Past Papers Advanced Higher Chemistry

2017 Marking Scheme

Grade Awarded	Mark Required		% candidates achieving grade
	(/130)	%	
A	89+	68.5%	30.1%
B	76+	58.5%	28.5%
C	63+	48.5%	24.7%
D	52+	43.1%	7.0%
No award	<52	<43.1%	9.7%

Section:	Multiple Choice	Extended Answer	Investigation
Average Mark:	21.0 /30	38.0 /70	19.8 /30

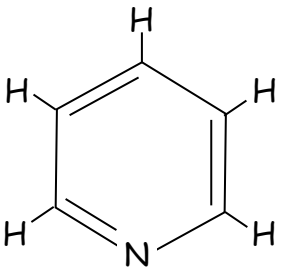
2017 Adv Higher Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	D	44	☒A Only helium is characterised by the filling of an s-orbital in outer shell ☒B most noble gases are characterised by filling of p-orbitals in outer shell but not He ☒C Neon and Argon do not have any d-orbitals ☑D He characterised by filling of s-orbital and other noble gases by filling of p-orbital
2	B	97	☒A Calcium in ground state has an electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ ☑B Scandium in ground state has an electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$ ☒C Titanium in ground state has an electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$ ☒D Vanadium in ground state has an electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
3	C	74	Mg atom has electronic configuration of $1s^2 2s^2 2p^6 3s^2$ ∴ Mg^{2+} ion is $1s^2 2s^2 2p^6$ Quantum Number: Principal n; Angular Momentum l; Magnetic m_l; Spin m_s Mg^{2+}: 2; 1; -1,0,+1; $+\frac{1}{2}$ or $-\frac{1}{2}$ ☒A outermost electron is in p-orbital where l=1 ∴m ranges from –l to +l (i.e. -1,0,1) ☒B outermost electron is in p-orbital where l=1 ☑C n=2, l=1, m_l=-1 and m_s=$+\frac{1}{2}$ is a set of quantum numbers for another e^- in Mg^{2+} ☒D Mg^{2+} ion has no 3rd shell with electron arrangement 2,8 ∴ n cannot equal 3
4	B	58	Radius ratio = $\frac{\text{Radius of positive ion}}{\text{Radius of negative ion}} = \frac{Zn^{2+}}{S^{2-}} = \frac{74}{184} = 0.40$
5	A	87	☑A 2xOH_2 ligands, 4xCl^- ligands, Co^{2+} central ion and overall charge of 2- ☒B diaqua in name of complex ion means 2xOH_2 ligands in complex ☒C cobaltate in name means the complex will have a negative charge overall ☒D diaqua in name of complex ion means 2xOH_2 ligands in complex
6	C	45	HCl (strong acid) and NH_3 solution (weak alkali) form salt with acidic pH ☒A bromothymol blue 6.0-7.6 ☒B phenolphthalein 8.2-10.0 ☑C methyl orange 3.2-4.4 ☒D phenol red 6.6-8.0
7	C	80	$pH = \frac{1}{2}pK_a - \frac{1}{2}\log_{10} c$ $= \frac{1}{2} \times (4.2) - \frac{1}{2} \times \log_{10}(0.01)$ $= 2.1 - \frac{1}{2} \times (-2)$ $= 2.1 - (-1)$ $= 3.1$
8	A	47	$\Delta G^o = \Delta H^o - T\Delta S^o$ $\Delta H^o = \Delta G^o + T\Delta S^o$ ΔH^o = -ve value + T x (-ve value) ΔH^o = -ve value + -ve value ΔH^o = -ve value
9	D	88	Experiment ❶+❷: [A] x2; [B] No Change; Effect on Rate: No effect; Order of Reactant: $[A]^0$ From rate equation rate = k $[B]^2$ ∴ B is 2nd order and A is zero order from experiment Comparing experiments 1+3: [A] is constant and [B] is doubled If B is 2nd order, doubling [B] gives a quadrupling of rate from 0.05 to 0.2mol l^{-1} s^{-1}
10	D	83	$k = \frac{\text{Rate}}{[NO_2]^2 \times [Cl_2]} = \frac{\text{mol } l^{-1} s^{-1}}{\text{mol}^2 l^{-2} \times \text{mol } l^{-1}} = \frac{\text{mol } l^{-1} s^{-1}}{\text{mol}^3 l^{-3}} = l^2 \text{ mol}^{-2} s^{-1}$

