JABchem

Past Papers Higher Chemistry

2008

Marking Scheme

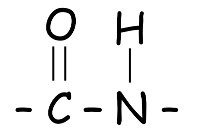
Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	70+	28.6%
B	58+	24.4%
C	46+	24.3%
D	40+	8.8%
No award	<40	13.9%

Section:	Multiple Choice	Extended Answer
Average Mark:	24.6 /40	34.1 /60

2008 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>D</td><td>58</td><td>☒A displacement: requires a metal and a metal ion to swap places
☒B neutralisation: not H^+ ions present for a neutralisation to take place
☒C oxidation: no loss of electrons for an oxidation reaction
☑D precipitation: $BaCl_2(aq) + 2AgNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + 2AgCl(s)$</td></tr>
<tr><td>2</td><td>B</td><td>53</td><td>☒A Hydrogen gas given off at zinc electrode: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
☑B Hydrogen gas given off at zinc electrode: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
☒C No gas given off at copper electrode as copper not reactive enough to react
☒D No gas given off at copper electrode as copper not reactive enough to react</td></tr>
<tr><td>3</td><td>A</td><td>53</td><td>☑A carbon dioxide dissolves in water to form an acid (pH<7)
☒B hydrogen oxide (water) has a neutral pH=7
☒C sodium oxide dissolves in water to form an alkali (pH>7)
☒D tin oxide is insoluble in water (p7 of data booklet)</td></tr>
<tr><td>4</td><td>D</td><td>57</td><td>0.6mol Cl^- ions ∴ 0.6mol NaCl f.u. ∴ 0.6mol Na^+ ions
0.2mol SO_4^{2-} ions ∴ 0.2mol Na_2SO_4 f.u. ∴ 0.4mol Na^+ ions
∴ 0.6mol Na^+ ions + 0.4mol Na^+ ions = 1mol Na^+ ions</td></tr>
<tr><td>5</td><td>A</td><td>87</td><td>$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{82-52}{8-2} = \frac{30}{6} = 5\text{cm}^3\ \text{min}^{-1}$</td></tr>
<tr><td>6</td><td>D</td><td>58</td><td>gfm Cu = 63.5g   no. of mol $= \frac{\textbf{mass}}{\textbf{gfm}} = \frac{5}{63.5} = 0.0787\text{mol}$
$Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$
1mol   2mol
0.0787mol   0.157mol
gfm Ag 107.9g   mass = no. of mol x gfm = 0.157mol x 107.9g mol^{-1} = 16.99g</td></tr>
<tr><td>7</td><td>D</td><td>61</td><td>☒A activated complex only forms if energy and angle of collision are both correct
☒B all molecules in area X have enough energy to form activated complex
☒C activated complex only forms if energy and angle of collision are both correct
☑D all molecules have enough energy to react (angle of collision must also be right)</td></tr>
<tr><td>8</td><td>C</td><td>70</td><td>The activation energy for the catalysed forward reaction = 35kJ mol^{-1}
The enthalpy change for the reaction = -30kJ mol^{-1}
The activation energy for the catalysed reverse reaction = 35 + 30 = 65kJ mol^{-1}</td></tr>
<tr><td>9</td><td>A</td><td>78</td><td>
<table>
<tr><th>Group 1 Element</th><th>Lithium</th><th>Sodium</th><th>Potassium</th><th>Rubidium</th><th>Caesium</th><th>Trend</th></tr>
<tr><td>Atomic Number</td><td>3</td><td>11</td><td>19</td><td>37</td><td>55</td><td></td></tr>
<tr><td>1st Ionisation Energy (kJ mol^{-1})</td><td>520</td><td>496</td><td>419</td><td>403</td><td>376</td><td>decreasing</td></tr>
<tr><td>Atomic Size (pm) (or Covalent Radius)</td><td>134</td><td>154</td><td>196</td><td>216</td><td>235</td><td>increasing</td></tr>
<tr><td>Density (g cm^{-3})</td><td>0.53</td><td>0.97</td><td>0.89</td><td>1.53</td><td>1.93</td><td>increasing</td></tr>
<tr><td>Melting Point (°C)</td><td>181</td><td>98</td><td>63</td><td>39</td><td>28</td><td>decreasing</td></tr>
</table>
</td></tr>
<tr><td>10</td><td>D</td><td>66</td><td>Electronegativity is the attraction for electrons of an atom
<table>
<tr><th>Element</th><th>Carbon</th><th>Nitrogen</th><th>Phosphorus</th><th>Silicon</th></tr>
<tr><td>Electronegativity</td><td>2.5</td><td>3.0</td><td>2.2</td><td>1.9</td></tr>
</table>
</td></tr>
<tr><td>11</td><td>C</td><td>83</td><td>☒A Any ionisation energy removes 1 mol of electrons
☒B Any ionisation energy removes 1 mol of electrons
☑C 3rd ionisation removes 1 electron from 2+ ion into 3+ ion: $Al^{2+}(g) \rightarrow Al^{3+}(g) + e^-$
☒D 3rd ionisation removes 1 electron from 2+ ion into 3+ ion: $Al^{2+}(g) \rightarrow Al^{3+}(g) + e^-$</td></tr>
<tr><td>12</td><td>D</td><td>36</td><td>☒A Breaking covalent bond in Cl–Cl requires energy put in ∴ endothermic reaction
☒B Melting and boiling absorbs energy ∴ endothermic process
☒C Removing electrons from atoms requires energy put in ∴ endothermic reaction
☑D Turning gases back into solids gives out energy ∴ exothermic reaction</td></tr>
</table>

