JABchem

Past Papers Higher Chemistry

2014

Marking Scheme

Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	73+	30.1%
B	60+	23.2%
C	47+	23.0%
D	40+	10.1%
No award	<40	13.6%

Section:	Multiple Choice	Extended Answer
Average Mark:	25.9 /40	35 /60

2014 Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	A	67	☑A Electron Arrangements: Ca^{2+} = 2,8,8 and Cl^{-} = 2,8,8 ☒B Electron Arrangements: K^{+} = 2,8,8 and Br^{-} = 2,8,18,8 ☒C Electron Arrangements: Mg^{2+} = 2,8 and Cl^{-} = 2,8,8 ☒D Electron Arrangements: Na^{+} = 2,8 and S^{2-} = 2,8,8
2	D	57	1mol of NaCl formula units ↔ 1mol Na^{+} ions; ∴ 0.6mol NaCl f.u. ↔ **0.6mol** Na^{+} ions 1mol of Na_2SO_4 formula units ↔ 2mol Na^{+} ions; ∴ 0.2mol Na_2SO_4 f.u. ↔ **0.4mol** Na^{+} ions Total number of Na^{+} ions = **0.6mol** + **0.4mol** = 1mol
3	D	75	☒A Mass number is unchanged as nucleus is unchanged as $X \rightarrow X^{+} + e^{-}$ ☒B The charge on the nucleus is unchanged as the number of electrons decreases ☒C The nucleus is unchanged during $X \rightarrow X^{+} + e^{-}$ ∴ atomic number is unchanged ☑D A group 1 element has 1 outer electron which is lost during $X \rightarrow X^{+} + e^{-}$
4	B	49	☒A displacement: higher up metals displaces a lower down metal from its ion ☑B neutralisation: Hydrogen H^{+} ions react to become water H_2O ☒C oxidation: increase in the oxygen : hydrogen ratio with electrons being lost ☒D reduction: decrease in the oxygen : hydrogen ratio with electrons being gained
5	C	76	activation energy (reverse catalysed reaction) = activation energy (catalysed forward reaction) + enthalpy change = 35 + (190-160) = 35 + 30 = 65kJ mol^{-1}
6	A	78	☑A enthalpy change ΔH= 100-200 = -100kJ mol^{-1} ☒B enthalpy change ΔH= 100-150 = -50kJ mol^{-1} ☒C endothermic reaction as products are higher in potential energy than reactants ☒D endothermic reaction as products are higher in potential energy than reactants
7	C	82	$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{0.0062-0.0020}{5-0} = \frac{0.0042}{5} = 0.00084 \text{ mol } l^{-1} \text{ min}^{-1}$
8	C	57	☒A Rate decreases as reaction proceeds ☒B Reaction comes to a slow stop not a sudden stop as reaction proceeds ☑C Reaction rate slows as reaction proceeds and comes a gradual stop ☒D Rate decreases as reaction proceeds
9	A	51	☑A volume of gas given off is less (0.5g chalk) and lump means less steep gradient ☒B lump would give a much slower initial reaction rate and gradient would be less ☒C reduction in mass of chalk to 0.5g would half the volume of gas given off ☒D Reaction rate would be approximately same so gradient would be similar
10	A	39	☑A Curve R: higher temperature & greater number of particles (area under curve) ☒B Curve R must have a higher temperature than curve Q ☒C Curve R has greater area due to greater number of particles ☒D Curve R must have a higher temperature than curve Q
11	C	52	**no.** of **mol** = **volume** x **concentration** = 0.1litre x 1mol l^{-1} = 0.1mol 0.1mol releases -3.1kJ ∴ 1mol releases -31kJ
12	D	83	☒A boiling points increase due to greater London dispersion forces down group 7 ☒B covalent radius increases as extra shell of electrons is added ☒C 1st ionisation energy decreases (electrons easier to remove further from nucleus) ☑D Van der Waals' forces are greater as bigger atoms more likely to temp dipole
13	B	61	

