forces between atoms<br>☑C Atoms in elements must have same electronegativity so bonds cannot be polar<br>☒D All molecular elements contain non-polar covalent bonding e.g. $H_2$, $N_2$, $O_2$, $P_4$ |
| 5 | D | 76<br>OldH=69 | ☒A Elements can not have ionic bonds (ionic bonding only found in compounds)<br>☒B Covalent bonds are strong bonds<br>☒C Melting does not involve the removal of outer electrons (melting=physical change)<br>☑D Weak inter-molecular bonds are easily overcome in elements with low melting pt |
| 6 | D | 58<br>OldH=36 | Compounds containing -OH hydroxyl groups have hydrogen bonding between molecules ∴ hydrogen bonding brings molecules closer together. Compound D has two –OH hydroxyl groups and is more viscous due to the additional hydrogen bonding compared to the other compounds which only have one –OH group per molecule. |
| 7 | A | 84 | Oxidising agents are reduced themselves while oxidising something else.<br>☑A $Li \rightarrow Li^+ + e^-$ is oxidation, lithium is top of ECS ∴ powerful reducing agent<br>☒B $Br_2 + 2e^- \rightarrow 2Br^-$ is a reduction reaction ∴ acts as an oxidising agent<br>☒C $F_2 + 2e^- \rightarrow 2F^-$ is a reduction reaction ∴ acts as an oxidising agent<br>☒D $Al \rightarrow Al^{3+} + 3e^-$ is oxidation, acts as a reducing agent but as high as Li in ECS |
| 8 | C | 85 | ☒A Butanal ($C_4H_8O$) is not an isomer of the structure shown ($C_4H_{10}O$)<br>☒B Butanone ($C_4H_8O$) is not an isomer of the structure shown ($C_4H_{10}O$)<br>☑C Butan-1-ol ($C_4H_9OH$) is an isomer of 2-methylpropan-2-ol ($C_4H_9OH$)<br>☒D Butanoic acid ($C_4H_8O_2$) is not an isomer of the structure shown ($C_4H_{10}O$) |
| 9 | D | 87<br>OldH=82 | ☒A hexanal has a formula of $C_6H_{12}O$<br>☒B hexan-2-ol has a formula of $C_6H_{14}O$, usually written as $C_6H_{13}OH$<br>☒C hexan-2-one has a formula of $C_6H_{12}O$<br>☑D hexanoic acid has a formula of $C_6H_{12}O_2$, usually written as $C_5H_{11}COOH$ |
| 10 | B | 84<br>OldH=73 | $CH_3CH_2CH_2COOCH_2CH_3$<br>carboxylic acid side (2nd name in ester): 4 carbon carboxylic acid ∴ **-butanoate**<br>alcohol side (1st name in ester): 2 carbon alcohol ∴ **ethyl-**<br>∴ Ester name = **ethyl butanoate** |

