JABchem

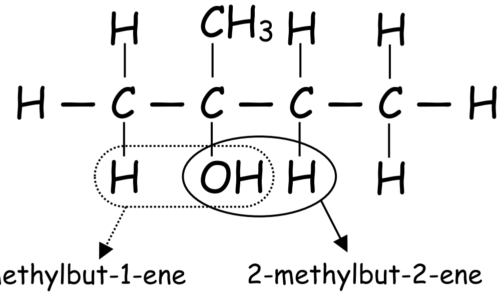
Past Papers Higher Chemistry

2000

Marking Scheme

2000 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>A</td><td>83</td><td>☑A Ca is a metal and Cl is a non-metal ∴ ionic bonding ∴ conducts when molten
☒B N and Cl are both non-metals ∴ covalent bonding ∴ no conduction when molten
☒C P and Cl are both non-metals ∴ covalent bonding ∴ no conduction when molten
☒D Si and Cl are both non-metals ∴ covalent bonding ∴ no conduction when molten</td></tr>
<tr><td>2</td><td>C</td><td>71</td><td>☒A Magnesium chloride and sodium nitrate are both soluble ∴ no precipitate
☒B Magnesium sulphate and sodium nitrate are both soluble ∴ no precipitate
☑C silver chloride is insoluble and forms as an insoluble precipitate
☒D Silver sulphate and sodium nitrate are both soluble ∴ no precipitate</td></tr>
<tr><td>3</td><td>A</td><td>59</td><td>no. of mol = volume x concentration = 0.05litres x 0.1mol l^{-1} = 0.005mol
$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$
1mol 2mol
0.005mol 0.01mol
$\text{volume} = \frac{\text{no. of mol}}{\text{concentration}} = \frac{0.01\text{mol}}{0.4\text{mol } l^{-1}} = 0.025\text{litres} = 25\text{cm}^3$</td></tr>
<tr><td>4</td><td>A</td><td>51</td><td>☑A Na is 2,8,1 ∴ Na^+ is 2,8 and O is 2,6 ∴ O^{2-} is 2,8
☒B Li is 2,1 ∴ Li^+ is 2 and F is 2,7 ∴ F^- is 2,8
☒C Ca is 2,8,8,2 ∴ Ca^{2+} is 2,8,8 and O is 2,6 ∴ O^{2-} is 2,8
☒D Ca is 2,8,8,2 ∴ Ca^{2+} is 2,8,8 and Br is 2,8,18,7 ∴ Br^- is 2,8,18,8</td></tr>
<tr><td>5</td><td>C</td><td>88</td><td>$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{0.20 - 0.05}{20 - 0} = \frac{0.15}{20} = 0.0075 \text{ mol } l^{-1} s^{-1}$</td></tr>
<tr><td>6</td><td>D</td><td>39</td><td>☒A $100cm^3$ of 2 mol l^{-1} HCl would give twice the volume of gas given off
☒B $100cm^3$ of 2 mol l^{-1} H_2SO_4 would give twice the volume of gas (two H^+ per f.u.)
☒C $100cm^3$ of 2 mol l^{-1} CH_3COOH would release gas more slowly (weak acid)
☑D magnesium would react faster than zinc but give off the same volume of gas</td></tr>
<tr><td>7</td><td>B</td><td>82</td><td>☒A x is the activation energy for the forward reaction
☑B y is the enthalpy change for the reaction
☒C x+y is the activation for the reverse reaction
☒D x-y is incorrect</td></tr>
<tr><td>8</td><td>B</td><td>52</td><td>Chlorine is smaller than sodium. Both atoms fill up the same outer electron shell but chlorine has a more protons in the nucleus so the outer shell is pulled closer to the nucleus in chlorine than sodium.</td></tr>
<tr><td>9</td><td>C</td><td>72</td><td>☒A Electronegativities: Cl=3.0 and Br=2.8 ∴ chlorine is more electronegative and δ-
☒B Electronegativities: Cl=3.0 and Cl=3.0 ∴ chlorine has no charge (pure covalent)
☑C Electronegativities: Cl=3.0 and F=4.0 ∴ chlorine is less electronegative and δ+
☒D Electronegativities: Cl=3.0 and I=2.6 ∴ chlorine is more electronegative and δ-</td></tr>
<tr><td>10</td><td>B</td><td>67</td><td>☒A Silicon dioxide is a covalent network and has no discrete molecules
☑B Silicon dioxide is covalent network as it has non-metals in it and a high m.pt.