Element	Li	Na	K	Rb	Cs	Deductions about Francium
Melting Point (°C)	181	98	63	39	28	Less than 28°C
1st Ionisation Energy (kJ mol^{-1})	520	496	419	403	376	Less than 282 kJ mol^{-1}

14	A	56	☑A Electronegativies: Be=1.5 & Cl=3.0 ∴difference = 1.5 ∴ least ionic character ☒B Electronegativies: Ca=1.3 & Cl=3.0 ∴difference = 1.7 ☒C Electronegativies: Li=1.0 & Cl=3.0 ∴difference = 2.0 ☒D Electronegativies: Cs=0.8 & Cl=3.0 ∴difference = 2.2 ∴ most ionic character
15	B	72	☒A CO_2 is linear and the molecule is non-polar due to shape ☑B NH_3 is trigonal pyramidal. Difference in the electronegativities means it is polar ☒C CCl_4 is tetrahedral and the molecule is non-polar due to shape ☒D CH_4 is non-polar due to the similar electronegativities of carbon and hydrogen
16	C	58	☒A Metallic substances (metal elements and alloys) are never compounds ☒B Covalent bonds are found in diatomic elements e.g. H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2 ☑C Hydrogen bonds are only found in covalent compounds with –OH,-NH or H-F bonds ☒D London dispersion forces are found in every substance
17	C	45	☒A 1mol C atoms = 12g ∴ **no.** of mol = $^{mass}/_{gfm}$ = $^{24}/_{12}$ = 2mol carbon atoms ☒B 1mol O_2 molecules = 32g ∴ **no.** of mol = $^{mass}/_{gfm}$ = $^{16}/_{32}$ = 0.5mol O_2 molecules ☑C 1mol H_2 molecules = 2g ∴ **no.** of mol = $^{mass}/_{gfm}$ = $^{2}/_{2}$ = 1mol H atoms ∴ 1mol e^- ☒D **no.** of mol = **v** x **c** = 1litre x 1mol l^{-1} = 1mol ∴ 1mol NaCl f.u. = 2mol ions
18	B	67	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 = $^{mass}/_{gfm}$ = $^{32}/_{32}$ = 1mol of O_2 ☒D gfm Ne=20.2g ∴ **no.** of mol = $^{mass}/_{gfm}$ = $^{80.8}/_{20.2}$ = 4mol of Ne
19	B	36	☒A Cracking produces smaller unsaturated hydrocarbons e.g. ethene and propene ☑B Cracking naphtha does not produce petrol directly (bits might be added to petrol) ☒C Reforming can produce benzene-based aromatic hydrocarbons ☒D Reforming can produce ringed cycloalkane hydrocarbons
20	A	78	☑A Straight chained hydrocarbons are more likely to auto-ignite ☒B Branched-chain hydrocarbons are less likely to auto-ignite ☒C Ringed cycloalkane hydrocarbons are less likely to auto-ignite ☒D Ringed aromatic hydrocarbons are less likely to auto-ignite
21	B	79	☒A ethanol has a higher relative cost ∴ petrol would cost more ☑B more ethanol required due to lower octane number and higher costs ☒C ethanol has a lower octane rating ∴ more ethanol would be required ☒D ethanol has a higher relative cost ∴ petrol would cost more
22	D	69	Comparison of heptane and 2-methylhexane: 2-methyl branch raises octane number from 0 to 43 Adding 2-methyl branch to 2,4-dimethylhexane to form 2,2,4-trimethylpentane: ∴ adding 2-methyl branch to 2,4-dimethylhexane raises octane number from 66 by similar amount ∴Octane number of 2,2,4-trimethylpentane = 66 + 43 = 99
23	C	70	☒A esters are insoluble in water and are used as solvents ☒B esters are sweet smelling and are used in perfumes ☑C Esters are not used in toothpastes ☒D esters are sweet smelling and are used in flavourings
24	D	74	☒A Polyester textile fibres are linear and not cross-linked ☒B Polyester fibres are long chain molecules ☒C polyesters are formed by condensation polymerisation ☑D cured polyester resins are strong due to cross-linking of the polyester chains
25	B	63	☒A ethene is not one of the two monomers used as ethene has only 2 carbons ☑B but-2-ene gives $–CH_3$ groups on adjacent carbons and propene has 1x $–CH_3$ group ☒C ethene is not one of the two monomers used as ethene has only 2 carbons ☒D but-1-ene is not a monomer used as there are no $–C_2H_5$ side groups in polymer