11 B 82

☒A sp^2 hybridisation contains one Pi bond
☑B sp^3 hybridisation contains only sigma/single bonds
☒C Pi bonds are found in C=C and C≡C but ethane has only single/sigma bonds
☒D Pi bonds are found in C=C and C≡C but ethane has only single/sigma bonds

12 C 53



Type of Bond	C - C	C = C	C - H	N=C	N-C
Number of bonds	2	2	5	1	1

Type of Bond		C - C	C = C	C - H	N=C	N-C
Sigma	σ	1	1	1	1	1
Pi	π	0	1	0	1	0

Sigma bonds = 2 (C - C) + 2 (C = C) + 5 (C - H) + 1 (N=C) + 1 (N-C)
= 2σ + 2σ + 5σ + 1σ + 1σ
= 11σ

13 B 83

☒A non-50% mixtures are still optically active but have a reduced activity.
☑B 50% mixtures of enantiomers cancel each other out to form a racemic mixture
☒C geometric isomers are not optically active
☒D geometric isomers are not optically active

14 D 80

Lone pair on N atom of NH_3 is attracted to δ+ of C in polar C-Br bond in CH_3CH_2Br
∴ NH_3 is acting as a nucleophile
Negative charge in OH^- ion is attracted to δ+ of C in polar C-Br bond in CH_3Br
∴ OH^- is acting as a nucleophile

15 C 89

☒A Compound A is an aldehyde which would reduce to form a primary alcohol
☒B Compound B contains a chlorine atom which would form H-Cl gas on burning
☑C Compound C is a ketone which would reduce to a secondary alcohol.
☒D Compound D C_8H_8O: gfm = (8x12)+(8x1)+(1x16) = 96+8+16 = 120g

16 D 91

Formula	Type of Amine	Boiling Point (°C)
$C_2H_5N(CH_3)_2$	Tertiary	37.5
$(C_2H_5)_2NH$	Secondary	56.3
$C_4H_9NH_2$	Primary	77.8

17 B 72

☒A propanal (aldehyde) cannot form an ester by a condensation reaction
☑B propan-1-ol oxidises to propanoic acid and both join together to form an ester
☒C propan-2-ol oxidises to form the ketone propanone which does not form esters
☒D propanoic acid (carboxylic acid) will not oxidise

18 A 82

☑A two rings of three delocalised electrons flatten benzene into a planar shape
☒B electrophiles are attracted to the rings of delocalised electrons
☒C nucleophiles are not attracted to benzene due to the delocalised electrons
☒D all 6 bonds between carbons in benzene are equal in length

19 B 30

Molecule	Chlorine Types		Mass of Chlorine in Molecule
1	3x ^{35}Cl	-	(3x35) = 105
2	2x ^{35}Cl	1x ^{37}Cl	(2x25) + (1x37) = 107
3	1x ^{35}Cl	2x ^{37}Cl	(1x25) + (2x37) = 109
4	-	3x ^{37}Cl	(3x37) = 111

20 C 50

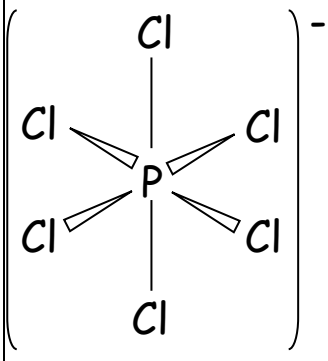
☒A 1700-1680cm^{-1} indicates presence of alkyl ketone which is found in substance
☒B 2962-2853cm^{-1} indicates presence of C-H alkane which is found in substance
☑C 3100-3000cm^{-1} indicates presence of benzene ring which is <u>not</u> found in substance
☒D 3500-3300cm^{-1} indicates presence of amine which is found in substance

21 A 70

☑A proteins are no longer made so antisense drugs are antagonists.
☒B antisense drugs bind to DNA ∴ DNA is the receptor
☒C agonists would allow the production of proteins
☒D agonists would allow the production of proteins