☒C Silicon dioxide is a covalent network but carbon dioxide has discrete molecules
☒D Silicon dioxide has strong covalent bonds which are much stronger than VderW</td></tr>
<tr><td>11</td><td>C</td><td>29</td><td>☒A ^{1}H has no neutrons
☒B 1g of ^{12}C = $^{1}/_{12}$ mol of atoms = $^{1}/_{2}$ mol of neutrons (6 neutrons per ^{12}C atom)
☑C 2g of ^{24}Mg = $^{2}/_{24}$mol of atoms = 1 mol of neutrons (12 neutrons per ^{24}Mg atom)
☒D 2g of ^{22}Ne = $^{2}/_{22}$mol of atoms = $^{24}/_{22}$ mol of neutrons (12 neutrons per ^{22}Ne atom)</td></tr>
<tr><td>12</td><td>A</td><td>80</td><td><table><tr><th>Name</th><th>butanoic acid</th><th>ethyl ethanoate</th><th>ethyl methanoate</th><th>ethyl propanoate</th><th>propyl ethanoate</th></tr><tr><td>Formula</td><td>C_3H_7COOH
$C_4H_8O_2$</td><td>$C_2H_5OOCCH_3$
$C_4H_8O_2$</td><td>$C_2H_5OOCH_3$
$C_3H_6O_2$</td><td>$C_2H_5OOCC_2H_5$
$C_5H_{10}O_2$</td><td>$C_3H_7OOCCH_3$
$C_5H_{10}O_2$</td></tr></table></td></tr>
</table>

13	B	61	
14	D	72	☒A esters can be used in flavourings e.g. pear drops ☒B esters have nice smells and can be used in perfumes ☒C esters are insoluble in water and are used as solvents e.g. nail varnish remover ☑D esters are not used in toothpastes
15	D	82	For condensation polymerisation to proceed each monomer needs to have 2 functional groups. Methanol (answer D) stops the reaction as it does not have the 2nd functional groups.
16	B	52	☒A ethane cannot undergo addition reactions as it does not have a C=C double bond ☑B ethane can be cracked into ethene (gets smaller and C=C double bond produced) ☒C hydrogenation is an addition reaction and ethane lacks a C=C double bond ☒D alkanes do not oxidise
17	A	68	☑A poly(ethenol) is soluble in water ☒B poly(ethyne) is an electrical conductor ☒C biopol is a biodegradable polymer ☒D kevlar is a very strong polymer
18	D	62	Amino acids join together to make proteins by condensation polymerisation where small monomers join together to make larger molecule with water/small molecule removed at join.
