JABchem

Past Papers Higher Chemistry

REVISED 2014 Marking Scheme

Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	71	35.3%
B	59	24.9%
C	48	20.7%
D	42	7.0%
No award	<42	12.1%

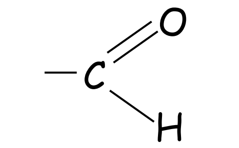
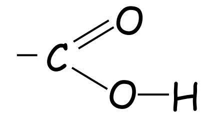
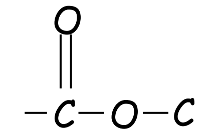
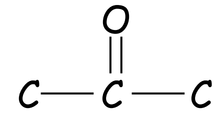
Section:	Multiple Choice	Extended Answer
Average Mark:	19.2 /40	43.6 /60

2014 Revised Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	B	75	Group 3 elements have three outer electrons which creates a full outer shell on 3rd ionisation and breaks a full outer shell on 4th ionisation.

Ionisation Energy	1st	2nd	3rd	4th
Example:	$Al_{(g)} \rightarrow Al^{+}_{(g)}+e^-$	$Al^{+}_{(g)} \rightarrow Al^{2+}_{(g)}+e^-$	$Al^{2+}_{(g)} \rightarrow Al^{3+}_{(g)}+e^-$	$Al^{3+}_{(g)} \rightarrow Al^{4+}_{(g)}+e^-$
Electron Arrangement	2,8,3 → 2,8,2	2,8,2 → 2,8,1	2,8,1 → 2,8	2,8 → 2,7
Energy Required:	578 $kJ\ mol^{-1}$	1817 $kJ\ mol^{-1}$	2745 $kJ\ mol^{-1}$	11577 $kJ\ mol^{-1}$

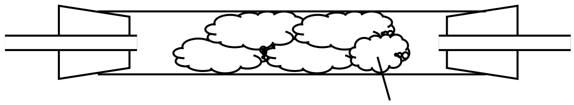
MC Qu	Answer	% Pupils Correct	Reasoning
2	C	90 OldH=83	☒A boiling points increase as greater London dispersion forces down group 7 ☒B covalent radius increases as extra shell of electrons is added ☑C Electronegativity decreases down group 7 (data booklet page 11) ☒D London dispersion forces are greater as bigger atoms more likely to temp dipole
3	A	67 OldH=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
4	B	35	☒A Argon is monatomic so would have less London dispersion forces than Cl_2 ☑B Chlorine Cl_2 is diatomic and twice as many atom than argon for the temp dipole ☒C nitrogen has many less electrons than chlorine & less likely to form temp dipole ☒D oxygen has many less electrons than chlorine & less likely to form temp dipole
5	A	87	☑A CO_2 is non-polar due to the shape of the molecule which cancels out polarity ☒B H_2O is a bent polar molecule with two polar O-H bonds ☒C HCl is a straight polar molecule with ane polar H-Cl bond ☒D $CHCl_3$ is a polar molecule with three polar C-Cl bonds
6	A	67	Caryophyllene is a hydrocarbon with formula $C_{15}H_{24}$. All hydrocarbons are non-polar. ☑A Hexane is a non-polar solvent an will dissolve caryophyllene ☒B Hexanal is a polar solvent and will dissolve caryophyllene (C=O is polar group) ☒C Hexan-2-ol is a polar solvent and will dissolve caryophyllene (O-H is polar group) ☒D Hexan-3-one is a polar solvent and will dissolve caryophyllene (C=O is polar group)
7	D	64	Oxidising agents are reduced themselves while oxidising something else. ☒A $Li^+ + e^- \rightarrow Li$ is a reduction reaction but further up table so less powerful agent ☒B $Li \rightarrow Li^+ + e^-$ is a oxidation reaction so would act as a reducing agent ☒C $2F^- \rightarrow F_2 + 2e^-$ is a oxidation reaction so would act as a reducing agent ☑D $F_2 + 2e^-$ $2F^-$ is a reduction reaction (low down table so powerful oxidising agent)
8	A	46 OldH=47	☑A $Al \rightarrow Al^{3+} + 3e^-$: aluminium metal is oxidised ∴ aluminium metal is reducing agent ☒B $Ag^+ + e^- \rightarrow Ag$: silver ions are reduced ∴silver ions acting as oxidising agent ☒C $Ag^+ + e^- \rightarrow Ag$: silver ions are reduced ∴silver ions are electron acceptors ☒D sulphide ions are unchanged and are spectator ions
9	B	84	☒A Structure shown is 6-hydroxy-4-methyl-2-pyrone ☑B Structure shown is 4-hydroxy-6-methyl-2-pyrone ☒C Structure shown is 3-hydroxy-5-methyl-2-pyrone ☒D Structure shown is 5-hydroxy-3-methyl-2-pyrone
10	C	59 OldH=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
11	D	73	☒A fats & oils both contain three ester links and no hydroxyl groups ☒B aldehydes & ketones contain carbonyl groups not carboxyl groups ☒C aldehydes & ketones contain carbonyl groups not carboxyl groups ☑D aldehydes/ketones contain carbonyl groups and fats/oils contain ester links