<table>
<tr><td>26</td><td>D</td><td>65</td><td>☒A isoprene monomer will form a polymer by addition due to C=C double bonds
☒B No –OH, -NH or H-F groups to form hydrogen bonds
☒C isoprene monomer will form a polymer by addition due to C=C double bonds
☑D addition polymer is formed due to C=C bonds and London dispersion between</td></tr>
<tr><td>27</td><td>D</td><td>72</td><td>☒A fats and oils do not cross-link between chains during hardening
☒B hardening of oils into fats is caused by adding hydrogen across C=C bonds
☒C chain length does not change during hardening
☑D number of C=C double bonds decreases during hardening/hydrogenation</td></tr>
<tr><td>28</td><td>A</td><td>79</td><td>☑A Acidified Dichromate gives a orange → green colour change on alcohol oxidation
☒B Benedict's solution does not react with primary alcohols like ethanol
☒C Fehling's solution does not react with primary alcohols like ethanol
☒D Tollen's reagent does not react with primary alcohols like ethanol</td></tr>
<tr><td>29</td><td>A</td><td>75</td><td>☑A Benzene is not a raw material as it has to be extracted from crude oil, etc
☒B Iron ore is iron oxide which is extracted from the ground ∴ raw material
☒C sodium chloride is salt and is extracted from the ground ∴ raw material
☒D water is widely available on this planet ∴ raw material</td></tr>
<tr><td>30</td><td>B</td><td>70</td><td>☒A due to the large quantities involved, iron production is a continuous process
☑B Medicines like aspirin are made by batch process as smaller quanities are required
☒C due to the large quantities involved, ammonia production is a continuous process
☒D due to the large quantities involved, making sulphuric acid is a continuous process</td></tr>
<tr><td>31</td><td>C</td><td>65</td><td>❶ $C_{(graphite)} + O_2 \rightarrow CO_2$ $\Delta H=-394\ kJ\ mol^{-1}$
❷ $C_{(diamond)} + O_2 \rightarrow CO_2$ $\Delta H=-395\ kJ\ mol^{-1}$

❶ $C_{(graphite)} + O_2 \rightarrow CO_2$ $\Delta H=-394\ kJ\ mol^{-1}$
❷x-1 $CO_2 \rightarrow C_{(diamond)} + O_2$ $\Delta H=+395\ kJ\ mol^{-1}$

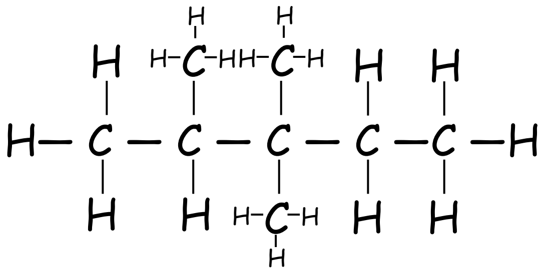
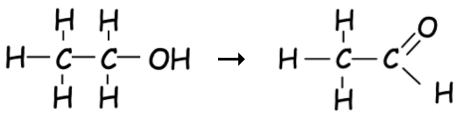
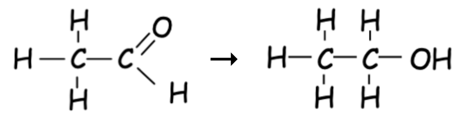
Add ❶+❷' $C_{(graphite)} \rightarrow C_{(diamond)}$ $\Delta H=+1\ kJ\ mol^{-1}$</td></tr>
<tr><td>32</td><td>B</td><td>58</td><td>❶ $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ ΔH_1
❷ $CH_3CHO + 2\frac{1}{2}O_2 \rightarrow 2CO_2 + 2H_2O$ ΔH_2
❸ $2O_3 \rightarrow 3O_2$ ΔH_3