19	D	70	☒A Fats and oils do not have hydrogen bonding ☒B Fats and oils do not have cross-links between molecules ☒C Fat molecules are more tightly packed compared to oil ☑D fat molecules are more saturated as fats have less C=C double bonds
20	D	67	☒A Land rental is a fixed cost as land leases usually last many years ☒B The cost of plant construction is an initial set cost and not a variable cost ☒C The cost of labour is a fixed cost as it will rise steadily of the years ☑D The cost of raw materials varies up and down due to market conditions
21	C	76	❶ $N_2 + 2O_2 \longrightarrow 2NO_2$ $\Delta H = +88$ kJ ❷ $N_2 + 2O_2 \longrightarrow N_2O_4$ $\Delta H = +10$ kJ ❶x-1 $2NO_2 \longrightarrow N_2 + 2O_2$ $\Delta H = -88$ kJ ❷ $N_2 + 2O_2 \longrightarrow N_2O_4$ $\Delta H = +10$ kJ add $2NO_2 \longrightarrow N_2O_4$ $\Delta H = -78$ kJ
22	A	87	☑A At equilibrium: rate of forward reaction = rate of reverse reaction ☒B At equilibrium the concentrations of reactants and products are *constant* ☒C The activation energy for forward and reverse reactions are not equal ☒D Chemical reaction do not have zero enthalpy change as bond are broken and different bonds are formed
23	C	70	☒A High temperature favours the endothermic (reverse) reaction ☒B High temperature favours the endothermic (reverse) reaction ☑C Low temperature and high pressure both favour the forward reaction ☒D Low pressure favours the pressure-increasing reverse reaction
24	B	76	☒A hydrochloric acid is a strong acid ☑B hydrochloric acid is a strong acid and 0.1 mol l^{-1} is considered a dilute solution ☒C hydrochloric acid is a strong acid ☒D 0.1 mol l^{-1} is considered a dilute solution

<table>
<tr><td>25</td><td>D</td><td>53</td><td>
<table>
<tr><td>pH = 4</td><td>pH = 6</td><td>pH 4 → 6 ∴ $[H^+]$ decreases $10^{-4} \rightarrow 10^{-6}$</td></tr>
<tr><td>$[H^+] = 10^{-4}$</td><td>$[H^+] = 10^{-6}$</td><td>Concentration decreases by factor of 100</td></tr>
</table>
</td></tr>
<tr><td>26</td><td>D</td><td>70</td><td>☒A sodium hydroxide has a higher pH than ammonia as it is fully ionised
☒B sodium hydroxide and ammonia have different formula masses
☒C sodium hydroxide has higher conductivity as it is fully ionised
☑D both 0.1 mol l^{-1} solutions will neutralise the same volume of acid</td></tr>
<tr><td>27</td><td>C</td><td>43</td><td>1. Write down the main species involved in the reaction
IO_3^- → I_2
2. Balance all atoms except O and H
$2IO_3^-$ → I_2
3. Add H_2O to other side to balance O atoms
$2IO_3^-$ → $I_2 + 6H_2O$
4. Add H^+ ions to other side to balance H atoms
$2IO_3^- + 12H^+$ → $I_2 + 6H_2O$
5. Add e^- to most positive side to balance charge
$2IO_3^- + 12H^+ + 10e^-$ → $I_2 + 6H_2O$</td></tr>
<tr><td>28</td><td>B</td><td>66</td><td>$Cu^{2+} + 2e^- \longrightarrow Cu$
2mol — 1mol
2x96500C — 1mol
193000C — 1mol
193000C x $^{0.25}/_{1}$ — 0.25mol
= 48250C</td></tr>
<tr><td>29</td><td>C</td><td>69</td><td>On β–emission, the mass number stays the same and the atomic number increases by one. This would turn a group 4 element into a group 5 element</td></tr>
<tr><td>30</td><td>C</td><td>83</td><td>
<table>
<tr><td>Time (years)</td><td>0</td><td>21</td><td>42</td><td>63</td></tr>
<tr><td>Fraction</td><td>1</td><td>½ = 0.5</td><td>¼ = 0.25</td><td>⅛ = 0.125</td></tr>
</table>
</td></tr>
<tr><td colspan="4">Q31→34 are Grid Questions which are a style of question no longer used in Higher Chemistry.
However the content of the questions can still come up in future exams.