13	A	65	☑A ethanol C_2H_5OH contain the O-H bond and has hydrogen bonding ☒B ethyl ethanoate: ester have no O–H, N–H or H-F bonds ∴ no hydrogen bonding ☒C hexane: alkanes have no O–H, N–H or H-F bonds ∴ no hydrogen bonding ☒D pent-1-ene: alkenes have no O–H, N–H or H-F bonds ∴ no hydrogen bonding
14	C	74	☒A H-Cl is a polar molecule (electronegativity difference = 3.0-2.2 = 0.8) ☒B H_2O is a polar molecule (electronegativity difference = 3.5-2.2 = 1.3) ☑C CO_2 is a non-polar molecule due to linear shape (O=C=O) ☒D $CHCl_3$ is a polar molecule (C-Cl electronegativity difference = 3.0-2.5 = 0.5)
15	B	41	☒A graphite: covalent bonds between carbon with one delocalised electron per atom ☑B sodium: metallic bonding with positively charged ions and delocalised outer electrons ☒C mercury is a liquid at room temperature (melting point = -39°C) ☒D phosphorus contains P_4 molecules with no delocalised electrons
16	C	46	1mol Na = 6.02×10^{23}atoms = 23g 1 atom = 23g × $\frac{1}{6.02\times10^{23}}$ = 3.8×10^{-23} g
17	D	69	☒A 1mol O_2 = 2mol O atoms 1mol CO = 1mol O atoms ☒B 1mol O_2 = 2mol O atoms 0.5mol CO_2 = 1mol O atoms ☒C 0.5mol O_2 = 1mol O atoms 1mol CO_2 = 2mol O atoms ☑D 1mol O_2 = 2mol O atoms 1mol CO_2 = 2 mol O atoms
18	B	39	☒A 1mol O_2 molecules = 32g ∴ 16g = 0.5mol O_2 molecules ☑B 1mol H_2 molecules = 2g ∴ 1g = 0.5mol H_2 molecules = 1mol e^- electrons ☒C 1mol C atoms = 12g ∴ 24g = 2mol C atoms ☒D no.of mol = volume x concentration = 1litre x 1mol l^{-1} = 1mol NaCl f.u. ∴ 2mol ions
19	C	54	$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ 2mol 1mol 2mol 2vol 1vol 2vol 4litres 2litres 4litres (+1litre of NO_2 leftover)
20	B	66	Methane (biogas) is produced in anaerobic conditions (no oxygen available) when bacteria are forced to break down materials into methane instead of carbon dioxide
21	D	50	H—C=C—C=C—H (each C bonded to one H below) Formula of butadiene = C_4H_6 n=4 ∴ 2n-2 = (2x4)–2 = 8-2 = 6 General Formula: C_nH_{2n-2}
22	A	71	Reaction / Name / Description X / Hydration / Hydration = water added across the C=C double bond; Propene + water → propan-1-ol Y / Oxidation / Oxidation = increase in oxygen : hydrogen ratio; Propan-1-ol → propanal
23	A	59	$3H_2 + N_2 \longrightarrow 2NH_3$ 3mol 2mol 6g 34g 6kg 34kg 60kg 34kg × $\frac{60}{6}$ =340kg (theoretical) %yield = $\frac{actual}{theoretical}\times 100 = \frac{80}{340}\times 100$ = 23.5%