22	D	41	☒A silver nitrate is soluble ∴ silver nitrate unsuitable for gravimetric analysis ☒B silver sulphate is soluble ∴ potassium sulphate unsuitable for gravimetric analysis ☒C barium carbonate is insoluble so silver ions cannot precipitate ☑D silver chloride is insoluble ∴ ammonium chloride suitable for gravimetric analysis
23	A	78	Green wavelengths transmitted ∴ Red & blue wavelengths are absorbed by Ni^{2+} ions. Red and Blue light is magenta/purple ∴ 390nm is absorbed
24	C	78	Solvent Front = 8.0cm If R_f value = 0.75 then spot would be found at 0.75 x 8.0cm = 6.0cm ∴ Spot Q
25	A	74	☑A caffeine should be more soluble in solvent than tea and solvent immiscible with tea ☒B if solvent was miscible with tea then there would be no separation ☒C if solvent was miscible with tea then there would be no separation ☒D caffeine not extracted from tea if was more soluble in tea than the solvent
26	B	92	☒A This would allow a judgement of the accuracy of the original result obtained ☑B Pure Vitamin C solution of known concentration would allow a control to be obtained ☒C This would improve the accuracy of the result obtained ☒D This would allow comparison of Vitamin C content of different juices
27	B	49	$Ba(OH)_2$ **n**o. of mol = **v**olume x **c**oncentration = 0.05litres x 0.010mol l^{-1} = 0.0005mol Na_2SO_4 **n**o. of mol = **v**olume x **c**oncentration = 0.05litres x 0.010mol l^{-1} = 0.0005mol $Ba(OH)_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaOH$ 1mol 1mol 1mol 2mol 0.0005mol 0.0005mol 0.0005mol 0.001mol **c**oncentration = $\frac{\textbf{n}\text{o. of mol}}{\textbf{v}\text{olume}} = \frac{0.001\text{ mol}}{0.1\text{ litres}} = 0.010\text{mol } l^{-1}$
28	C	60	Br_2 gfm = 2x79.9 = 159.8g **n**o. of mol = $\frac{\textbf{m}\text{ass}}{\textbf{gfm}} = \frac{5.16g}{159.8g\text{ mol}^{-1}} = 3.23\times10^{-2}\text{mol}$ $C_6H_5NH_2 + 3Br_2 \longrightarrow C_6H_2Br_3NH_2 + 3HBr$ 1mol 3mol 1.06×10^{-2}mol 3.23×10^{-2}mol
29	B	72	Ibuprofen $C_{13}H_{18}O_2$ = (13x12)+(18x1)+(2x16) = 156+18+32 = 206g 300mg ibuprofen = 0.3g ibuprofen ⟷ 1 tablet 206g ibuprofen ⟷ 1 tablet x $^{206}/_{0.3}$ =687 tablets
30	A	75	$BaCl_2{\bullet}2H_2O$ gfm = (1x137.3)+(2x35.5)+(4x1)+(2x16) = 137.3+71+4+32 = 244.3g %Cl = $\frac{\text{mass of Cl}}{\text{gfm}}$ x100 = $\frac{71}{244.3}$ x100 = 29.1% ☑A These results are close enough together to be precise and accurate at 29.1% ☒B These results are not close enough to be considered precise. ☒C These results are precise but not near the accurate figure of 29.1% ☒D These results are not precise or near the accurate figure of 29.1%

2017 Adv Higher Chemistry Marking Scheme

Long Qu	Answer	Reasoning
1a(i)	Answer to include:	1st Mark: electrons promoted/excited 2nd Mark: electrons falls and energy/photon/light emitted
1a(ii)	Electron transitions between different energy levels	The various energy levels and subshells in an atom have various differences in energy between them. Each different transition will correspond to a different wavelength of light.
1b	185.9	$E = \frac{L \times h \times c}{\lambda} = \frac{6.02\times10^{23}\ mol^{-1} \times 6.63\times10^{-34}\ J\ s \times 3\times10^{8}\ m\ s^{-1}}{644 \times 10^{-9} m}$ $= 185928\ J\ mol^{-1}$ $= 185.9\ kJ\ mol^{-1}$
2a(i)	0.0304	$PCl_5 \rightleftharpoons PCl_3 + Cl_2$ 1mol 1mol 1mol 0.0420mol (reacted) 0.0420mol 0.0420mol no. of mol PCl_5 unreacted = 0.1000mol – 0.0420mol = 0.0580mol $K = \frac{[PCl_3]\,[Cl_2]}{[PCl_5]} = \frac{[0.0420] \times [0.0420]}{[0.0580]} = 0.0304$
2a(ii)	More forward reaction Value of K increases	Increase in temp favours the endothermic reaction (forward reaction) More products formed and less reactants remain $K = \frac{\uparrow [\text{Product concentrations}]}{\downarrow [\text{Reactant concentrations}]} = \uparrow$ value of K
2b(i)		$\text{electron pairs} = \frac{\text{no. of outer electrons in central atom + no. of bonds - charge}}{2}$ $= \frac{5+6-(-1)}{2} = \frac{12}{2} = 6$ electron pairs (octahedral)
2b(ii)	Greater electron repulsion from P=O	The P=O double bond has 4 electrons in it (one sigma and one pi bond) which pushes the P-Cl bonds closer together.
3a(i) Part A	-882	$\Delta H^o = \Sigma\Delta H_f^o{}_{(products)} - \Sigma\Delta H_f^o{}_{(reactants)}$ $= (2x-350) + (2x-297) - (2x-206)+(3x0)$ $= (-700 - 594) - (-412 - 0)$ $= -1294 - (-412)$ $= -882\ kJ\ mol^{-1}$
3a(i) Part B	-147	$\Delta S^o = \Sigma S^o_{(products)} - \Sigma S^o_{(reactants)}$ $= (2x44) + (2x248) - (2x58)+(3x205)$ $= 88 + 496 - (116 + 615)$ $= 584 - 731$ $= -147\ J\ K^{-1}\ mol^{-1}$
3a(ii)	6000	The reaction becomes thermodynamically feasible when $\Delta G^o = 0$ $\Delta G^o = \Delta H^o - T\Delta S^o = 0 \ \therefore\ T\Delta S^o = \Delta H^o \ \therefore\ T = \frac{\Delta H^o}{\Delta S^o} = \frac{-882 \times 1000\ J\ mol^{-1}}{-147\ J\ K^{-1}\ mol^{-1}} = 6000K$