(If the question suggests there is more than 1 answer then there are usually 2 answers)</td></tr>
<tr><td>31a</td><td>C</td><td colspan="2">
<table>
<tr><td>pH</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr>
<tr><td>$[H^+]$</td><td>1</td><td>$1x10^{-1}$</td><td>$1x10^{-2}$</td><td>$1x10^{-3}$</td><td>$1x10^{-4}$</td><td>$1x10^{-5}$</td><td>$1x10^{-6}$</td><td>$1x10^{-7}$</td><td>$1x10^{-8}$</td><td>$1x10^{-9}$</td><td>$1x10^{-10}$</td><td>$1x10^{-11}$</td><td>$1x10^{-12}$</td><td>$1x10^{-13}$</td><td>$1x10^{-14}$</td></tr>
</table>
</td></tr>
<tr><td>31b</td><td>F</td><td colspan="2">$[OH^-]$ before dilution = 0.1mol l^{-1} ∴ $[OH^-]$ after dilution = 0.01mol l^{-1} = $1x10^{-2}$ mol l^{-1}
$[H^+] = \frac{10^{-14}}{[OH^-]} = \frac{10^{-14}}{10^{-2}} = 1x10^{-12}$</td></tr>
<tr><td>32a</td><td>B+C
(both for 1 mark)</td><td colspan="2" rowspan="2">
<table>
<tr><td>1mol CO = 28g</td><td>7g CO = 0.25mol CO molecules</td><td>2 atoms per molecule</td><td>0.5mol of atoms</td></tr>
<tr><td>1mol CH_4 = 16g</td><td>32g CH_4 = 2mol CH_4 molecules</td><td>5 atoms per molecule</td><td>10mol of atoms</td></tr>
<tr><td>1mol H_2 = 2g</td><td>4g H_2 = 2mol H_2 molecules</td><td>2 atoms per molecule</td><td>4mol of atoms</td></tr>
<tr><td>1mol SO_2 = 64.1g</td><td>32g SO_2 = 0.5mol SO_2 molecules</td><td>3 atoms per molecule</td><td>1.5mol of atoms</td></tr>
<tr><td>1mol NH_3 = 17g</td><td>17g NH_3 = 1mol NH_3 molecules</td><td>4 atoms per molecule</td><td>4mol of atoms</td></tr>
</table>
</td></tr>
<tr><td>32b</td><td>C+E
(both for 1 mark)</td></tr>
<tr><td>33a</td><td>B</td><td colspan="2">Temperature is directly proportional to the average kinetic energy of the particles in a substance.</td></tr>
<tr><td>33b</td><td>A,D
(1 mark each)</td><td colspan="2">☑A An increase in the particle size will decrease the rate of reaction
☒B An increase in temperature will increase the rate of reaction
☒C An increase in surface area available for reaction will increase the rate of reaction
☑D An increase in activation energy will decrease the rate of reaction
☒E An increase in concentration will increase the rate of reaction
☒F An increase in average kinetic energy of reactants will increase the rate of reaction.</td></tr>
<tr><td>34a</td><td>C</td><td colspan="2">Fats and oils are hydrolysed as they break down into glycerol and 3 fatty acids. Water is added across the breaks in the molecules.</td></tr>
<tr><td>34b</td><td>B,E
