JABchem

Past Papers Higher Chemistry

2004

Marking Scheme

Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	75+	23.1%
B	60+	23.3%
C	45+	26.3%
D	37+	11.3%
No award	<37	16.1%

2004 Higher Chemistry Marking Scheme

<table>
<tr><th>MC Qu</th><th>Answer</th><th>% Pupils Correct</th><th>Reasoning</th></tr>
<tr><td>1</td><td>B</td><td>54</td><td>☒A Iodine does not conduct as it is a non-metallic covalent substance
☑B Potassium melts at 64°C and is a metal so has a high electrical conductivity
☒C silicon oxide is a covalent network compound with high mpt. and low conductivity
☒D Potassium fluoride has a high mpt (i.e. ionic) but will conduct when molten</td></tr>
<tr><td>2</td><td>C</td><td>59</td><td>Ferroxyl indicator turns blue in the presence of Fe^{2+} ions.
Experiment 1: Fe^{2+} ions produced as nail P corrodes to protect the copper metal
Experiment 2: No Fe^{2+} ions produced as zinc corrodes to prevent nail Q from corroding</td></tr>
<tr><td>3</td><td>A</td><td>73</td><td>Argon has electron arrangement of 2,8,8
Sulphur atoms (2,8,6) gains 2 electrons to become S^{2-} sulphide ions (2,8,8)
Calcium atoms (2,8,8,2) lose 2 electrons to become Ca^{2+} calcium ions (2,8,8)</td></tr>
<tr><td>4</td><td>A</td><td>64</td><td>no. of mol = volume x concentration = 0.05litres x 0.1mol l^{-1} = 0.005mol
$$\underset{\substack{1mol\\0.005mol}}{H_2SO_4} + \underset{\substack{2mol\\0.01mol}}{2NaOH} \longrightarrow Na_2SO_4 + 2H_2O$$
$$\text{volume} = \frac{\text{no. of mol}}{\text{concentration}} = \frac{0.01mol}{0.4mol\ l^{-1}} = 0.025\text{litres} = 25cm^3$$</td></tr>
<tr><td>5</td><td>D</td><td>77</td><td><table>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>$[^1H_2{}^{16}O]^+$</td><td>$[^1H_2{}^{17}O]^+$</td><td>$[^1H_2{}^{18}O]^+$</td><td>$[^2H_2{}^{16}O]^+$</td><td>$[^2H_2{}^{17}O]^+$</td><td>$[^2H_2{}^{18}O]^+$</td></tr>
<tr><td>^1H 2x1 =2
^{16}O 1 x16 =16</td><td>^1H 2x1 =2
^{17}O 1 x17 =17</td><td>^1H 2x1 =2
^{18}O 1 x18 =18</td><td>^2H 2x2 =4
^{16}O 1 x16 =16</td><td>^2H 2x2 =4
^{17}O 1 x17 =17</td><td>^2H 2x2 =4
^{18}O 1 x18 =18</td></tr>
<tr><td>=18</td><td>=19</td><td>=20</td><td>=20</td><td>=21</td><td>=22</td></tr>
</table></td></tr>
<tr><td>6</td><td>C</td><td>50</td><td>☒A Rate decreases (reaction slows down) as reaction proceeds
☒B Rate at end should be horizontal if reaction is approaching zero
☑C Rate falls sharply at start and gradually comes to horizontal where rate = zero
☒D Rate decreases (reaction slows down) as reaction proceeds</td></tr>
<tr><td>7</td><td>B</td><td>44</td><td>0.8 mol of H_2 remaining ∴ 0.2 mol H_2 reacted
$$\underset{\substack{1mol\\0.2mol}}{H_2} + I_2 \rightarrow \underset{\substack{2mol\\0.4mol}}{2HI}$$</td></tr>
<tr><td>8</td><td>D</td><td>72</td><td>Enthalpy change is endothermic type (uphill overall)
Activation energy is measured from reactants to top of hill (120-40=80)</td></tr>