12	B	84	☒A hydration: removal of a water molecule leaving behind a C=C double bond ☑B oxidation: nicotinyl alcohol → nicotinic acid is primary alcohol → carboxylic acid ☒C reduction would reverse the reaction of carboxylic acid → primary alcohol ☒D condensation: two smaller molecules join together removing water at join point
13	C	65	☒A proteins are mainly covalent structures. ☒B covalent bonds would take more energy to break than denaturing requires ☑C hydrogen bonding between side groups in protein are broken during denaturing ☒D covalent bonds would take more energy to break than denaturing requires
14	D	62	☒A Benzaldehyde is less soluble as it lakes the polar –OH hydroxyl group ☒B Benzaldehyde is less soluble as it lakes the polar –OH hydroxyl group ☒C Benzaldehyde would be more volatile as it has less intermolecular attractions ☑D Benzaldehyde is less soluble and more volatile than vanillin
15	D	74	Group: Aldehyde / Carboxylic Acid / Ester / Ketone Structure:    
16	B	84	☒A head of soap is hydrophilic (likes water) & tail of soap is hydrophobic (likes oil) ☑B head of soap is hydrophilic (likes water) & tail of soap is hydrophobic (likes oil) ☒C head of soap is hydrophilic (likes water) & tail of soap is hydrophobic (likes oil) ☒D head of soap is hydrophilic (likes water) & tail of soap is hydrophobic (likes oil)
17	D	32	☒A structure shown is glycerol (propane-1,2,3-triol) ☒B structure shown is a fat or oil ☒C structure shown is a fatty acid ☑D structure shown acts as an emulsifier as it has an –OH group and fatty group.
18	B	76	Formula of humulene = $C_{15}H_{24}$. Isoprene units are units of 5 carbons ∴ humulene formed from 3 isoprene units
19	B	58 OldH=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
20	A	68 OldH=67	☑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
21	C	59 OldH=59	☒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
22	A	59 OldH=51	☑A slower gradient of line (powder→lump) and volume of gas halved (1g→0.5g) ☒B gradient of line less steep as lumps react slower than powder ☒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
23	A	38 OldH=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