(1 mark each)</td><td colspan="2">Hydrogen is added across the C=C double bonds in the oils to harden them into fats. This reaction is called hardening, hydrogenation or addition.</td></tr>
</table>

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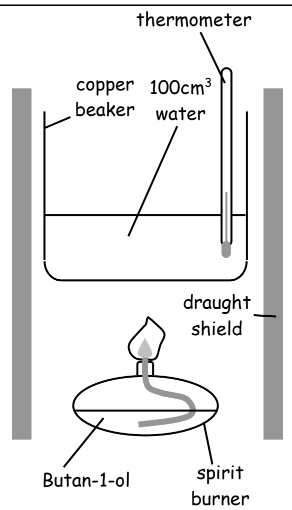
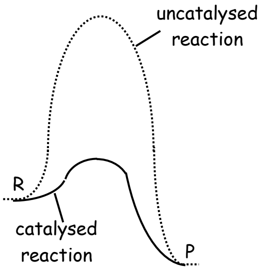
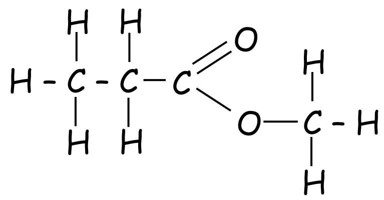
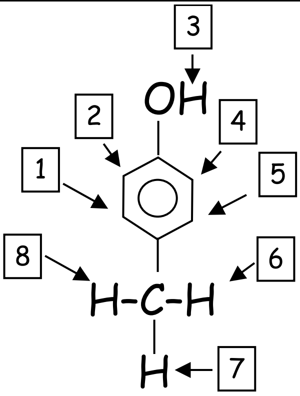
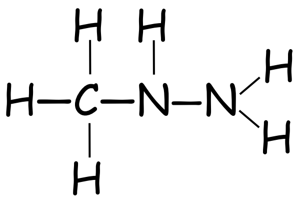
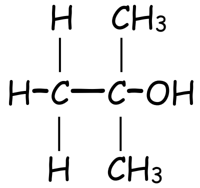
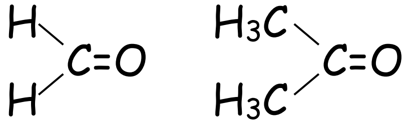
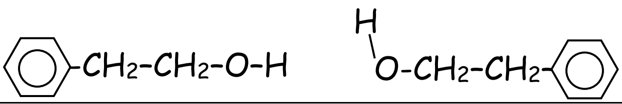
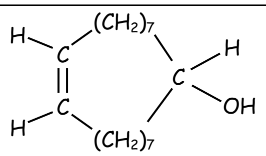
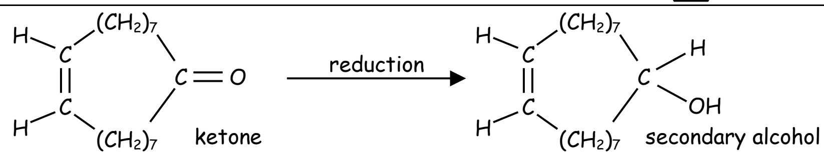
Long Qu	Answer	Reasoning
1a	Naphtha	Petrol is made by reforming naphtha fraction Diesel is made by blending gas oil fraction
1b	2,2-dimethylhexane	Part of Name – Meaning hexane – six carbons in main chain -dimethyl – two $-CH_3$ methyl groups 2,2- – Side groups both located on C_2
1c	straight molecules get too close to each other and auto-ignite before spark	Straight petrol molecules fit too closely together and will auto-ignite before the spark . This is called knocking or pinking. The addition of branched chain molecules or ring molecules keeps the molecules far enough apart to prevent autoignition before the spark.
2a	1.64	HNO_3 **no.** of mol = **v**olume x **c**oncentration = 0.05litres x 0.200mol l^{-1} = 0.01mol $CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$ 1mol 2mol 0.005mol 0.01mol **gfm** $CaCO_3$ = (1x40.1) + (1x12) + (3x16) = 40.1 + 12 + 48 = 100g **m**ass = **n**o. of mol x **gfm** = 0.005 x 100.1g = 0.50g Mass of calcite unreacted = Total mass of calcite – mass of calcite reacted = 2.14g – 0.50g = 1.64g
2b	Answer to include:	Filter contents of beaker to collect unreacted calcite Dry calcite and weigh calcite on balance.
3a	Fibrous	Fibrous proteins are linear structural proteins e.g. collagen Globular proteins are specially-shaped proteins found in enzymes
3b(i)	Hydrogen peroxide	PPA Technique Question. Catalase is an enzyme found in potatoes which catalyses the following reaction: $H_2O_2 \longrightarrow H_2O + \frac{1}{2}O_2$
3b(ii)	Count the number of bubbles of gas given off in a set time	PPA Technique Question. The number of oxygen bubbles given off in 30 seconds is proportional to the rate of reaction.
4a	Nuclear Equation showing:	$^{252}_{98}Cf + ^{11}_{5}B \rightarrow ^{257}_{103}Lr + 6\,^{1}_{0}n$
4b	Stars or the sun	Nuclear fusion reactions require the extremely high temperature found in stars to join the nuclei of atoms together.