<tr><td>9</td><td>C</td><td>94</td><td>☒A electronegativity of Cs = 0.8 (p11 databooklet)
☒B electronegativity of O = 3.5 (p11 databooklet)
☑C electronegativity of F = 4.0 (p11 databooklet)
☒D electronegativity of I = 2.6 (p11 databooklet)</td></tr>
<tr><td>10</td><td>A</td><td>79</td><td>☑A Boiling point increases as atoms get bigger → more Van der Waals (p6 data book)
☒B density increases down group 7 (p5 data book)
☒C 1st ionisation energy decreases down group 7 (p11 data book)
☒D atomic size increases down group 7 (p7 data book)</td></tr>
<tr><td>11</td><td>D</td><td>76</td><td>Add 1st + 2nd Ionisation energies together from p10 of data booklet to remove 2 electrons per atom
☒A Sc ΔH= 633 + 1235 = 1868kJ mol^{-1}
☒B Ti ΔH= 659 +1310 = 1969kJ mol^{-1}
☒C V ΔH= 651 + 1410 = 2061kJ mol^{-1}
☑D Cr ΔH= 653 + 1591 = 2244kJ mol^{-1}</td></tr>
<tr><td>12</td><td>C</td><td>63</td><td>☒A CH_4: non-polar molecule as electronegativity difference is cery low
☒B CO_2:C-O bond has a large enough electroneg. difference but linear shape makes it non-polar
☑C NH_3: N-H bond is polar as electronegativity difference is large enough
☒D CCl_4:C-Cl bond is large enough Eneg. difference but tetrahedral shape makes it non-polar</td></tr>
</table>

13	A	58	$2NO + O_2 \rightarrow 2NO_2$ 2mol 1mol 2mol 2vol 1vol 2vol (at same conditions of temperature & pressure!) 1litre ½litre 1litre (NB 2 litres of O_2 available ∴ 1½ litres of O_2 left over)
14	B	63	gfm of SO_2=64.1g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{128.2}/_{64.1}$ = 2mol of SO_2 ☒A gfm H_2=2g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{2.0}/_{2}$ = 1mol of H_2 ☑B gfm He=4g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{8.0}/_{4}$ = 2mol of He ☒C gfm O_2=32g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{32.0}/_{32}$ = 1mol of O_2 ☒D gfm Ne=20.2g ∴ no. of mol = $^{mass}/_{gfm}$ = $^{80.8}/_{20.2}$ = 4mol of Ne
15	D	25	gfm Cu = 63.5g no. of mol = $\frac{mass}{gfm} = \frac{5}{63.5}$ = 0.0787mol $Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$ 1mol 2mol 0.0787mol 0.157mol gfm Cu = 107.9g mass = no. of mol x gfm = 0.157 x 107.9 = 17.0g
16	A	42	☑A Reforming: converting straight chains into branched and ring structures ☒B Hydrogenation/addition: H_2 added across the C=C double bond ☒C Dehydration: Water eliminated from molecule leaving a C=C double bond ☒D Cracking: Larger molecules made smaller producing a molecule with a C=C bond
17	B	72	☒A aldehyde ☑B ketone ☒C carboxylic acid ☒D ester
18	B	71	2,2-dimethylpentan-1-ol is $CH_3CH_2CH_2C(CH_3)_2CH_2OH \rightarrow C_7H_{16}O$ ☒A 2-methylpentan-1-ol is $C_6H_{14}O$ ☑B 2,3,3-trimethylbutan-1-ol is $C_7H_{16}O$ ☒C octan-1-ol is $C_8H_{18}O$ ☒D 3,3,4-trimethylpentan-1-ol is $C_8H_{18}O$
19	B	49	Cracking is when larger less useful molecules are turned into smaller more useful molecules: $C_2H_6 \rightarrow C_2H_4 + H_2$. C_2H_4 is smaller than C_2H_6 and can more usefully be used in making plastics.