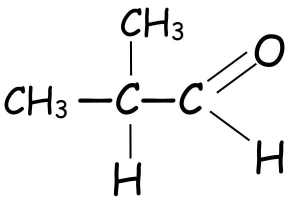
<table>
<tr><td>24</td><td>B</td><td>56</td><td>☒A methanol is made by reacting synthesis gas: $CO + 2H_2 \rightarrow CH_3OH$
☑B Alkenes must have 2 carbons for a C=C double bond i.e. methene does not exist
☒C methanol is oxidised to methanal which is further oxidised to methanoic acid
☒D acidified potassium dichromate will oxidise methanol to methanal</td></tr>
<tr><td>25</td><td>A</td><td>56</td><td>☑A This is the diacid monomer used for the polyester formed
☒B Carboxylic Acid groups must be on carbons 1 + 3 to form polyester as shown
☒C Molecule drawn is a diol not a diacid
☒D There is no $-CH_2CH_2-$ group between benzene and –COOH carboxyl group</td></tr>
<tr><td>26</td><td>B</td><td>42</td><td>☒A Single esters are used for flavourings, perfumes and solvents
☑B Polymeric esters are long chain polymer polyesters used in fibres and resins
☒C Polyester resins contain cross-links but polyester fibres are straight molecules
☒D Protein is the polymer made by condensation polymerisation of amino acids</td></tr>
<tr><td>27</td><td>C</td><td>88</td><td>Enzymes are denatured by temperatures above the optimum temperature (usually body temperature 37°C) as they change shape and no longer catalyse their chemical reaction.</td></tr>
<tr><td>28</td><td>B</td><td>82</td><td>Peptide and amide links are the same group chemically
• Peptide links are found in proteins
• Amide links are found in polyamide polymers e.g. nylon, kevlar