5a	134kJ	gfm C_4H_9OH = (4x12) + (10x1) + (1x16) = 48 + 10 + 16 = 74g mass = no. of mol x gfm = 0.1 x 74 = 7.4g From graph: when mass = 7.4g then heat released = 134kJ
5b		PPA Technique Question: Copper beaker to allow better heat transference from flame to water Beaker clamped into flame instead of using tripod Beaker stirred to ensure equal temperature of water Draught shield to prevent heat being lost to draughts
5c(i)	-1430 kJ mol^{-1}	0.1mol = 143kJ 1mol = 1430kJ mol^{-1} = -1430kJ mol^{-1} (exothermic reaction)

<table>
<tr><td>5c(ii)</td><td>-2686kJ mol^{-1}</td><td>
<table>
<tr><td>Alcohol</td><td>Methanol</td><td>Ethanol</td><td>Propan-1-ol</td><td>Butan-1-ol</td></tr>
<tr><td>Enthalpy of Combustion</td><td>-727 kJ mol^{-1}</td><td>-1367 kJ mol^{-1}</td><td>-2020 kJ mol^{-1}</td><td>-</td></tr>
<tr><td>Difference</td><td></td><td>-640</td><td>-653</td><td>(-666)</td></tr>
<tr><td>Prediction</td><td>-</td><td>-</td><td>-</td><td>-2689 kJ mol^{-1}</td></tr>
</table>
</td></tr>
<tr><td>5c(iii)</td><td>Incomplete combustion</td><td>Incomplete combustion results in less heat energy being released than from complete combustion.
The enthalpy of combustion definition states that it must be complete combustion.</td></tr>
<tr><td>6a(i)</td><td>H^+ are not used up in reaction</td><td>A catalyst speeds up a chemical reaction and is chemically unchanged at the end of the reaction.</td></tr>
<tr><td>6a(ii)</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>6b</td><td>
</td><td>Catalysts reduce the activation energy. The activation energy is the energy barrier which must be overcome if reactants are to become products. The removal of a catalyst will increase the activation energy and increase the height of the activation barrier. Catalysts do not alter the value of the enthalpy change so R and P are unchanged</td></tr>
<tr><td>7a</td><td>Attraction for electrons within a bond</td><td>Electronegativity is a measure of the attraction for electrons an element has within a bond. The more electronegative an element is the more the electrons with a covalent bond are attracted to the nucleus of that atom.</td></tr>
<tr><td>7b</td><td>35cm^3</td><td>
<table>
<tr><td>$2P_2H_{4(g)}$</td><td>+</td><td>$7O_{2(g)}$</td><td>$\longrightarrow$</td><td>$P_4O_{10(s)}$</td><td>+</td><td>$4H_2O_{(l)}$</td></tr>
<tr><td>2mol</td><td></td><td>7mol</td><td></td><td>1mol</td><td></td><td>4mol</td></tr>
<tr><td>2vol</td><td></td><td>7vol</td><td></td><td>negligible volume</td><td></td><td>negligible volume</td></tr>
<tr><td>10cm^3</td><td></td><td>35cm^3</td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>7c</td><td>0.12 litres</td><td>gfm P_2H_4 = (2x31)+(4x1) = 62 + 4 = 66g mol^{-1}
$$\textbf{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.330\text{ g}}{66\text{g mol}^{-1}} = 0.005\text{mol}$$
Volume = no. of mol x Molar Volume = 0.005mol x 24.0 litres mol^{-1} = 0.12litres</td></tr>
<tr><td>8a(i)</td><td>$$K = \frac{[NH_3]^2}{[N_2] \times [H_2]^3}$$</td><td>Problem Solving Question</td></tr>
<tr><td>8a(ii)</td><td>No change to position of equilibrium</td><td>Catalysts decrease the activation energy of both the forward and reverse of reactions and allows equilibrium to be achieved quicker. However, the position of equilibrium and the relative amounts of reactants and products are unchanged.</td></tr>