20	A	74	$CH_3CH_2COO^-Na^+$ is the salt sodium propanoate. It is made from reacting an acid and an alkali together (i.e. propanoic acid + sodium hydroxide)
21	D	66	☒A Methanol is a primary alcohol which oxidises into methanal & methanoic acid ☒B Methanol is a primary alcohol which oxidises into methanal ☒C Synthesis gas ($CO + H_2$) can be turned into methanol (to make methanal for plastics) ☑D Alkenes need at least 2 carbons to have a C=C bond
22	A	51	gfm H_2 = 2g gfm NH_3 = 17g $N_2 + 3H_2 \rightleftharpoons 2NH_3$ 1mol 3mol 2mol 6g 34g 60g 340g 60kg 340kg %yield= $\frac{actual}{theoretical}$ x100 = $\frac{80}{340}$ x100 = 23.5%
23	D	71	Synthesis gas is a mixture of carbon monoxide and hydrogen
24	D	79	☒A contains 2 function groups (-COOH) ☒B contains 2 function groups (-OH) ☒C contains 2 functional groups (-COOH and –OH) ☑D methanol only has 1 functional group ∴ polymer cannot continue to polymerise
25	A	96	☑A Kevlar is extremely strong and is used in bullet-proof vests ☒B Biopol is a biodegradable plastic ☒C Poly(ethenol) is a soluble plastic ☒D Poly(ethyne) is a plastic which is an electrical conductor

26	A	84	Glycerol (propane-1,2,3-triol) has 3 carbons, each containing an –OH group
27	B	74	☒A Fats & Oils have the same structure to produce the same no. of hydrogen bonds ☑B Fat molecules are have less C=C bonds which allows them to pack more closely ☒C Fat molecules are more closely packed ☒D Fats & Oils have no cross links between the molecules
28	C	91	Enzymes are globular proteins. Proteins are polymers made from amino acid monomer units
29	D	38	Raw materials are chemicals which are taken from the Earth and used as chemical reactants in the chemical industry. Raw materials include: sodium chloride (salt), water, methane and air
30	B	68	❶ $C + O_2 \rightarrow CO_2$ ΔH=-393.5 kJ ❷ $CO + \frac{1}{2}O_2 \rightarrow CO_2$ ΔH=-283.0 kJ ❶ $C + O_2 \rightarrow CO_2$ ΔH=-393.5 kJ ❷x-1 $CO_2 \rightarrow CO + \frac{1}{2}O_2$ ΔH=+283.0 kJ ❶ +❷' $C + \frac{1}{2}O_2 \rightarrow CO$ ΔH=-110.5 kJ
31	D	78	Catalysts do not alter the position of equilibrium (same % of reactants & products) Catalysts do not change the value of the enthalpy change (ΔH)
32	C	29	$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ equilibrium establishes. ☒A By adding $NH_4^+Cl^-$, $[NH_4^+]$ will increase ☒B By adding $NH_4^+Cl^-$, $[H^+]$ unaffected in this equilibrium ☑C By adding $NH_4^+Cl^-$, equilibrium shifts to left to remove NH_4^+ ions and $[OH^-]$ also ↓ ☒D By adding $NH_4^+Cl^-$, $[Cl^-]$ will increase
33	C	71	☒A pH must less than pH=1 ☒B pH must be between pH=1 and pH=2 ☑C pH must be between pH=2 and pH=3 ☒D pH must be greater than 3
34	A	83	Sulphuric acid is a strong acid (fully dissociates) 0.1mol l^{-1} is classified as a dilute solution.
35	C	78	☒A Ethanoic acid would take longer to react as ethanoic acid has lower $[H^+]$ ☒B Ethanoic acid would take longer to produce the first 10cm^3 of gas ☑C Same total no. of moles of H^+ present as volume & conc of each acid is same ☒D The average rate of reaction was slower for ethanoic acid
36	B	56	$NaOH_{(aq)}$ has a higher pH than $NH_{3(aq)}$ as NaOH is fully dissociated $NaOH_{(aq)}$ has a higher conductivity than $NH_{3(aq)}$ as NaOH is fully dissociated
37	D	46	1. Balance atoms (other than H and O) $2IO_3^- \rightarrow I_2$ 2. Balance O by adding H_2O to other side $2IO_3^- \rightarrow I_2 + 6H_2O$ 3. Balance H by adding H^+ to other side $2IO_3^- + 12H^+ \rightarrow I_2 + 6H_2O$ 4. Balance charge by adding e^- to most positive side $2IO_3^- + \underline{12}H^+ + 10e^- \rightarrow I_2 + \underline{6}H_2O$
38	C	51	☒A No H^+ present so not acting as an acid ☒B No neutralisation of acid so not acting as a base ☑C $Mg \rightarrow Mg^{2+} + 2e^-$: Mg is oxidised so NH_3 is acting as an oxidising agent ☒D If NH_3 was a reducing agent, Mg would be reduced and gain electrons.