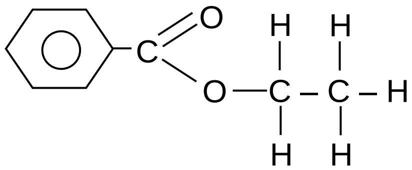
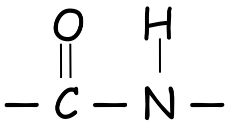
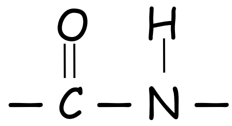
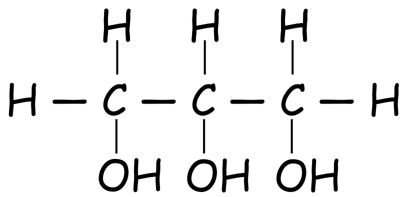
24	C	68 OldH=76	activation energy (reverse catalysed reaction) = activation energy (catalysed forward reaction) + enthalpy change = 35 + (190-160) = 35 + 30 = 65kJ mol^{-1}
25	C	50 OldH=52	no. of moles = volume x concentration = 0.1litre x 1mol l^{-1} = 0.1mol 0.1mol releases -3.1kJ ∴ 1mol releases -31kJ
26	C	90	The enthalpy of combustion is defined as the energy change for the complete combustion of one mole of a substance.
27	B	67 OldH=65	❶ $C_{(graphite)}$ + O_2 → CO_2 ΔH=-394 kJ mol^{-1} ❷ $C_{(diamond)}$ + O_2 → CO_2 ΔH=-395 kJ mol^{-1} ❶ $C_{(graphite)}$ + O_2 → CO_2 ΔH=-394 kJ mol^{-1} ❷x-1 CO_2 → $C_{(diamond)}$ + O_2 ΔH=+395 kJ mol^{-1} Add ❶+❷' $C_{(graphite)}$ → $C_{(diamond)}$ ΔH=+1 kJ mol^{-1}
28	D	39	☒A Substance A would be 4th peak as it has six polar –OH groups ☒B Substance B would be 1st peak as it has no polar –OH groups ☒C Substance C would be 2nd peak as it has two polar –OH groups ☑D Substance D is the biggest peak (peak 3) as it has three polar –OH groups
29	D	48	☒A bottom of meniscus is used to show correct volume on pipette ☒B the liquid should overshoot the mark and then released to the mark ☒C bottom of meniscus is used to show correct volume on pipette ☑D the bottom of the meniscus should be used to measure volume on a pipette and the mark should be overshot and liquid released back to down to the mark.
30	C	48	☒A neither a dropper or a measuring cylinder are accurate ways to dilute ☒B a measuring cylinder is not an accurate enough way of measuring $10cm^3$ ☑C pipettes & volumetric flasks are accurate methods of measuring volume for dilution ☒D a measuring cylinder is not an accurate enough way of measuring $500cm^3$

2014 Revised 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>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>1c(i)</td><td>distillation</td><td>(Fractional) Distillation separates chemicals with different boiling points</td></tr>
<tr><td>1c(ii)</td><td>5.77×10^7 tonnes</td><td>1.3% mass $\longleftrightarrow$ 750000 tonnes
100% mass $\longleftrightarrow$ 750000 tonnes $\times\frac{100}{1.3}$
$= 5.77\times10^7$ tonnes</td></tr>
<tr><td>1c(iii)</td><td>Magnesium reacts with oxygen</td><td>Magnesium is a reactive metal which would react woth any available oxygen gas to form magnesium oxide (in a vigorous reaction)</td></tr>
<tr><td>1c(iv)</td><td>Open Question Answer to Include:</td><td><table><tr><th>3 mark answer</th><th>2 mark answer</th><th>1 mark answer</th></tr><tr><td>Demonstrates a good understanding of the chemistry involved. A good comprehension of the chemistry has provided in a logically correct, including a statement of the principles involved and the application of these to respond to the problem.</td><td>Demonstrates a reasonable understanding of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.</td><td>Demonstrates a limited understanding of the chemistry involved. The candidate has made some statement(s) which are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.</td></tr></table></td></tr>
<tr><td>2a(i)</td><td>Enzyme changes shape when heated</td><td>Enzymes are denatured when the conditions of pH or temperature are too far from the optimum pH or temperature. This change of shape prevents the substrate molecule from fitting into the exact shape of the enzyme and prevents the chemical reaction from being catalysed by the enzyme.</td></tr>
<tr><td>2a(ii)</td><td>Decrease in oxygen:hydrogen ratio</td><td>Reduction is defined as a reduction in the oxygen : hydrogen ratio.
The reduction reaction in the question is the opposite of the oxidation of primary alkanol ethanol to alkanal ethanal.</td></tr>
<tr><td>2a(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
$\%Yield = \frac{Actual}{Theoretical}\times100 = \frac{445}{511.1}\times100 = 87.1\%$</td></tr>
<tr><td>2b</td><td>-29717</td><td>1mol C_2H_5OH = (2x12)+(6x1)+(1x16) = 24+6+16 = 46g = 0.046kg
1mol C_2H_5OH = 0.046kg = -1367 kJ
1 kg = $-1367\text{ kJ}\times\frac{1}{0.046}$
= -29717 kJ kg^{-1}</td></tr>
</table>