</td></tr>
<tr><td>29</td><td>B</td><td>85</td><td>A catalyst lowers the activation energy of both the forward and reverse reactions. This increases the rates of the forward and reverse reactions. The catalyst allows equilibrium to be established more quickly. The final concentrations of reactants and products remains the same as the position of equilibrium remains unchanged.</td></tr>
<tr><td>30</td><td>C</td><td>29</td><td>The red colour will fade as equilibrium shifts to right.
☒A Equilibrium shifts to left as product (H^+) is added to equilibrium
☒B Equilibrium shifts to left as product (Br^-) is added to equilibrium
☑C Equilibrium shifts to right as product (Br^-) is removed by $Ag^+Br^-_{(s)}$ precipitation
☒D Equilibrium shifts to left as product (OBr^-) is added to equilibrium</td></tr>
<tr><td>31</td><td>B</td><td>71</td><td>☒A nitric acid is a strong acid
☑B 0.1mol l^{-1} solution is a dilute solution and nitric acid is strong acid
☒C 0.1mol l^{-1} solution is a dilute solution
☒D 0.1mol l^{-1} solution is a dilute solution</td></tr>
<tr><td>32</td><td>B</td><td>53</td><td>☒A polar molecules are covalent molecules so do not conduct electricity
☑B little dissociation of $H_2O \rightarrow H^+ + OH^-$: few ions means small conductivity
☒C hydrogen bonding is between non-conducting molecules
☒D the low conductivity of water is not dependent on equal numbers of H^+ and OH^-</td></tr>
<tr><td>33</td><td>C</td><td>72</td><td>☒A ammonia solution is a weak alkali and has pH>7
☒B ammonia solution is a weak alkali and only partially ionised (dissociated)
☑C ammonia solution is an alkali so it contains more OH^- ions than H^+ ions
☒D In neutralisation reactions with acids, ammonia solution forms ammonium salts</td></tr>
<tr><td>34</td><td>A</td><td>78</td><td><table><tr><th>Acid</th><th>Type</th><th>pH</th><th>Conductivity</th><th>Rate of Reaction With Magnesium</th><th>Volume of Alkali neutralised</th></tr><tr><td>Hydrochloric acid</td><td>Strong</td><td>lower (e.g. pH=0)</td><td>High</td><td>Fast</td><td rowspan="2">same</td></tr><tr><td>Ethanoic acid</td><td>Weak</td><td>higher (e.g. pH=4)</td><td>Low</td><td>Slow</td></tr></table></td></tr>
<tr><td>35</td><td>C</td><td>23</td><td>☒A HCl has one H^+ in formula. NaOH has one OH^- in formula ∴ final pH=7
☒B HCl has one H^+ in formula. $Ca(OH)_2$ has two OH^- in formula ∴ final pH>7
☑C H_2SO_4 has two H^+ in formula. NaOH has one OH^- in formula ∴ final pH<7
☒D H_2SO_4 has two H^+ in formula. $Ca(OH)_2$ has two OH^- in formula ∴ final pH=7</td></tr>
<tr><td>36</td><td>D</td><td>46</td><td>☒A sodium nitrate solution is neutral (no weak acids or alkalis in salt)
☒B barium sulphate solution is insoluble and does not change the pH
☒C potassium ethanoate solution is alkaline (weak acid in the salt)
☑D ammonium chloride solution is acidic (weak alkali in the salt)</td></tr>
</table>

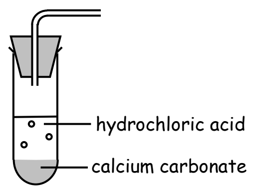
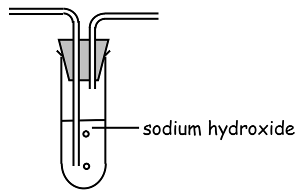
<table>
<tr><td>37</td><td>D</td><td>58</td><td>❶ $2I^- \longrightarrow I_2 + 2e^-$
❷ $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

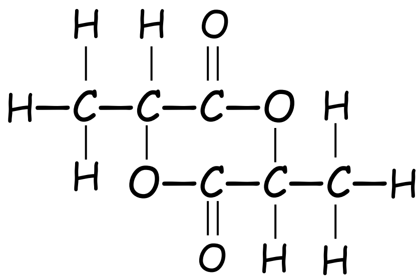
❶x5 $10I^- \longrightarrow 5I_2 + 10e^-$
❷x2 $2MnO_4^- + 16H^+ + 10e^- \longrightarrow 2Mn^{2+} + 8H_2O$