| | | | |
|---|---|---|---|
| 11 | A | 86<br>OldH=70 |  |
| 12 | C | 91<br>OldH=83 | ☒A oils are liquids at room temperature<br>☒B oils are liquids at room temperature<br>☑C oils are liquids and have a higher proportion of unsaturated molecules<br>☒D oils are liquids at room temperature but are more unsaturated than fats |
| 13 | D | 65<br>OldH=36 | ☒A Amino Acid with R group = $-CH_3$ should be left side of dipeptide formed<br>☒B Amino Acids shown in dipeptide are not next to each other in tripeptride X<br>☒C Amino Acid with R group = $-CH(CH_3)_2$ should be right side of dipeptide formed<br>☑D Dipeptide shown has middle and right amino acid joined in correct order |
| 14 | C | 80 | ☒A Cyclohexane is a non-polar hydrocarbon and not a solvent for polar erythrose<br>☒B hexane is a non-polar hydrocarbon and not a solvent for polar erythrose<br>☑C hydrogen bonding in ethanol makes it best solvent for –OH groups is erythrose<br>☒D trichloromethane is polar but not best solvent for erythrose as no H-bonding |
| 15 | A | 93 | ☑A shape is distorted during denaturing and does not revert back when cooled<br>☒B amide links in a protein are not broken/hydrolysed during denaturing<br>☒C amide links in a protein are not broken/hydrolysed during denaturing<br>☒D amide links in a protein are not broken/hydrolysed during denaturing |
| 16 | C | 76<br>OldH=68 | ☒A compound 2 (butan-2-ol) is a secondary alcohol and oxidises to form an ketone<br>☒B compound 2 (butan-2-ol) is a secondary alcohol and oxidises to form an ketone<br>☑C Both alcohols are primary alcohols and oxidise to aldehydes then carboxylic acids<br>☒D compound 3 (2-methylpropan-2-ol) is a tertiary alcohol and does not oxidises |
| 17 | B | 70 | ☒A 2-methylbutanal ($C_5H_{10}O$) is not an isomer of hexanal ($C_6H_{12}O$)<br>☑B 3-methylpentan-2-one ($C_6H_{12}O$) is an isomer of hexanal ($C_6H_{12}O$)<br>☒C 2,2-dimethylbutan-1-ol ($C_6H_{13}OH$) is not an isomer of hexanal ($C_6H_{12}O$)<br>☒D 3-ethylpentanal ($C_7H_{14}O$) is not an isomer of hexanal ($C_6H_{12}O$) |
| 18 | C | 61 | ☒A condensation: small molecules joining together with removal of water molecule<br>☒B esterification: alcohol and carboxylic acid joining together with water removed<br>☑C hydrolysis: splitting molecule into smaller molecule with water added at break<br>☒D oxidation: increase in oxygen:hydrogen ratio |
| 19 | B | 88 | Formula of limonene = $C_{10}H_{16}$.<br>Isoprene units are units of 5 carbons ∴ limonene formed from 2 isoprene units |
| 20 | A | 58<br>OldH=50 | 4mol of $Br^-$ ions in $MgBr_2$ ∴ 2mol of $MgBr_2$ formula units ∴ 2 mol of $Mg^{2+}$ ions<br>3 mol of $Mg^{2+}$ ions in total = 2 mol $Mg^{2+}$ ions in $MgBr_2$ + 1 mol $Mg^{2+}$ ions in $MgSO_4$<br>1 mol of $Mg^{2+}$ ions in $MgSO_4$ ∴1 mol $MgSO_4$ formula units ∴ 1 mol $SO_4^{2-}$ ions |
| 21 | A | 76<br>OldH=70 | $2C_2H_{2(g)}$ + $5O_{2(g)}$ → $4CO_{2(g)}$ + $2H_2O_{(l)}$<br>2mol 5mol 4mol 2mol<br>2vol 5vol 4vol negligible volume<br>100cm³ 200cm³ - |
| 22 | D | 91<br>OldH=82 | Factor: Change after two hours<br>Rate of Forward Reactions: Reaction already at equilibrium so remains unchanged two hours later<br>Rate of Back Reaction: Reaction already at equilibrium so remains unchanged two hours later |
| 23 | C | 67<br>OldH=68 | ☒A increase in pressure would favour the forward reaction to reduce gas volume<br>☒B same no. of moles of gas on either side of arrow ∴ pressure has no effect<br>☑C increase in pressure would favour the reverse reaction to reduce gas volume<br>☒D same no. of moles of gas on either side of arrow ∴ pressure has no effect |
| 24 | B | 53 | ☒A Equilibrium lies to left ∴ percentage yield so low<br>☑B atom economy is high and percentage yield is low<br>☒C Equilibrium lies to left ∴ percentage yield so low<br>☒D atom economy = 100% as there is only one product |