<table>
<tr><td>2c</td><td>3.87</td><td>Specific gravity before fermentation = 1035
Specific gravity after fermentation = 1005
Change in specific gravity = 1035 – 1005 = 30 ∴ f=0.129
% alcohol = change in specific gravity × f
= 30 × 0.129
= 3.87%</td></tr>
<tr><td>3a</td><td>-545</td><td><table>
<tr><td><u>Bond Breaking Steps</u>
1x H-H = 1x436kJ = 436kJ
1x F-F = 1x159kJ = 159kJ
Total = 595kJ</td><td><u>Bond Forming Steps</u>
2x H-F = 2x570kJ = 1140kJ
Total = 1140kJ</td></tr>
<tr><td colspan="2">ΔH = ΣBond enthalpies for bonds broken - ΣBond enthalpies for bonds formed
ΔH = 595 - 1140
ΔH = -545 kJ mol^{-1}</td></tr>
</table></td></tr>
<tr><td>3b</td><td>Answer to include:</td><td>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.</td></tr>
<tr><td>4a</td><td>Diagram showing:</td><td>
calcium oxide</td></tr>
<tr><td>4b(i)</td><td>37.8</td><td>E_h = c × m × ΔT
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 × $^{-43.89}/_{-65}$
= 37.8g</td></tr>
<tr><td>4b(ii)</td><td>-147</td><td>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}</td></tr>
<tr><td>5a(i)</td><td>$C_6H_8O_6$
↓
$C_6H_6O_6 + 2H^+ + 2e^-$</td><td>Redox equation: $I_2 + C_6H_8O_6 \longrightarrow C_6H_6O_6 + 2H^+ + 2I^-$
Reduction equation: $I_2 + 2e^- \longrightarrow 2I^-$
Oxidation equation: $C_6H_8O_6 \longrightarrow C_6H_6O_6 + 2H^+ + 2e^-$</td></tr>
<tr><td>5a(ii)</td><td><table>
<tr><td>Glass ware</td><td>water</td><td>iodine</td><td>Fruit juice</td></tr>
<tr><td>Pipette</td><td></td><td></td><td>✓</td></tr>
<tr><td>Burette</td><td></td><td>✓</td><td></td></tr>
<tr><td>conical flask</td><td>✓</td><td></td><td></td></tr>
</table></td><td><table>
<tr><td rowspan="2">Rinse</td><td>pipette with fruit juice</td><td rowspan="2">(both for 1 mark)</td></tr>
<tr><td>burette with iodine solution</td></tr>
<tr><td>Rinse</td><td>conical flask with water</td><td>(1mark)</td></tr>
</table></td></tr>
<tr><td>5a(iii)</td><td>Answer to include:</td><td>improve reliability or allow average value to be taken</td></tr>
</table>