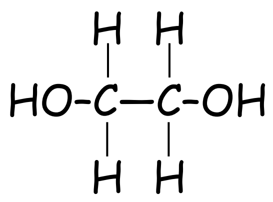
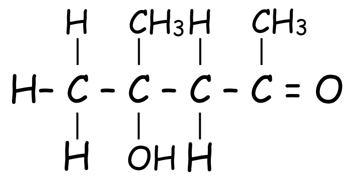
add $2MnO_4^- + 16H^+ + 10I^- \longrightarrow 2Mn^{2+} + 8H_2O + 5I_2$
2mol 10mol
1mol <u>5mol</u></td></tr>
<tr><td>38</td><td>A</td><td>57</td><td>Oxidising Agents are chemicals which oxidise something else and are reduced themselves
☑A H^+ ions are reduced into H_2 gas ($2H^+ + 2e^- \rightarrow H_2$) and Mg is oxidised into Mg^{2+}
☒B H^+ ions are neutralised and not taking part in a redox reaction
☒C H^+ ions are neutralised and not taking part in a redox reaction
☒D H^+ ions join up with ethanoate ions CH_3COO^- to form CH_3COOH molecules</td></tr>
<tr><td>39</td><td>C</td><td>92</td><td>$^{227}_{90}Th \rightarrow ^{223}_{88}Ra \rightarrow ^{219}_{86}Rn \rightarrow ^{215}_{84}Po \rightarrow ^{211}_{82}Pb$
∴ 4 alpha particles removed</td></tr>
<tr><td>40</td><td>C</td><td>83</td><td><table><tr><th>Fraction</th><th>Time (years)</th></tr><tr><td>1</td><td>0</td></tr><tr><td>0.5</td><td>21</td></tr><tr><td>0.25</td><td>42</td></tr><tr><td>0.125</td><td>63</td></tr></table></td></tr>
</table>

2008 Higher Chemistry Marking Scheme

<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1</td><td>Molecular covalent
Covalent network</td><td>Both carbon dioxide and silicon dioxide are covalent substances containing only non-metals. Compounds containing only non-metals are covelent and do not conduct in any state.
• CO_2 is a gas at room temperature indicating it has discrete covalent molecules
• SiO_2 is a solid with a really high melting point indicating it is a covalent network.</td></tr>
<tr><td>2a</td><td>Esters</td><td>Each fat/oil molecule has three ester bonds between the alcohol glycerol and the three fatty acids</td></tr>
<tr><td>2b</td><td>Hydrogen added across C=C double bond</td><td>Oils have C=C double bonds which makes the carbon chain bent and this keeps the molecules far enough apart to ensure the oil is a liquid at room temperature. When hydrogen is added across the C=C double bond, the molecule straightens, which means they fit together more closely and makes the fat a solid at room temperature</td></tr>
<tr><td>2c</td><td>Oils provide energy</td><td>Oils are more healthy for you in your diet as they lower cholesterol etc.</td></tr>
<tr><td>3a</td><td>Volume of KI and volume of H_2O always adds up to $25cm^3$</td><td>The concentration of potassium iodide (KI) is altered by decreasing the volume of KI from $25cm^3$ by $5cm^3$ at the same time as the water volume in creased by $5cm^3$
<table>
<tr><td>Volume of KI (cm^3)</td><td>25</td><td>20</td><td>15</td><td>10</td><td>5</td></tr>
<tr><td>Volume of water (cm^3)</td><td>0</td><td>5</td><td>10</td><td>15</td><td>20</td></tr>
<tr><td>Total Volume of liquid (cm^3)</td><td>25</td><td>25</td><td>25</td><td>25</td><td>25</td></tr>
</table></td></tr>
<tr><td>3b</td><td>23.3</td><td>$\text{Rate} = \frac{1}{\text{time}} \therefore \text{time} = \frac{1}{\text{rate}} = \frac{1}{0.043} = 23.3s$</td></tr>
<tr><td>4a</td><td>Synthesis gas</td><td>Synthesis gas is a mixture of carbon monoxide and hydrogen. It is made by:
<table>
<tr><th>Steam reforming of methane</th><th>Stem reforming of coal</th></tr>
<tr><td>$CH_4 + H_2O \rightarrow CO + 3H_2$</td><td>$C + H_2O \rightarrow CO + H_2$</td></tr>
</table></td></tr>
<tr><td>4b</td><td>$CH_3CH(CH_3)CHO$ or
</td><td>2-methylpropanal
methyl $-CH_3$ group on C_2 | 3 carbons on main chain with single bonds | aldehyde -CHO group on C_1</td></tr>
<tr><td>4c(i)</td><td>Silver mirror produced</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</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(ii)</td><td>In a hot water bath</td><td>As reactants are flammable a naked flame e.g. Bunsen burner must not be used for safety reasons</td></tr>
<tr><td>4d</td><td>Primary</td><td>
<table>
<tr><td rowspan="3">Oxidation of alcohols</td><td>Primary Alcohol → Aldehyde → Carboxylic Acid</td></tr>
<tr><td>Secondary Alcohol → Ketone ↛ [No oxidation]</td></tr>
<tr><td>Tertiary Alcohol ↛ [No oxidation]</td></tr>
</table></td></tr>
<tr><td>5a</td><td>Beta Particle or β</td><td>$^{99}_{42}Mo \rightarrow ^{99}_{43}Tc + ^{0}_{-1}e$</td></tr>
<tr><td>5b(i)</td><td>Curve with points:</td><td>
<table>
<tr><td>Time (hours)</td><td>0</td><td>6</td><td>12</td><td>18</td><td>24</td></tr>
<tr><td>Mass (g)</td><td>0.5</td><td>0.25</td><td>0.125</td><td>0.06</td><td>0.003</td></tr>
</table></td></tr>
<tr><td>5b(ii)</td><td>Short half-life</td><td>The half life of isotope is short enough that it does last in the body for very long.</td></tr>
<tr><td>6a(i)</td><td>Benzene does not decolourise bromine</td><td>Benzene does not decolourise bromine solution rapidly as benzene has no C=C double bonds</td></tr>
<tr><td>6a(ii)</td><td>Ring of 6 carbons with 6 delocalised electrons</td><td>Benzene is a flat planar molecule with six carbons in a ring with a bond angle of 120°C and equal bond lengths. Each carbon has one unbonded electron which ends up in a delocalised ring of electrons.</td></tr>
</table>