| | | | |
|---|---|---|---|
| 25 | A | 68<br>OldH=69 | ☑A both factors would increase the rate of reaction<br>☒B an increase in activation energy would decrease the rate of reaction<br>☒C an increase in particle size would decrease the rate of reaction<br>☒D a decrease in surface area of reactants would decrease the rate of reaction |
| 26 | B | 57<br>OldH=43 | For a reaction to take place at room temperature:<br>• reaction is likely to have a small activation energy<br>• reaction is likely to be exothermic |
| 27 | A | 77<br>OldH=81 | 1mol $CH_3OH$ = (1x12) + (4x1) + (1x16) = 12+4+16 = 32g<br>1mol $CH_3OH$ = -727 kJ = 32g<br>= -72.7 kJ = 32g x $^{-72.7}/_{-727}$<br>= 3.2g |
| 28 | A | 78<br>OldH=83 | ❶ $HCOOH + \frac{1}{2}O_2 \rightarrow CO_2 + H_2O$ $\Delta H = b$<br>❷ $C + O_2 \rightarrow CO_2$ $\Delta H = c$<br>❸ $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ $\Delta H = d$<br>❶x-1 $CO_2 + H_2O \rightarrow HCOOH + \frac{1}{2}O_2$ $\Delta H = -b$<br>❷ $C + O_2 \rightarrow CO_2$ $\Delta H = c$<br>❸ $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ $\Delta H = d$<br>Add ❶'+❷+❸ $C + H_2 + O_2 \rightarrow HCOOH$ $\Delta H = c+d-b = a$ |
| 29 | B | 53 | ☒A beakers do not accurately measure volumes<br>☑B burette will measure volumes to an accuracy of $\pm 0.1 cm^3$<br>☒C pipettes will accurately the volume marked on pipette (not any other volume)<br>☒D measuring cylinders do not accurately measure volumes |
| 30 | D | 85 | ☒A Collection over Water: gases can be collected after bubbling through water<br>☒B Distillation: separation of liquids with different boiling points<br>☒C Evaporation: Used to separate water/solvent from solute in a solution<br>☑D Filtration: separation of insoluble solids from water/solutions |

# 2013 Revised Higher Chemistry Marking Scheme

| Long Qu | Answer | Reasoning |
|---|---|---|
| 1a(i) | $K(g) \rightarrow K^+(g) + e^-$ | 1st Ionisation Energy: The energy required to remove one mole of electrons from one mole of atoms in the gaseous state. |
| 1a(ii) | Outer electron is further from nucleus | Potassium atoms are bigger than chlorine atoms so the outer electron is further from the nucleus of potassium than an outer electron in a chlorine atom and the nucleus of the atom has less of a hold on electrons further from the nucleus. |
| 1b | 8 | Fatty acids contain carboxyl -COOH groups which react with hydroxyl –OH groups to form an ester group. Sucrose contains 8 hydroxyl -OH groups. |
| 2a | Terminates/reacts with free radicals | Free radical scavengers are chemicals that are able to mop up free radicals (chemicals with an unpaired electron) and will stop further free radical reactions. |
| 2b | $C_6H_8O_6$ ↓ $C_6H_6O_6 + 2H^+ + 2e^-$ | Write down the main species: $C_6H_8O_6 \longrightarrow C_6H_6O_6$<br>Balance all atoms other than O and H (not needed in this example): $C_6H_8O_6 \longrightarrow C_6H_6O_6$<br>Balance O atoms by adding $H_2O$ to other side (not needed in this example): $C_6H_8O_6 \longrightarrow C_6H_6O_6$<br>Balance H atoms by adding $H^+$ to other side: $C_6H_8O_6 \longrightarrow C_6H_6O_6 + 2H^+$<br>Balance charge by adding $e^-$ to the most positive side: $C_6H_8O_6 \longrightarrow C_6H_6O_6 + 2H^+ + 2e^-$ |
| 3a | Answer to include: | Trichloromethane is a polar molecule and there are permanent dipole to permanent dipole attractions with the polar water molecules making it soluble. Tetrachloromethane is a non-polar molecule due to the shape, of the molecule and is insoluble in polar water. |
| 3b | -115 | Bond Breaking Steps: 4x C–H = 1x412kJ = 1648kJ; 1x Cl–Cl = 1x243kJ = 243kJ; Total = 1891kJ<br>Bond Forming Steps: 3xC–H = 3x412 = 1236kJ; 1xC–Cl = 1x338 = 338kJ; 1xH–Cl = 1x432 = 432kJ; Total = 2006kJ<br>$\Delta H$ = ΣBond enthalpies for bonds broken - ΣBond enthalpies for bonds formed<br>$\Delta H$ = 1891 - 2006<br>$\Delta H$ = -115 kJ mol$^{-1}$ |
| 4a(i) | One from: | Tollen's Reagent; Benedict's Solution / Fehling's Solution; Acidified Dichromate solution; hot copper (II) oxide |
| 4a(ii) | Carboxylic acids | Phenylethanal is an aldehyde and oxidise into carboxylic acids<br>Oxidation of Alcohols: Primary alcohol → Aldehyde → Carboxylic Acid; Secondary alcohol → Ketone → X [No oxidation]; Tertiary alcohol → X [No oxidation] |
| 4b(i) | One answer from: | Keeps oil & water-soluble materials mixed; Allow immiscible substances to mix; To allow fat and water to mix; To form a suspension |
| 4b(ii) | Glycerol | Glycerol is also known as propane-1,2,3-triol and has the structure:  |
| 4c | 6.67 | 28% of 17g biscuit = $\frac{28}{100}$ x17g = 4.76g chocolate<br>1.0g chocolate = 1.4mg theobromine<br>4.76g chocolate = 1.4mg theobromine x $\frac{4.76}{1}$<br>= 6.67mg theobromine |