❶ $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ ΔH_1
❷x-1 $2CO_2 + 2H_2O \rightarrow CH_3CHO + 2\frac{1}{2}O_2$ $-\Delta H_2$
❸x½ $O_3 \rightarrow 1\frac{1}{2}O_2$ $\frac{1}{2}\Delta H_3$

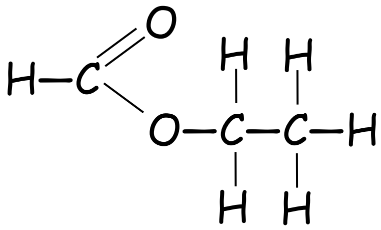
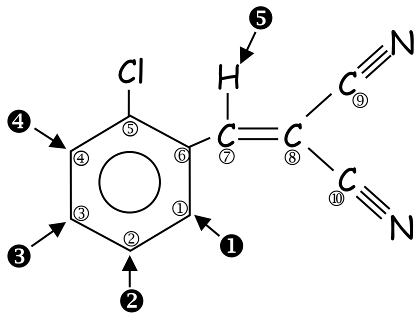
Add ❶+❷'+❸' $C_2H_4 + O_3 \rightarrow CH_3CHO + O_2$ $\Delta H_1-\Delta H_2+\frac{1}{2}\Delta H_3$</td></tr>
<tr><td>33</td><td>A</td><td>67</td><td>☑A At equilibrium, rates of forward & reverse reactions are equal
At equilibrium, concentrations of reactants and products are constant
☒B At equilibrium, rate of forward reaction = rate of reverse reaction
☒C At equilibrium, concentrations of reactants and products are constant
☒D At equilibrium, concentrations of reactants and products are constant</td></tr>
<tr><td>34</td><td>C</td><td>59</td><td>☒A forward reaction is endothermic ∴ high temperature favours forward reaction
☒B forward reaction is endothermic ∴ high temperature favours forward reaction
☑C low pressure and high temperature favour the production of carbon dioxide
☒D forward reaction increases pressure ∴ low pressure favours forward reaction</td></tr>
<tr><td>35</td><td>D</td><td>68</td><td><table>
<tr><td>0.1mol l^{-1} Alkali</td><td>pH</td><td>Mass of Solute</td><td>Conductivity</td><td>Moles of HCl neutralised</td></tr>
<tr><td>sodium hydroxide</td><td>13</td><td>higher gfm ∴higher</td><td>Higher</td><td rowspan="2">Same volume</td></tr>
<tr><td>ammonium solution</td><td>10</td><td>lower gfm ∴ lower</td><td>Lower</td></tr>
</table></td></tr>
<tr><td>36</td><td>B</td><td>77</td><td>☒A catalyst will result in same final concentration of reactant
☑B catalyst gives steeper initial gradient on graph and same final concentration
☒C catalyst will result in same final concentration of reactant
☒D catalyst will speed up reaction and give steeper initial gradient on graph</td></tr>
</table>