6b	Reforming	Reforming is a reaction which rearranges the carbon chain in a hydrocarbon to make the hydrocarbons in petrol less likely to auto-ignite before the spark. C_6H_{14} (hexane) → $C_6H_6 + 3H_2$ (benzene) Straight chain → aromatic ring C_8H_{18} (octane) → $CH_3CH(CH_3)CH_2C(CH_3)_2CH_3$ (2,2,4-trimethylpentane) Straight chain → branched chain
6c	Prevents/reduces auto-ignition	Ring hydrocarbons are added to petrol to keep hydrocarbons far enough apart to prevent auto-ignition before the spark from the spark plug.
7a	Depletion of ozone layer	Chlorofluorocarbons (CFCs) react with ozone (O_3) and breaks it down. Ozone layer absorbs harmful UV radiation from sun which can result in skin cancer.
7b	615	1mol CaF_2 = (1x40) + (2x19) = 40 + 38 = 78g $\text{no. of mol} = \frac{\text{mass}}{\text{gfm}} = \frac{1000g}{78} = 12.82\text{mol}$ $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$ 1mol CaF_2 → 2mol HF 12.82mol → 25.64mol Volume = no. of mol x Molar Volume = 25.64litres x 24litres mol^{-1} = 615 litres
8a	$2B_2O_3 + 7C$ ↓ $B_4C + 6CO$	$2B_2O_3 + 7C \rightarrow B_4C + 6CO$
8b	Diagrams showing:	**X:** Working method of CO_2 production  e.g. flask with hydrochloric acid and calcium carbonate **Y:** Working method to remove unreacted carbon dioxide  e.g. bubbling gases through sodium hydroxide solution
8c	Incomplete combustion of fuel	Incomplete Combustion: Limited air supply means fuel cannot form carbon dioxide during combustion and carbon monoxide is formed instead Complete Combustion: Plentiful supply of oxygen means that all the carbon atoms in a fuel burn to form carbon dioxide
9a	Answer to include:	1st Mark: Hydrogen molecules have weak London dispersion forces between them. 2nd Mark: London dispersion forces are causes by a temporary dipole in an atom caused by the majority of electrons being temporarily found on one side of an atom causing a temporary dipole to be formed.
9b(i)	To saturate the carbon rods with gas	The surface of carbon rods trap gases during the first couple of minutes of gas production and so pausing for a couple of minutes will prevent the error in the volume of gas collected.
9b(ii)	0.00187	Q = I x t = 0.3 x (10x60) = 180C $2H^+ + 2e^- \longrightarrow H_2$ 2mol → 1mol 2x96500C → 2g 193000C → 2g 180C → 2g x $^{180}/_{193000}$ = 0.00187g
9c	10^{-13}	$[OH^-] = \frac{10^{-14}}{[H^+]} = \frac{10^{-14}}{1x10^{-1}} = 1x10^{-13}\ mol\ l^{-1}$