<table>
<tr><td>4d</td><td>Open Question<br>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>75%</td><td>$C_7H_6O_3 + C_4H_6O_3 \longrightarrow C_9H_8O_4 + C_2H_4O_2$<br>1mol 1mol 1mol 1mol<br>138g 102g 180g<br>atom economy = $\frac{\text{mass of desired product}}{\text{total mass of reactants}} \times 100 = \frac{180g}{240g} \times 100 = 75\%$</td></tr>
<tr><td>5b</td><td>40.0%</td><td>gfm salicylic acid $C_7H_6O_3$ = (7x12)+(6x1)+(3x16) = 84+6+48 = 138g<br>gfm aspirin $C_9H_8O_3$ = (9x12)+(8x1)+(4x16) = 108+8+64 = 180g<br>$C_7H_6O_3 + C_4H_6O_3 \longrightarrow C_9H_8O_4 + C_2H_4O_2$<br>1mol 1mol<br>138g 180g<br>5.02g 180g x $^{5.02}/_{138}$<br>=6.58g (100% theoretical)<br>% yield = $\frac{\text{actual}}{\text{theoretical}} \times 100 = \frac{2.62}{6.58} \times 100 = 40.0\%$</td></tr>
<tr><td>6a(i)</td><td>Carboxyl</td><td>The carboxyl group is found in carboxylic acids and</td></tr>
<tr><td>6a(ii)</td><td>Diagram showing:</td><td>  </td></tr>
<tr><td>6a(iii)</td><td>Diagram showing:</td><td>  </td></tr>
<tr><td>6b</td><td>25min</td><td>Anaesthetic X resembles procaine on the left side<br>∴ 7min duration must be starting point in calculation of duration of X<br>Anaesthetic X has N-containing ring structure:<br>Mepivacaine has the same N-containing ring structure and has a duration 18 min longer than lidocaine which lacks the n-containing ring (and looks like procaine too)<br>∴ Anaesthetic X should have a duration 18 minutes longer than procaine<br>= 7 + 18 min = 25 min</td></tr>
</table>

**6c** — 31.5

1kg body mass = 4.5 mg lidocaine

70kg body mass = 4.5 mg lidocaine $\times \frac{70}{1}$

= 315mg lidocaine

10mg lidocaine = 1cm$^3$ lidocaine solution

315mg lidocaine = 1cm$^3$ lidocaine solution $\times \frac{315}{10}$

= 31.5cm$^3$ lidocaine solution

**6d(i)** — Benzocaine is a smaller molecule or Tetracaine is bigger

Other acceptable answers:

| | | |
|---|---|---|
| Benzocaine has weaker London Dispersion Forces | Benzocaine has lower boiling point | Benzocaine more soluble/attracted to mobile phase |
| Benzocaine has weaker Van der Waal's forces | Benzocaine is more polar | Benzocaine less strongly attracted to the stationary phase |