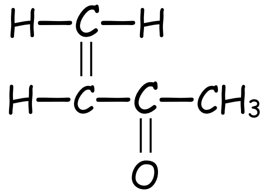
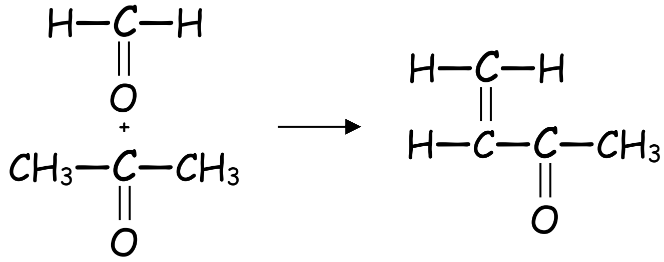
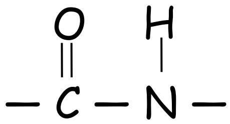
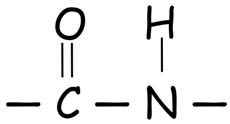
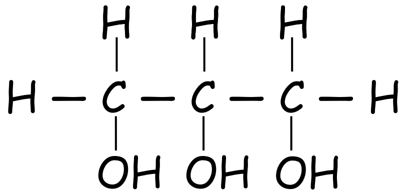
37	A	47	☑A Al → Al^{3+} + $3e^-$: aluminium metal is oxidised ∴ aluminium metal is reducing agent ☒B Ag^+ + e^- → Ag: silver ions are reduced ∴silver ions acting as oxidising agent ☒C Ag^+ + e^- → Ag: silver ions are reduced ∴silver ions are electron acceptors ☒D sulphide ions are unchanged and are spectator ions
38	B	58	☒A the low conductivity of water is due to the low concentrations of ions in water ☑B there are very few ions in pure water and this results in low conductivity ☒C hydrogen bonding between water molecules does not contribute to conductivity ☒D the low conductivity is due to number of ions not the ratio of H^+ and OH^- ions
39	D	62	☒A concentration of H^+ ions decreases during dilution from pH=4 to pH=6 ☒B concentration of H^+ ions decreases during dilution from pH=4 to pH=6 ☒C pH=4 to pH=6 is a difference in H^+ concentration by a factor of 100 not 2 ☑D Dilution from pH=4 to pH=6 is a decrease in H^+ concentration by a factor of 100
40	D	76	☒A beta radiation is negative and is attracted to the positive plate ☒B beta radiation is negative and is attracted to the positive plate ☒C beta radiation is negative and is attracted to the positive plate ☑D alpha bends to negative, beta bends to positive and gamma does not bend

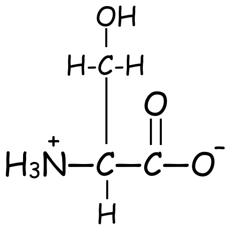
2014 Higher Chemistry Marking Scheme

<table>
<tr><th>Long Qu</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>1a</td><td>
<table>
<tr><td>metallic</td><td></td><td>covalent</td><td></td></tr>
<tr><td></td><td>network</td><td></td><td>molecular</td></tr>
</table>
</td><td>
<table>
<tr><th>Bonding</th><th>1st Twenty Elements</th></tr>
<tr><td>Metallic solid</td><td>lithium, beryllium, sodium, magnesium, aluminium, potassium, calcium</td></tr>
<tr><td>Monatomic gas</td><td>helium, neon, argon</td></tr>
<tr><td>Covalent network</td><td>boron, carbon (diamond), carbon (graphite), 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 electrons jump from atom to atom</td><td>The electrons in the outer shells of metals are delocalised as they are able to jump from atom to atom allowing electrical conduction through the metal.</td></tr>
<tr><td>1c</td><td>Same shell filling up and more positive nucleus pulls in outer shell more</td><td>Elements in same period have same number of occupied electron shells meaning the element does not increase in size across period. The nucleus becomes increasing positive across a period and this increased charge is attracted to the outer shell more and decreases the size of the atom.</td></tr>
<tr><td>2a</td><td>naphtha</td><td>Petrol is made by reforming the naphtha fraction.
Diesel is made by blending the gas oil fraction.</td></tr>
<tr><td>2b(i)</td><td>diagram showing:</td><td></td></tr>
<tr><td>2b(ii)</td><td>cycloalkanes or aromatic hydrocarbons</td><td>Petrol will auto-ignite before the spark if there is a high a degree of straight chained hydrocarbons. By adding hydrocarbon molecules with branches or rings then the likelihood of auto-ignition before the spark is reduced.</td></tr>
<tr><td>2c(i)</td><td>Answer to include:</td><td>
<table>
<tr><th>½mark</th><th>½mark</th></tr>
<tr><td>Temperature not too high to denature the enzyme.</td><td>Temperature high enough to give fast reaction.</td></tr>
</table>
</td></tr>
<tr><td>2c(ii)</td><td>Decrease in oxygen : hydrogen ratio</td><td>Reduction is defined as a reduction in the oxygen : hydrogen ratio.
It can also be viewed as the opposite of oxidation.
<table>
<tr><td>Oxidation:
ethanol → ethanal
primary alcohol → aldehyde