5a(iv)	0.2794g	no. of mol I_2 = volume x concentration = 0.0254litres x 0.00125mol l⁻¹ = 3.175×10^{-5}mol $C_6H_8O_6$ + I_2 ⟶ $C_6H_6O_6$ + $2H^+$ + $2I^-$ 1mol 1mol 3.175×10^{-5}mol 3.175×10^{-5}mol ∴ 20cm³ orange juice contains 3.175×10^{-5}mol Vitamin C ($C_6H_8O_6$) ∴ 1000cm³ orange juice contains 3.175×10^{-5}mol $\times ^{1000}/_{20}$ = 1.5975×10^{-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** = 1.5975×10^{-3} mol x 176 g mol⁻¹ = 0.2794g
5b	80%	1 litre = 1000cm³ orange juice = 240mg vitamin C 200cm³ orange juice = 240mg vitamin C $\times \frac{200}{1000}$ = 48mg vitamin C % rda = $\frac{48mg}{60mg} \times 100$ = 80%
6a(i)	water bath	No naked flames should be used to heat the ester as both the reactants and products are flammable.
6a(ii)	condensation	Condensation joins together smaller molecules together to form a larger molecule with the removal of a small molecule (e.g. water) where the molecules join together. Hydrolysis is the opposite reaction.
6a(iii)	Diagram showing:	
6b	82.3%	$2C_6H_5COOH$ + Na_2CO_3 ⟶ $2C_6H_5COONa$ + H_2O + CO_2 2mol 1mol 2mol 1mol 1mol 244g 106g 288g 350g atom economy = $\frac{\text{mass of desired product}}{\text{total mass of reactants}} = \frac{288}{350}$ x100 = 82.3%
7a		Amide links are found in polyamide polymers while peptide links are found in proteins. Both have the structure: 
7b	Hydroxyl	Hydroxyl groups have the formula -OH and found in alcohols and alkanols
7c(i)	Glycerol	Glycerol is also known as propane-1,2,3-triol and has the structure: 
7c(ii)	£18	5g behenic acid ⟷ 50.0 cm³ ben oil 20g behenic acid ⟷ 50.0 cm³ ben oil $\times \frac{20}{5}$ =200 cm³ ben oil 1 litre = 1000cm³ ben oil ⟷ £90 200cm³ ben oil ⟷ £90 $\times \frac{200}{1000}$ = £18

<table>
<tr><td>7c(iii)</td><td>Dotted line between N-H group and O-H group or between OH groups</td><td>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.</td></tr>
<tr><td>7d</td><td>Open Question Answer to Include:</td><td>
<table>
<tr><th>3 mark answer</th><th>2 mark answer</th><th>1 mark answer</th></tr>
<tr><td>Demonstrates a <u>good</u> understanding of the chemistry involved. A good comprehension of the chemistry has provided in a logically correct, including a statement of the principles involved and the application of these to respond to the problem.</td><td>Demonstrates a <u>reasonable</u> understanding of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.</td><td>Demonstrates a <u>limited</u> understanding of the chemistry involved. The candidate has made some statement(s) which are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.</td></tr>
</table>
</td></tr>
<tr><td>8a(i)</td><td>Atom/molecule with unpaired electron</td><td>Free radicals are extremely reactive species that contain an unpaired electron. This unpaired electron will react with many other species to become paired again.</td></tr>
<tr><td>8a(ii)</td><td>UV radiation breaks bonds</td><td>Ultraviolet radiation breaks bonds in molecules and forms reactive atoms/molecules with an unpaired electron.</td></tr>
<tr><td>8a(iii)</td><td>Propagation</td><td>
<table>
<tr><th>Step</th><th>Reactants
(before Arrow)</th><th>⟶</th><th>Products
(after Arrow)</th></tr>
<tr><td>Initiation</td><td>No free radicals on Left Hand Side</td><td>⟶</td><td>Free radicals on Right Hand Side</td></tr>
<tr><td>Propagation</td><td colspan="3">Free Radicals found on both sides of arrow</td></tr>
<tr><td>Termination</td><td>Free radicals on Left Hand Side</td><td>⟶</td><td>No free radicals on Right Hand Side</td></tr>
</table>
</td></tr>
<tr><td>8b</td><td>Diagram showing:</td><td>O=C=C=C=O</td></tr>
<tr><td>9a</td><td>14°C</td><td>When rate = 0.02 s^{-1} then temperature = 38°C
When rate = 0.04 s^{-1} then temperature = 52°C
∴ temperature rise = 52°C – 38°C = 14°C</td></tr>
<tr><td>9b</td><td>Correct energy and correct geometry</td><td>For a collision to be successful and product molecules formed, the correct energy must be supplied to the collision to overcome the activation energy and the angle of collision must also be correct for a successful collision.</td></tr>
<tr><td>10a</td><td>Answer to include:</td><td>
<table>
<tr><td>1 mark:</td><td>Primary alcohol (-OH on end) of molecule has higher boiling point <u>or</u>
Secondary/Tertiary alcohol (-OH in middle) has lower boiling point</td></tr>
<tr><td>1 mark:</td><td>Straight-chained alkanols have a higher boiling point <u>or</u>
Branched-chained alkanols have a lower boiling points</td></tr>
</table>
</td></tr>
<tr><td>10b</td><td>Temperature between
121°C-149°C</td><td>
<table>
<tr><th>Alkanol</th><th>Butan-1-ol</th><th>Butan-2-ol</th><th>Pentan-1-ol</th><th>Pentan-2-ol</th><th>Hexan-1-ol</th><th>Hexan-2-ol</th></tr>
<tr><td>Boiling Point (°C)</td><td>118°C</td><td>93°C</td><td>137°C</td><td>119°C</td><td>159°C</td><td>-</td></tr>
<tr><td>Difference</td><td colspan="2">25°C</td><td colspan="2">18°C</td><td colspan="2">(11-25°C)</td></tr>
<tr><td>Predicted Boiling Point (°C)</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>134-148°C</td></tr>
</table>
NB hexan-2-ol boiling point must be lower than boiling point of hexan-1-ol (159°C)
hexan-2-ol boiling point must be greater than boiling point of pentan-2-ol (119°C)
</td></tr>
<tr><td>11a</td><td>$IO_4^- + 2H^+ + 2e^-$
↓
$IO_3^- + H_2O$</td><td>Write down the main species involved in the reaction
$IO_4^- \rightarrow IO_3^-$
Balance all atoms except O and H (not required in this question)
$IO_4^- \rightarrow IO_3^-$
Add H_2O to other side to balance O atoms
$IO_4^- \rightarrow IO_3^- + H_2O$
Add H^+ ions to other side to balance H atoms
$IO_4^- + 2H^+ \rightarrow IO_3^- + H_2O$
Add e^- to most positive side to balance charge
$IO_4^- + 2H^+ + 2e^- \rightarrow IO_3^- + H_2O$</td></tr>
</table>