39	B	60	☒A nucleus gains α and loses p → mass no. +3 & atomic no. +1 → correct answer ☑B nucleus gains p and loses α → mass no. -3 & atomic no. -1 ☒C nucleus gains α and loses n → mass no. +3 & atomic no. +2 → correct answer ☒D nucleus gains n and loses α → mass no. -3 & atomic no. -2 → correct answer
40	C	69	☒A This is electron capture ☒B Nuclear fusion: small atoms join together top become a bigger atom ☑C Nuclear fission: large atoms split into smaller atoms ☒D Neutron capture followed by proton emission.

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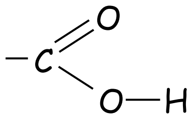
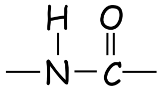
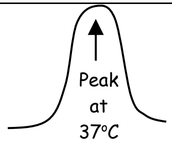
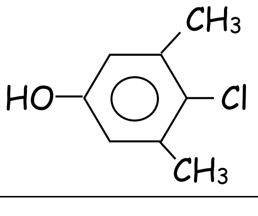
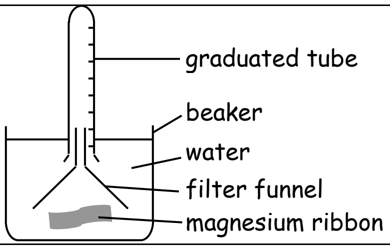
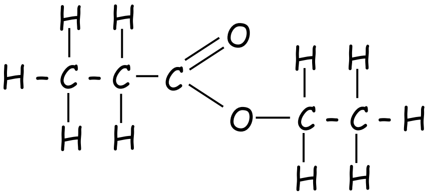
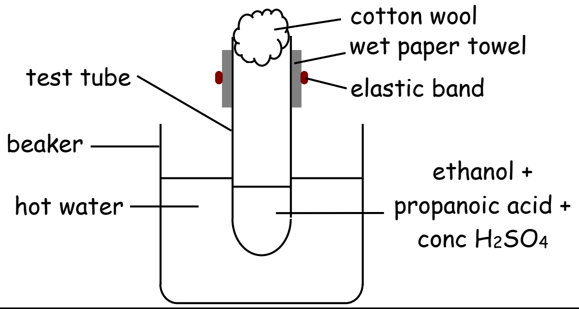
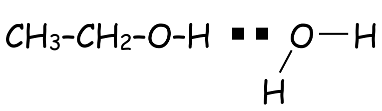
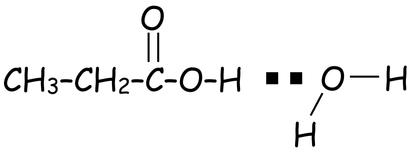
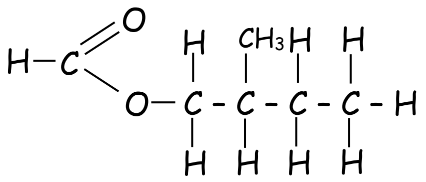
<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1a</td><td>Any answer from:</td><td>
<table>
<tr><th>Bonding</th><th>Element</th></tr>
<tr><td>(Metallic solid)</td><td>(sodium)</td></tr>
<tr><td>Monatomic gas</td><td>helium, neon, argon</td></tr>
<tr><td>Covalent network</td><td>boron, carbon (graphite), carbon (diamond), silicon</td></tr>
<tr><td>Discrete covalent molecular gas</td><td>hydrogen, nitrogen, oxygen, fluorine, chlorine</td></tr>
<tr><td>Discrete covalent molecular solid</td><td>sulphur, phosphorus, carbon (fullerene)</td></tr>
</table>
</td></tr>
<tr><td>1b</td><td>Delocalised outer electrons jump from outer shell to neighbouring atom</td><td>Metallic bonding has inner positive cores (nucleus + inner electron shells) and delocalised electrons which can move from atom to atom conducting electricity</td></tr>
<tr><td>2a</td><td>$^{32}_{15}P \rightarrow ^{32}_{16}S + ^{0}_{-1}e$</td><td>βeta emission involves the splitting of a neutron in the nucleus into a proton (stays in the nucleus) and an electron (emitted as a βeta particle)</td></tr>
<tr><td>2b(i)</td><td>1.505×10^{23}</td><td>1mol ^{32}P = 32g = 6.02×10^{23} atoms
8g = 6.02×10^{23} atoms $\times ^{8}/_{32}$
= 1.505×10^{23} atoms</td></tr>
<tr><td>2b(ii)</td><td>42.9days</td><td>
<table>
<tr><th>Time (days)</th><th>Mass of ^{32}P remaining</th></tr>
<tr><td>0</td><td>8g</td></tr>
<tr><td>14.3</td><td>4g</td></tr>
<tr><td>28.6</td><td>2g</td></tr>
<tr><td>42.9</td><td>1g</td></tr>