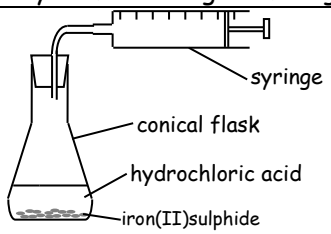
**6d(ii)** — Lidocaine and caffeine peaks overlap

The area under the peak is proportional to the quantity of chemical.
When peaks overlap due to similar retention times it is impossible to calculate the individual areas for each chemical.

**6d(iii)** — Peak drawn showing:

Peak must be at same retention time as peak E (~6.3minutes)
Peak must be approximately half the height of original peak E

**7a(i)** — Diagram Showing:




**7a(ii)** — 0.289g

$$\text{no. of mol} = \frac{\text{Volume}}{\text{Molar Volume}} = \frac{0.079_{\text{litres}}}{24 \text{ litres mol}^{-1}} = 0.00329\text{mol}$$

$$FeS + 2HCl \longrightarrow FeCl_2 + H_2S$$

1mol 1mol

0.00329mol 0.00329mol

1mol FeS = (1x55.8) + (1x32.1) = 55.8+32.1 = 87.9g

**mass** = **no.** of mol x **gfm** = 0.00329mol x 87.9 g mol$^{-1}$ = 0.289g

**7b(i)** — Covalent Molecular or Discrete Covalent

Sublimation from a solid into a gas at 310°C would indicate covalent bonding as ionic compounds melt at higher temperatures.
Insolubility on water could indicate non-polar bonding (ionic bonding is polar and can dissolve in water)

**7b(ii)** — Equation showing:

$$\underset{\text{aluminium sulphide}}{Al_2S_3} + \underset{\text{water}}{6H_2O} \longrightarrow \underset{\text{aluminium oxide}}{Al_2O_3} + \underset{\text{hydrogen sulphide}}{3H_2S}$$

**8a** — 206

| | | |
|---|---|---|
| ❶ | $CO + \frac{1}{2}O_2 \rightarrow CO_2$ | $\Delta H$= -283 kJ mol$^{-1}$ |
| ❷ | $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ | $\Delta H$= -242 kJ mol$^{-1}$ |
| ❸ | $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ | $\Delta H$= -803 kJ mol$^{-1}$ |
| ❶x-1 | $CO_2 \rightarrow CO + \frac{1}{2}O_2$ | $\Delta H$= +283 kJ |
| ❷x-3 | $3H_2O \rightarrow 3H_2 + 1\frac{1}{2}O_2$ | $\Delta H$= +726 kJ |
| ❸ | $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ | $\Delta H$= -803 kJ |
| Add ❶'+❷'+❸ | $CH_4 + H_2O \rightarrow CO + 3H_2$ | $\Delta H$= +206 kJ mol$^{-1}$ |

**8b** — decrease / increase

Forward reaction is exothermic
∴ decrease in temperature favours forward reaction
Forward reaction reduces gas pressure (from 3mol to 1mol)
∴ increase in pressure favours forward reaction