C_2H_6O → C_2H_4O</td><td>Reduction:
ethanal → ethanol
aldehyde → primary alcohol

C_2H_4O → C_2H_6O</td></tr>
</table>
</td></tr>
<tr><td>2c(iii)</td><td>87.1%</td><td>
$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$
1mol → 2mol
180g → 92g
1000g → $92g \times {}^{1000}/_{180}$
= 511.1g
$\%Yield = \frac{Actual}{Theoretical} \times 100 = \frac{445}{511.1} \times 100 = 87.1\%$
</td></tr>
<tr><td>3a(i)</td><td>Answer to include:</td><td>Decrease the volume of potassium iodide solution and increase the volume of water to ensure the total volume of the two solutions is the same.</td></tr>
</table>

3a(ii)	2 answers from:	Use a smaller measuring cylinder or syringe for volumes; Use a white tile for observing colour changes; Ensure the beakers are dry before use so concentrations are accurate
3b	1 answer from:	Collision angle must be correct; Collision energy must be in excess of the minimum energy to overcome the activation energy.
4a	Answer to include:	H-F has hydrogen bonding which raises the b.pt. by bringing the molecules closer together. F-F is non-polar covalent molecular. B.pt. is lower as there is only weak London dispersion forces between molecules.
4b	pH > 7 e.g. 8-11	The salt of a weak acid and a strong alkali neutralisation reaction gives an alkaline pH when dissolved in water.
5a(i)	condensation	Nylon is a polyamide polymer made by condensation polymerisation of a diacid monomer and a diamine monomer. Other condensation polymers include Kevlar and polyester
5a(ii)	one functional group on monomer	Condensation polymers require monomers with 2 functional groups per monomer so that the polymer chain keeps on going in both directions. When molecules containing only one functional group are added, the polymer chains are prevented from becoming very long as the one-functional group monomer prevents the polymer from extending any further.
5b	conductor	Polymer: Biopol / Poly(ethenol) / Poly(ethyne) / kevlar Property: Biodegradable / Soluble / Conductor / Very strong
6	Answer to include:	OH^- ions in alkali react with H^+ ion in equilibrium by neutralisation. Removal of H^+ ions (product) from equilibrium moves equilibrium to right to replace H^+ ∴ colour becomes more yellow as equilibrium moves to right.
7a	${}^{1}_{1}p$	${}^{14}_{7}N + {}^{1}_{0}n \rightarrow {}^{14}_{6}C + {}^{1}_{1}p$ nitrogen nucleus; neutron captured; carbon nucleus; proton ejected
7b	Neutron splits into proton and electron	During Beta-emission, a neutron splits into a proton and an electron. ${}^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}e$ Neutron in nucleus; Proton stays in nucleus; β particle ejected
7c(i)	24225 years	From graph: 5% of carbon-14 content at 4.25 half lives 1 half-life = 5700 years 4.25 half-lives = 5700 years x $^{4.25}/_{1}$ = 24225 years
7c(ii)	Too many half-lives have passed to measure	When too many half-lives have passed, it is not possible to measure half-life with any accuracy as there is too little ^{14}C left in the sample.
8a	37.8	$E_h = c \times m \times \Delta T$ Energy = specific heat capacity × mass × change in temperature Energy = 4.18 × 0.21 × 50 Energy = -43.89kJ 1mol CaO = (1x40)+(1x16) = 40+16 = 56g -65kJ ↔ 56g -43.89kJ ↔ 56g x $^{-43.89}/_{-65}$ = 37.8g
8b	-147	❶ $Ca_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CaO_{(s)}$ ΔH=+635kJ mol^{-1} ❷ $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ ΔH=-286kJ mol^{-1} ❸ $Ca_{(s)} + O_{2(g)} + H_{2(g)} \rightarrow Ca(OH)_{2(s)}$ ΔH=+986kJ mol^{-1} ❹ $Ca(OH)_{2(s)} \rightarrow Ca(OH)_{2(aq)}$ ΔH=-82kJ mol^{-1} ❶x-1 $CaO_{(s)} \rightarrow Ca_{(s)} + \frac{1}{2}O_{2(g)}$ ΔH=-635kJ ❷x-1 $H_2O_{(l)} \rightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$ ΔH=+286kJ ❸ $Ca_{(s)} + O_{2(g)} + H_{2(g)} \rightarrow Ca(OH)_{2(s)}$ ΔH=+986kJ ❹ $Ca(OH)_{2(s)} \rightarrow Ca(OH)_{2(aq)}$ ΔH=-82kJ Add ❶+❷+❸+❹ $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$ ΔH=-147kJ mol^{-1}