</table>
</td></tr>
<tr><td>3a</td><td>Sulphur dioxide</td><td>sphalerite is impure zinc sulphide. Under high temperature, sulphur in zinc sulphide reacts with oxygen from air to form SO_2. This SO_2 is further reacted to form sulphuric acid (H_2SO_4)</td></tr>
<tr><td>3b</td><td>displacement</td><td>Higher up metal (zinc) displaces lower down metals from their ions (lead, silver, gold and copper ion impurities in ore)</td></tr>
<tr><td>3c</td><td>Arrow from sulphuric acid into the neutraliser</td><td>The zinc oxide in the neutraliser requires an acid to neutralise. As zinc sulphate is produced in the neutraliser, the acid must be sulphuric acid</td></tr>
<tr><td>3d</td><td>58.555kg</td><td>Q=It = 2000A x (24x60x60)seconds = 172800000C
$Zn + 2e^- \rightarrow Zn$
1mol 2mol 1mol
2x96500C 65.4g
193000C 65.4g
172800000C 65.4g x $^{172800000}/_{193000}$ = 58555g = 58.555kg</td></tr>
<tr><td>4a</td><td>Starch</td><td>Starch $(C_6H_{10}O_5)_n$ is a long chain polymer made of glucose $C_6H_{12}O_6$ monomer units joined together by condensation polymerisation</td></tr>
<tr><td>4b(i)</td><td>Silver mirror produced</td><td>Tollen's reagent produces a silver mirror in the presence of aldehyde groups</td></tr>
<tr><td>4b(ii)</td><td></td><td>Aldehydes oxidise into carboxylic acid groups</td></tr>
<tr><td>4c</td><td>Renewable resource</td><td>Glucose, from sugar cane, is a renewable resource and can be replaced every year by growing more sugar cane. Methane in natural gas takes millions of years to form and is a non-renewable resource.</td></tr>
<tr><td>5a</td><td>
<table>
<tr><td>Rate of forward & reverse reactions</td><td>Same</td></tr>
<tr><td>Concentration of reactants compared to products</td><td>Usually different</td></tr>
</table>
</td><td>At equilibrium: the rate of forward reaction = rate of reverse reaction
The concentrations of reactants and products at equilibrium are rarely equal and depend on conditions like temperature and pressure.</td></tr>
<tr><td>5b(i)</td><td>forward reaction is exothermic</td><td>Increase in temperature favours the endothermic reaction
Equilibrium shifts to left so reverse reaction must be endothermic
∴Forward reaction must be exothermic</td></tr>
</table>

5b(ii)	No change	Both reactant and product sides of reaction contain 4 moles of gaseous chemicals. TYhere is no pressure change for forward and reverse reactions so changing pressure does not affect the equilibrium.