| | | |
|---|---|---|
| **9a** | 9.0 | The total volumes of $Cu^{2+}$ solution and $NH_3$ solution must equal $10cm^3$ |
| **9b** | 4 | Maximum colour intensity when $Cu^{2+}$ : $NH_3$ is 1:4 in experiment D<br>$\therefore$ 4 $NH_3$ molecules reacts with each $Cu^{2+}$ ion. |
| **10a** | $I_2 + 2e^- \rightarrow 2I^-$ | Oxidising agent oxidises another species and the oxidising agent is reduced itself.<br>Reduction is gain of electrons and electrons appear on LEFT of arrow.<br>$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$<br>Split up species into two half reactions<br>$I_2 \rightarrow 2I^-$<br>$2S_2O_3^{2-} \rightarrow S_4O_6^{2-}$<br>Balance each equation by adding electrons<br>$I_2 + 2e^- \rightarrow 2I^-$<br>$2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e^-$ |
| 10b(i) | 1st titration is rough and excluded from average | The rough titration is used to work out the rough volume by adding around $1cm^3$ at a time until the colour change is achieved. The experiment is then repeated by adding the majority of the rough titre volume in one go and them adding small volumes from this point until the colour change is achieved accurately. The experiment is repeated until concordancy is achieved (two or more volumes within $0.2cm^3$ of each other) |
| 10b(ii) | 0.0045375 | **n**o. of mol $S_2O_3^{2-}$ = **v**olume x **c**oncentration = $0.01815_{litres} \times 0.01_{mol\ l^{-1}} = 0.0001815_{mol}$<br>$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$<br>1mol : 2mol<br>0.00009075mol : 0.0001815mol<br>**c**oncentration = $\frac{\text{**n**o. of mol}}{\text{**v**olume}} = \frac{0.00009075_{mol}}{0.02_{litres}} = 0.0045375 mol\ l^{-1}$ |
| 10b(iii) | Answer to include | <u>1 mark</u><br>Mass of sodium thiosulphate = 3.96g<br><br><u>Working to get 3.96g</u><br>**n**o. of mol. = **v**olume x **c**oncentration<br>= 0.25 x 0.10<br>= <u>0.025mol</u><br><br>**gfm** $Na_2S_2O_3$ = (2x23)+(2x32.1)+(3x16)<br>= 46 + 64.2 + 48<br>= <u>158.2g</u><br><br>**m**ass = **n**o. of mol x **gfm**<br>= 0.025 x 158.2<br>= <u>3.96g</u><br><br><u>1 mark</u><br>Mention of risings<br><br><u>1 mark</u><br>Mention of making flask up to the mark |
| 11a(i) | Fermentation | glucose $\rightarrow$ ethanol + carbon dioxide<br>$C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$ |
| 11a(ii) | 10.1-10.3 | Line of best fit must be used to extrapolate the concentration of ethanol which has an absorbance of 0.9818 g $cm^{-3}$. |
| 11b(i) | 113.75 | 14% abv = 24.5 degrees proof<br>65% abv = 24.5 degrees proof x $\frac{65}{14}$<br>= 113.75 degrees proof |

<table>
<tr><td>11b(ii)</td><td>£3.30</td><td>46% abv = 0.7litres<br>65% abv = 0.7litres x $\frac{46}{65}$<br>= 0.495litres<br><br>195 litres = £1300<br>0.495litre = £1300 x $\frac{0.495}{195}$<br>= £3.30</td></tr>
<tr><td>11b(iii)</td><td>Answer:</td><td>5-butyl-4-ethyltetrahydrofuran-2-ol<br>(1C methyl group on original replaced with 2C ethyl group)</td></tr>
<tr><td>11c(i)</td><td>Addition or hydration</td><td>Water molecule adds across double bond in ethane to form ethanol</td></tr>
<tr><td>11c(ii)</td><td>No change</td><td>Catalysts have no effect on position of equilibrium. Equilibrium concentrations of reactants and products remain the same but a catalyst will speed up the rate at which equilibrium is achieved.</td></tr>
<tr><td>12</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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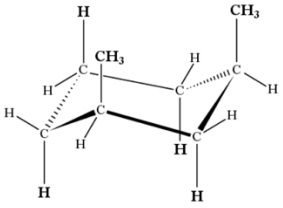
</td></tr>
<tr><td>13a</td><td>Diagram showing:</td><td>Any ring structure with two $CH_3$ groups both pointing up or both pointing down<br>  </td></tr>
<tr><td>13b(i)</td><td>Larger the group the larger the steric strain</td><td>The larger the atom (H<F<Br) the larger the steric strain<br>The larger the group the larger the steric strain e.g. $CH_3$ < $(CH_3)_3C$</td></tr>
<tr><td>13b(ii)</td><td>7.8</td><td>Steric Strain = 2 x steric strain between H and $CH_3$ = 2 x 3.8 = 7.6</td></tr>
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