9a(i)	conc sulphuric acid	PPA Technique Question
9a(ii)	Reactants flammable	PPA Technique Question
9a(iii)	Diagram Showing:	
9b	$CHCl_3 + 4NaOH$ ↓ $HCOONa + 3NaCl + 2H_2O$	$CHCl_3 + 4NaOH \longrightarrow HCOONa + 3NaCl + 2H_2O$
10a	heterogeneous	Homogeneous: Catalyst in *same* state as the reactants Heterogeneous: Catalyst in *different* state from the reactants
10b	$CH_{4(g)} + 2H_2O_{(g)}$ ↓ $CO_{2(g)} + 4H_{2(g)}$	❶ $CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3H_{2(g)}$ ❷ $CO_{(g)} + H_2O_{(g)} \rightarrow CO_{2(g)} + H_{2(g)}$ Add ❶+❷ $CH_{4(g)} + 2H_2O_{(g)} \rightarrow CO_{2(g)} + 4H_{2(g)}$
10c(i)	44.8	Q = I x t = 200 x (30x60) = 360000C $2H^+ + 2e^- \longrightarrow H_2$ 2mol — 1mol 2x96500C — 24 litres 193000C — 24 litres 360000C — 24 litres x $^{360000}/_{193000}$ = 44.8litres
10c(ii)	Water is a renewable source	The hydrogen formed by the electrolysis of water is burned and turns back into water again. This means water will not run out.
11a	w=10 x=5 y=2 z=1	
11b	4-methylpentan-2-one	1. Identify functional group: -one 2. Identify longest chain with functional group: -pentanone 3. Give lowest numbering system to functional group: -pentan-2-one 4. Identify side groups: -methylpentan-2-one 5. Give side groups number from existing numbering system: 4-methylpentan-2-one
11c	CFCs destroy ozone	Chlorofluorocarbons break down ozone. Ozone is required to absorb harmful ultraviolet light from sun. U.V. light can cause sunburn and skin cancer.
11d(i)	hydrogenation	Addition of hydrogen across C=C double bond is also known as hydrogenation