<table>
<tr>
<td>11b(i)</td>
<td>Answer to include:</td>
<td>
<table>
<tr><td>1 mark:</td><td>mention of transferring rinsings</td></tr>
<tr><td>1 mark:</td><td>mention of making solution up to the mark of flask</td></tr>
</table>
</td>
</tr>
<tr>
<td>11b(ii)</td>
<td>0.000235g
or
12.93mg</td>
<td>Line of best fit must be used to work out concentration from absorbance
From Graph: Absorbance = 0.3 ∴ permanganate concentration = 28mg l^{-1}
NB Although the point on the graph for Absorbance=0.30 has a concentration of 30mg l^{-1}, the absorbance must be read from the best fit straight line drawn instead.
1 litre of solution ∴ solution contains 28 mg of permanganate ions MnO_4^-
gfm MnO_4^- = (1x54.9)+(4x16) = 54.9+64 = 118.9g
$\text{no. of mol} = \frac{\text{mass}}{\text{gfm}} = \frac{0.028g}{118.9g\ mol^{-1}} = 0.000235mol$
$Mn_{(s)} \longrightarrow Mn^{+2+}_{(aq)} \longrightarrow MnO_4^-{}_{(aq)}$
1mol   1mol
0.000235mol   0.000235mol
gfm Mn = 54.9g
mass = no. of mol x gfm = 0.000235mol x 54.9g mol^{-1} = 0.01293g = 12.93mg</td>
</tr>
<tr>
<td>12a</td>
<td>0.973litres</td>
<td>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
$\text{no. of mol} = \frac{\text{mass}}{\text{gfm}} = \frac{1g}{222\ g\ mol^{-1}} = 0.00450mol$
$C_3H_6N_6O_{6(s)} \longrightarrow 3CO_{(g)} + 3H_2O_{(g)} + 3N_{2(g)}$
1mol   3mol   3mol   3mol
1mol   9mol
0.00450mol   0.0405mol
Volume = no. of mol x Molar Volume = 0.0405mol x 24litres mol^{-1} = 0.973litres</td>
</tr>
<tr>
<td>12b</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 → 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 → $4H_2O$</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 → $3CO_2$</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 → $2N_2$</td><td>2</td><td>4</td><td>3</td><td>2</td></tr>
</table>
</td>
</tr>
</table>