10a	Arrow pointing to level point of graph	At equilibrium, the concentrations of reactants and products are equal. This is indicated on the graph by levelling off horizontally
10b	Same number of moles of gas on either side of arrow	The equation has 1 mole of gas on both the reactant side and the product side of the equation. Changing the pressure in this reaction has no effect on the equilibrium as neither the forward nor reverse reaction can change the pressure of the reaction.
10c	Graph showing propene and cyclopropane reaching same final concentrations as part a	The final concentrations of products and reactants at equilibrium is the same regardless of the starting concentrations of reactants/products.
11a	Answer to include:	Alkalis contain the OH^- hydroxide ion. Alcohols contain the –OH hydroxyl functional group but alcohols do not form OH^- ions in water $\therefore$ alcohols are neutral
11b	Answer to include:	Iodine reacts with starch and turns blue/black. Potassium iodide contains iodide I^- ions not iodine. Iodide ions do not react with starch.
12a	Enzymes have a specific shape to fit reactant only	Enzymes are globular proteins which have a specific shape which fits a substrate exactly like a key in a lock. The enzyme will then catalyse the chemical reaction. Enzymes are very sensitive to changes in temperature and pH which change the shape of the enzyme.
12b	-202.6	❶ $C_6H_4(OH)_{2(aq)} \longrightarrow C_6H_4O_{2(aq)} + H_{2(g)}$ $\Delta H = +177.4$ kJ ❷ $H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{2(aq)}$ $\Delta H = -191.2$ kJ ❸ $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(g)}$ $\Delta H = -241.8$ kJ ❹ $H_2O_{(g)} \longrightarrow H_2O_{(l)}$ $\Delta H = -43.8$ kJ ❶ $C_6H_4(OH)_{2(aq)} \longrightarrow C_6H_4O_{2(aq)} + H_{2(g)}$ $\Delta H = +177.4$ kJ ❷x-1 $H_2O_{2(aq)} \longrightarrow H_{2(g)} + O_{2(g)}$ $\Delta H = +191.2$ kJ ❸x2 $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)}$ $\Delta H = -483.6$ kJ ❹x2 $2H_2O_{(g)} \longrightarrow 2H_2O_{(l)}$ $\Delta H = -87.6$ kJ add $C_6H_4(OH)_{2(aq)} + H_2O_{2(aq)} \longrightarrow C_6H_4O_{2(aq)} + 2H_2O_{(l)}$ $\Delta H = -202.6$ kJ
13a	Hydroxyl	The –OH group is the hydroxyl group. It is the functional group of alcohols
13b(ii)	Biopol	Polymer: biopol; poly(ethenol); poly(ethyne); kevlar Property: Biodegradable; Soluble; Conductor; Very strong
13b(ii)	The reactants are turned into products. When the products are all used up for its purpose, fresh products are made	A batch process is for smaller quantities of products e.g. medicines. The process is cheaper because huge quantities are not required. A continuous process is for large quantities of chemicals e.g. fertilisers. The process is expensive to set up but is cheaper in the long run due to the larger quantities.
13b(iii)	Diagram showing:	