11d(ii)		
12a	Fibrous	Protein / Description Fibrous: Structural protein needed to support the internal structures in organisms e.g. collagen Globular: Specifically shaped proteins like needed to regulate body systems e.g. enzymes and hormones
12b		Amide links are found in polyamide polymers while peptide links are found in proteins. Both have the structure: 
12c	Hydroxyl	Hydroxyl groups have the formula -OH and found in alcohols.
12d(i)	Glycerol	Glycerol is also known as propane-1,2,3-triol and has the structure: 
12d(ii)	Dotted line between N-H group and O-H group or between OH groups	Hydrogen bonding occur between molecules containing N-H groups, O-H groups or H-F molecules. The boiling point of the substance is elevated as the molecules become closer together due to the hydrogen bonding.
13a	Use top of liquid to measure volume	PPA Technique Question: The bottom of the curve (meniscus) is usually used to measure the starting and end volumes in a burette. When the solution is not transparent, the top of the curve must be used as the meniscus is not visible.
13b	colourless → blue/black	PPA Technique Question: Iodine is in the burette at start ∴ colour in conical flask must be colourless as there is not iodine in conical flask to turn colour blue/black. As iodine is added, it reacts with the vitamin C. When the vitamin C runs out, added iodine remains in the conical flask and the starch indicator turns blue/black.
13c	Larger volumes are added to work out roughly where colour change takes place	The rough titration is deliberately inaccurate but is used to work out roughly where the colour change will take place. Typically 1cm^3 is added at one time and the flask stirred. The volume from the rough titration will be inaccurate but the next titration then adds the majority of the rough titration volume in one go and remainder of the volume added drop by drop so that the final volume is very accurately determined.
13d	0.2794g	**n**o. of mol I_2 = **v**olume x **c**oncentration = 0.0254litres x 0.00125mol l^{-1} = 3.175x10^{-5}mol $C_6H_8O_6$ + I_2 ⟶ $C_6H_6O_6$ + $2H^+$ + $2I^-$ 1mol 1mol 3.175x10^{-5}mol 3.175x10^{-5}mol ∴ 20cm^3 orange juice contains 3.175x10^{-5}mol Vitamin *C* ($C_6H_8O_6$) ∴ 1000cm^3 orange juice contains 3.175x10^{-5}mol x^{1000}/$_{20}$ = 1.5975x10^{-3} mol Vitamin *C* ($C_6H_8O_6$) 1 mol Vitamin *C* ($C_6H_8O_6$) = (6x12) + (8x1) + (6x16) = 72+8+96 = 176g **m**ass = **n**o. of mol x **gfm** = 1.5975x10^{-3} mol x 176 g mol^{-1} = 0.2794g
14a	0.973litres	1mol of RDX produces 9 moles of gas produced (3mol *CO* + 3mol H_2O + 3mol N_2) **gfm** $C_3H_6N_6O_6$ = (3x12)+(6x1)+(6x14)+(6x16) = 36+6+84+96 = 222g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}}$ = $\frac{1g}{222\ g\ mol^{-1}}$ = 0.00450mol $C_3H_6N_6O_6(s)$ ⟶ $3CO(g)$ + $3H_2O(g)$ + $3N_2(g)$ 1mol 3mol 3mol 3mol 1mol 9mol 0.00450mol 0.0405mol **V**olume = **n**o. of mol x **M**olar **V**olume = 0.0405mol x 24litres mol^{-1} = 0.973litres

<table>
<tr>
<td>14b</td>
<td>$C_5H_6N_6O_6$
↓
$2CO+4H_2O+3CO_2+2N_2$</td>
<td>
<table>
<tr><th rowspan="2">Rule</th><th rowspan="2">Quantity</th><th rowspan="2">Reaction</th><th colspan="4">Total Moles of Products</th></tr>
<tr><th>CO</th><th>H_2O</th><th>CO_2</th><th>N_2</th></tr>
<tr><td>1</td><td>5xC</td><td>$5C \rightarrow 5CO$</td><td>5</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>4O of total 7O react with 8H</td><td>$8H + 4O \rightarrow 4H_2O$</td><td>5</td><td>4</td><td></td><td></td></tr>
<tr><td>3</td><td>3O remaining react with 3CO</td><td>$3CO + 3O \rightarrow 3CO_2$</td><td>2</td><td>4</td><td>3</td><td></td></tr>
<tr><td>4</td><td>4N join to form N_2</td><td>$4N \rightarrow 2N_2$</td><td>2</td><td>4</td><td>3</td><td>2</td></tr>
</table>
</td>
</tr>
<tr>
<td>15a</td>
<td></td>
<td>It is important to redraw the serine molecule into the same format as the glycine molecule first. Once the $-CH_2OH$ group in serine has been identified, the zwitterion is easy to draw using the template in the example.</td>
</tr>
<tr>
<td>15b</td>
<td>Answer to include:</td>
<td>1×10^{-5} mol l^{-1} sodium hydroxide solution ∴ $[OH^-] = 1 \times 10^{-5}$
∴ $[H^+] = 1 \times 10^{-9}$ ∴ pH = 9
As pH is less than IEP pH=9.7 ∴ positive ion is formed
∴ positive ions attracted to negative electrode</td>
</tr>
</table>