6a	purple → colourless	Permanganate is purple and loses its colour when it reacts with oxalic acid
6b(i)	83.3seconds	Rate at 40°C = $0.012s^{-1.}$ time = $\frac{1}{rate} = \frac{1}{0.012s^{-1}} = 83.3s$
6b(ii)	Colour change is slow and hard to time exactly	Colour changes which indicate the end of a reaction must be relatively fast. Slow colour changes lead to error if the colour transition is over a number of seconds.
6c	Curve moves to right	Increases in temperature increase the average kinetic energy of the molecules in the reaction. This moves the peak of the curve to the right. (NB the no. of molecules has not changed ∴ total area under the curve should be equal)
7a	 $-\overset{H}{\underset{}{N}}-\overset{O}{\overset{\Vert}{C}}-$	Peptide links are formed when the acid group (-COOH) of an amino acid joins with the amine group ($-NH_2$) of another amino acid by condensation polymerisation and a water molecule is removed at the join.
7b		At temperatures above 37°C, the enzyme activity reduces as the enzyme changes shape and denatures.
7c	Changes shape	pH changes can change the shape of an enzyme as H^+ and OH^- can react with the structure of the globular protein and change its shape.
8a	-54.34	Average temperature at start= 19°C c=4.18 kJ kg^{-1} $°C^{-1}$ Final temperature = 25.5°C volume of water $40cm^3$ ∴Temperature change ΔT=6.5°C ∴mass of water = 0.04kg $E_h = cm\Delta T = 4.18 \times 0.04 \times 6.5 = 1.0868$ kJ $NaOH + HCl \rightarrow NaCl + H_2O$ 1mol 1mol **n**o. of mol H^+ = **v**olume x **c**oncentration = 0.02litres x 1mol l^{-1} = 0.02mol 0.02mol ⇔ 1.0868kJ 1mol ⇔ 1.0868kJ x $^1/_{0.02}$ = 54.34kJ mol^{-1} Exothermic reaction =-54.34kJ mol^{-1}
8b	10^{-14}mol l^{-1}	$[OH^-] = \frac{10^{-14}}{[H^+]} = \frac{10^{-14}}{1} = 10^{-14}$ mol l^{-1}
9a	P^{3-} ion has one more complete electron shell than Al^{3+}	P^{3-}ion has an electron arrangement of 2,8,8 and has three complete electron shells. Al^{3+} ion has an electron arrangement of 2,8 and has only two complete electron shells
9b	More protons in Ca^{2+} nucleus to draw in outer electron shell	Ca^{2+} and P^{3-} have the same electron arrangement (2,8,8) and both have three complete electron shells. Ca^{2+} ions have 20 protons in the nucleus but P^{3-} ions only have 15 protons in the nucleus. Greater positive charge in Ca^{2+} nucleus draws in outer electron shell closer and makes Ca^{2+} ion smaller than P^{3-} ion.
10a(i)	6 delocalised electrons of the benzene ring	The 6 delocalised electrons (3 above and 3 below the carbon ring) flatten and add stability to the structure of benzene
10a(ii)	$C_6H_2OHCl_3$	Each corner of the hexagon structure of benzene has a hydrogen attached (except where another group has been substituted)
10a(iii)		NB Phenol –OH group is carbon number 1
10b	Making petrol	Reforming is changing straight chain hydrocarbons into branched and ring hydrocarbons necessary for use as petrol (to stop auto-ignition before the spark)

11a	Diagram showing:	
11b	<u>Measurements</u> Mass of Mg at start Mass of Mg at end Volume of H_2 produced	<u>Method</u> Calculate no. of moles of magnesium reacted from mass reacted. Use 1mol → 1mol Mg:H_2 ratio to calculate no. of moles of H_2 produced. Use maths proportion to calculate the volume of 1 mole of H_2 gas
12a	Brown colour decolourises (Vitamin C in excess)	**no.** of mol $C_6H_8O_6$ = **volume** x **concentration** = 0.05litres x 0.1mol l^{-1} = 0.005mol no. of mol $I_2 = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.54}{253.8}$ = 0.00213mol $\underset{\underset{0.00213mol}{1mol}}{C_6H_8O_6} + \underset{\underset{0.00213mol}{1mol}}{I_2} \rightarrow C_6H_6O_6 + 2H^+ + 2I^-$ More $C_6H_8O_6$ available (0.005mol) than is needed to react with I_2 (0.00213mol) All I_2 reacts with excess $C_6H_8O_6$ so brown colour of iodine disappears Excess $C_6H_8O_6$ present → all iodine reacted → brown colour decolourises
12b	$C_6H_8O_6$ ↓ $C_6H_6O_6 + 2H^+ + 2e^-$	$C_6H_8O_6 \rightarrow C_6H_6O_6 + 2H^+ + 2e^-$
13a	butan-2-ol	butan-2-ol ↙ ↓ ↘ 4 carbons in longest chain containing functional group functional group on carbon number 2 functional group is –OH group
13b	Structure of 2-methylpropan-2-ol	Tertiary alcohols have 3 carbons directly attached to the carbon with the -OH group.