<tr><td>8b</td><td>Products are removed before equilibrium is reached</td><td>In the Haber process, materials are removed, cooled, unreacted reactants recycled and liquid ammonia collected. By removing a product before equilibrium is achieved, more and more product ammonia is made to replace the removed ammonia.</td></tr>
<tr><td>9a</td><td>Diagram showing:</td><td></td></tr>
<tr><td>9b(i)</td><td>Sodium hydroxide</td><td>
<table>
<tr><td>ACID</td><td>+</td><td>METAL HYDROXIDE</td><td>$\longrightarrow$</td><td>SALT</td><td>+</td><td>WATER</td></tr>
<tr><td>propanoic acid</td><td>+</td><td>sodium hydroxide</td><td>$\longrightarrow$</td><td>sodium propanoate</td><td>+</td><td>water</td></tr>
<tr><td>C_2H_5COOH</td><td>+</td><td>NaOH</td><td>$\longrightarrow$</td><td>$C_2H_5COO^-Na^+$</td><td>+</td><td>H_2O</td></tr>
</table>
</td></tr>
<tr><td>9b(ii)</td><td>Answer including:</td><td>Propanoate ions join up with H^+ ions from water to form propanoic acid molecules: $C_2H_5COO^-_{(aq)} + H^+_{(aq)} \rightarrow C_2H_5COOH_{(l)}$
Equilibrium in water moves to replace H^+ ions: $H_2O_{(l)} \rightarrow H^+_{(aq)} + OH^-_{(aq)}$
H^+ ions are removed but OH^- ion concentration increases and makes the solution alkaline.</td></tr>
</table>

10a	Fullerene is molecular Diamond and graphite are networks	Fullerene is a molecular covalent substance with C_{60} in a spherical shape. Diamond and graphite are covalent networks with no definite molecules and long lines of covalent bonds in all directions.
10b(i)	0.004	**gfm** K_3C_{60} = (3x39.1) + (60x12) = 117.3 + 720 =837.3g ∴ 1mol K_3C_{60} contains 720g of carbon. $\text{no. of mol} = \frac{\text{mass of carbon}}{\text{mass of carbon in 1 mol}} = \frac{2.88\text{g}}{720\text{g mol}^{-1}} = 0.004 \text{ mol}$
10b(ii)	0.4692g	1mol K_3C_{60} = (3x39.1) + (60x12) = 117.3 + 720 =837.3g ∴ 1mol K_3 = 3 x 39.1 = 117.3g **mass** = **no.** of mol x **gfm** = 0.004 x 117.3 = 0.4692g
11a	Oxidation	Oxidation is indicated by: loss of electrons increase in oxygen : hydrogen ratio decrease in hydrogen : oxygen ratio
11b	x=8	Compound A contains 8 hydrogen atoms 
11c	Acid denatures the enzyme	Enzymes are specifically-shaped globular proteins which are very sensitive to changes in temperature or pH. These changes alter the shape of the enzyme and the substrate molecule no longer fits the enzyme exactly
12a	x=9 y=12 z=4	$5N_2O_4 + 4CH_3NHNH_2 \longrightarrow 9N_2 + 12H_2O + 4CO_2$
12b		Hydrazine compounds are very reactive chemicals due to the N-N single bond present in the molecule.
12c	53 kJ mol^{-1}	$C + N_2 + 3H_2 \longrightarrow CH_3NHNH_2$ ❶ $CH_3NHNH_2 + 2\frac{1}{2}O_2 \longrightarrow CO_2 + 3H_2O + N_2$ ΔH= -1305 kJ ❷ $C + O_2 \longrightarrow CO_2$ ΔH= -394 kJ ❸ $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$ ΔH= -286 kJ ❶x-1 $CO_2 + 3H_2O + N_2 \longrightarrow CH_3NHNH_2 + 2\frac{1}{2}O_2$ ΔH= +1305 kJ ❷ $C + O_2 \longrightarrow CO_2$ ΔH= -394 kJ ❸x3 $3H_2 + 1\frac{1}{2}O_2 \longrightarrow 3H_2O$ ΔH= -858 kJ add $C + N_2 + 3H_2 \longrightarrow CH_3NHNH_2$ ΔH= +53kJ
13a	$Na_{(g)} \longrightarrow Na^+_{(g)} + e^-$	1st Ionisation Energy: the energy required to remove one mole of electrons from 1 mole of gaseous atoms