<table>
<tr><td>14a</td><td>homogeneous</td><td>
<table>
<tr><th>Type of Catalyst</th><th>Definition</th></tr>
<tr><td>Homogeneous</td><td>Catalyst in same state as reactants</td></tr>
<tr><td>Heterogeneous</td><td>Catalyst in different state from reactants</td></tr>
</table>
</td></tr>
<tr><td>14b(i)</td><td>No effect</td><td>Catalysts speed up a chemical reaction by lowering the activation energy but have no effect on the enthalpy change of a reaction.</td></tr>
<tr><td>14b(ii)</td><td>-152</td><td>no. of mol H_2O_2 = volume x concentration = 0.05litres x 0.88mol l^{-1} = 0.044mol
$\Delta H = cm\Delta T$ = 4.18 x 0.1 x 16 = 6.69kJ
0.044mol H_2O_2 ↔ 6.69kJ
1mol H_2O_2 ↔ 6.69kJ x $^1/_{0.044}$
= -152kJ mol^{-1} (exothermic reaction ∴ negative sign)</td></tr>
<tr><td>15a(i)</td><td></td><td>ethane-1,2-diol
2 carbons
functional groups on C_1 and C_2
2 functional groups
-OH functional group</td></tr>
<tr><td>15a(ii)</td><td>Sodium chloride will cause rusting</td><td>Salt increases the rate of corrosion as it is an electrolyte and helps to complete the circuit better.</td></tr>
<tr><td>15b</td><td>Butane</td><td>
<table>
<tr><th>Compound</th><th>Formula</th><th>Gram Formula Mass</th></tr>
<tr><td>Ethane-1,2-diol</td><td>$C_2H_6O_2$</td><td>(2x12) + (6x1) + (2x16) = 24 + 6 + 32 = 62g</td></tr>
<tr><td>Butane</td><td>C_4H_{10}</td><td>(4x12) + (10x1) = 48 + 10 = 58g</td></tr>
</table>
</td></tr>
<tr><td>16a</td><td>Diagram showing:</td><td></td></tr>
<tr><td>16b</td><td>methanal</td><td>Methanal lacks the $-CH_3$ group attached to the CHO group so the aldol condensation reaction cannot take place</td></tr>
<tr><td>16c</td><td>Water not produced in condensation reaction</td><td>In condensation reactions water (or another small molecule) is removed when two molecules join together to make a bigger molecule.</td></tr>
<tr><td>17a</td><td>$MnO_4^- + 8H^+ + 5e^-$
↓
$Mn^{2+} + 4H_2O$</td><td>
<table>
<tr><td>Redox:</td><td>$5(COOH)_2 + 6H^+ + 2MnO_4^- \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$</td></tr>
<tr><td>Reduction:</td><td>$2MnO_4^- \rightarrow 2Mn^{2+}$
$2MnO_4^- + 16H^+ + 10e^- \rightarrow 2Mn^{2+} + 8H_2O$
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$</td></tr>
<tr><td>Oxidation:</td><td>$5(COOH)_2 \rightarrow 10CO_2 + 10H^+ + 10e^-$
$(COOH)_2 \rightarrow 2CO_2 + 2H^+ + 2e^-$</td></tr>
</table>
</td></tr>
<tr><td>17b</td><td>Colour changes from colourless to purple without indicator</td><td>Permanganate ions are self indicating as they are purple and become colourless as they react to become manganese Mn^{2+} ions</td></tr>
<tr><td>17c(i)</td><td>Rough titre is inaccurate</td><td>The 1st titre is also known as the rough titre and should not be used in averaging of the volume from the burette. The rough titre is only used to get a rough idea of where the colour change will take place and the next titration can be much more accurate as a result and accurate to arounf one drop from the burette.</td></tr>
<tr><td>17c(ii)</td><td>0.0538mol</td><td>no. of mol MnO_4^- = volume x concentration = 0.0269litres x 0.040mol l^{-1} = 0.001076mol
$5(COOH)_2 + 6H^+ + 2MnO_4^- \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
5mol   2mol
0.00269mol   0.001076mol
0.00269 mol oxalic acid in 25cm³ rhubarb juice
$^{500}/_{25}$ x 0.00269 mol oxalic acid in 500cm³ rhubarb juice
= 0.0538mol oxalic acid</td></tr>
</table>