13c	But-2-ene	But-2-ene (Z) reacts with HBr to produce only 2-bromobutane But-1-ene (Y) reacts with HBr to produce 1-bromobutane and 2-bromobutane
14a(i)	Diagram showing:	
14a(ii)	Diagram showing:	
14a(iii)	Diagrams showing:	 

14b	Diagram showing:	 a) ethanoic acid in example but methanoic acid in question – replace CH_3 in acid with H ∴ carboxylic acid in ester is methanoic acid b) If alkene is 2-methylbut-1-ene then $R=CH_3$ and $R'=C_2H_5$ (or vice versa) ∴ Alcohol in ester must be 2-methylbutan-1-ol
15a	-484	Equation ❶x-1: $2CO_2 + 2H_2O \rightarrow CH_3COOH + 2O_2$ $\Delta H=+876kJ$ Equation ❷x2: $2C + 2O_2 \rightarrow 2CO_2$ $\Delta H=-788kJ$ Equation ❸x2: $2H_2 + O_2 \rightarrow 2H_2O$ $\Delta H=\underline{-572}kJ$ Add ❶'+❷'+❸' $2C + 2H_2 + O_2 \rightarrow CH_3COOH$ $\Delta H=\underline{-484}kJ\ mol^{-1}$
15b	Answer to include:	$Na^+CH_3COO^-$ fully ionises when dissolved in water to form Na^+ and CH_3COO^- ions $CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$ CH_3COO^- ions join up with H^+ ions in water to form molecules of CH_3COOH as equilibrium lies well to left $H_2O \rightleftharpoons H^+ + OH^-$ As H^+ ions are removed as they join up with CH_3COO^- H_2O dissociates into more H^+ ions and OH^- ions. H^+ ions are removed but OH^- remain ∴ $[OH^-] > [H^+]$ ∴ pH>7
16a	$4KMnO_4$ ↓ $2K_2O + 4MnO_2 + 3O_2$	$4KMnO_4 \rightarrow 2K_2O + 4MnO_2 + 3O_2$ (or $2KMnO_4 \rightarrow K_2O + 2MnO_2 + 1\frac{1}{2}O_2$)
16b(i)	Any two from:	Remove funnel from top of burette before taking any readings Use a white tile under conical flask to aid visibility of colour change Repeat experiment and average results (ignoring rough titration)
16b(ii)	1.50	**n**o of mol MnO_4^- = **v**olume x **c**oncentration = 0.025litres x 0.2mol l^{-1} = 0.005mol $5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$ 5mol 1 mol 0.025mol 0.005mol **c**oncentration = $\frac{\textbf{n}\text{o. of mol}}{\textbf{v}\text{olume}} = \frac{0.025_{mol}}{0.0167_{litres}}$ = 1.50mol l^{-1}
17a	5.5 – 4.5	Page 16 of data booklet
17b	propyne	Peak at Chemical Shift =1 → $-CH_3$ Peak at Chemcial shift =2.7 " $-C\equiv CH$
17c	Two peaks drawn:	Peak at ChemShift=1 to relative Height 3 ($-CH_3$ so ChemShift=1 and height 3 as 3H in group) Peak at ChemShift=3.7 to relative Height 2 ($-CH_2Cl$ so ChemShift=3.7 and height 2 as 2H in group)