13b	1.806×10^{24}	$B_{(g)} \longrightarrow B^+_{(g)} + e^-$ $B^+_{(g)} \longrightarrow B^{2+}_{(g)} + e^-$ $B^{2+}_{(g)} \longrightarrow B^{3+}_{(g)} + e^-$ $B_{(g)} \longrightarrow B^{3+}_{(g)} + 3e^-$ 3moles of electrons = 3 x 6.02×10^{23} = 1.806 $\times10^{24}$ electrons
14a(i)	Hydrolysis	Molecule splits and water added across the break

14a(ii)	 2-methylpropan-2-ol	The key strategy in this question is drawing propanone in the same way that methanal is drawn in the question.  methanal propanone
14a(iii)	74.9%	1mol CH_2O = (1x12) + (2x1) + (1x16) = 12 + 2 + 16 = 30g 1mol C_2H_5OH = (2x12) + (6x1) + (1x16) = 24 + 6 + 16 = 46g methanal → ethanol 1mol → 1mol 30g → 46g 5.01g → 46g x $^{5.01}/_{30}$ = 7.682g (theoretical 100%) $\%Yield = \frac{actual}{theoretical} \times 100 = \frac{5.75g}{7.682g} \times 100 = 74.9\%$
14b	Making plastics	Methanal was previously known as formaldehyde and reacts with urea to make the plastic *urea formaldehyde*
15a	$I_2 + 2e^- \rightarrow 2I^-$	Redox: $C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2H^+ + 2I^-$ Reduction: $I_2 \rightarrow 2I^-$ $I_2 + 2e^- \rightarrow 2I^-$ Oxidation: $C_6H_8O_6 \rightarrow C_6H_6O_6 + 2H^+$ $C_6H_8O_6 \rightarrow C_6H_6O_6 + 2H^+ + 2e^-$
15b(i)	Answer to include:	A deionised water bottle washes all the contents of the beaker into the conical flask through a funnel. Care must be taken to ensure no spillage. The directional jet of the water bottle is used to hit the bottom of the beaker and all the contents are pushed into the conical flask. The funnel is also thoroughly washed. The conical flask is then filled up to the 250cm^3 line.
15b(ii)	Colourless to Blue/Black	There is no iodine in the flask at the start of the titration ∴ colourless in flask at beginning. When all the vitamin C has reacted, further iodine remains in the flask unreacted and turns starch indicator blue/black.
15c	1.0384	**n**o. of mol I_2 = **v**olume x **c**oncentration = 0.0295$_{litres}$ x 0.02$_{mol\ l^{-1}}$ = 0.00059mol $C_6H_8O_6 + I_2 \longrightarrow C_6H_6O_6 + 2H^+ + 2I^-$ 1mol 1mol 0.00059mol 0.00059mol 25cm^3 vitamin *C* solution contains 0.00059mol vitamin *C* 250cm^3 vitamin *C* solution contains 0.0059mol vitamin *C* ∴ 1 vitamin *C* tablet = 0.0059mol **gfm** VitC $C_6H_8O_6$ = (6x12) + (8x1) + (6x16) = 72 + 8 + 96 = 176g **m**ass = **n**o. of mol x **gfm** = 0.0059mol x 176g mol^{-1} = 1.0384g
16a(i)	Esters often have sweet smells	esters can be used in flavourings e.g. pear drops esters have pleasant smells and can be used in perfumes esters are insoluble in water and are used as solvents e.g. nail polish remover
16a(ii)	Geranyl acetate will decolourise bromine solution	Geranyl acetate has a C=C double bond which will decolourise bromine solution. *p*-cresyl acetate will have no effect on bromine water as it has no C=C double bond.
16b	Diagram showing:	
16c		
17a(i)	Delocalised electron on each carbon can jump to another carbon atom	Carbon atoms in graphite each have one electron not used in covalent bonding. These electrons can jump from atom to atom and conduct electricity.
17a(ii)	sodium hydroxide + hydrogen	$2Na + 2H_2O \longrightarrow 2NaOH + H_2$
17b	Deacon Process has more expensive raw materials	Castner-Kellner cell uses brine (saturated salt water) which is cheap.