3b — Answer to include:

1st Mark: Zinc is a gas at 1200°C and is cooled in a condenser
2nd Mark: Lead is a liquid at 1200°C and collected at bottom of container

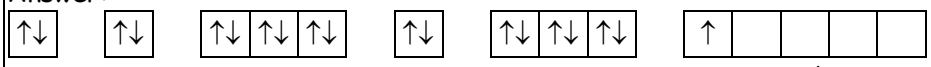
4a(i) — 4 or +4 or IV

$V + (2x-2) = 0 \quad \therefore V - 4 = 0 \quad \therefore V = +4$

4a(ii) — Diagram showing:

(V atom: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$ ∴ V in VO_2 $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$)

Answer:



4b(i) — Rate = k $[V^{3+}]$ $[Fe^{3+}]$

Rate = k $[V^{3+}]^1$ $[Fe^{3+}]^1$ = k $[V^{3+}]$ $[Fe^{3+}]$

4b(ii) Part A — Zero order Fe^{2+} only in fast step

Reactants that do not appear in the slow step do not take part in the rate determining step. These reactants are zero order.

4b(ii) Part B — Reactants and catalyst are in same state

Type of Catalyst	Definition
Homogeneous	Catalyst is in the same state as the reactants
Heterogeneous	Catalyst is in a different state to the reactants

4c — 92.3mg

71ppm = 71mg Vanadium in 1000g steel

1000g steel ⟷ 71mg Vanadium

1300g steel ⟷ 71mg x $^{1300}/_{1000}$

= 92.3mg Vanadium

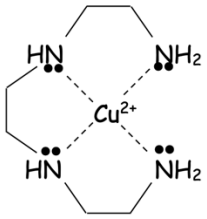
5 — Open Question to include:

3 mark answer	2 mark answer	1 mark answer
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.	Demonstrates a **reasonable understanding** of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.	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.

6a(i) — Both electrons in bond come from same atom

Dative covalent bonds are formed when a lone pair of electrons on an atom provides both electrons to form a covalent bond. One formed, a dative covalent bond is identical to the other covalent bonds.

6a(ii)



The lone pairs on the nitrogen atoms in the ligand are attracted to central Cu^{2+} ion at the centre of the complex.

6b(i) — Neutralisation

acid + metal hydroxide ⟶ salt + water

ethanoic acid + zinc hydroxide ⟶ zinc ethanoate + water

$2CH_3COOH + Zn(OH)_2 \longrightarrow Zn(CH_3COO)_2 + 2H_2O$

6b(ii) — Partial ionisation in solution

Type of Acid	Definition
Strong	Full dissociation of acid into ions
Weak	Partial dissociation of acid into ions

6b(iii) Part A — Desiccator

A desiccator is a device for holding samples in a moisture-free environment and can be used to allow samples to cool when heating a sample to a constant mass, removing any water in the sample.

6b(iii) Part B — 2

$Zn(CH_3COO)_2$ gfm = (1x65.4)+(4x12)+(6x1)+(4x16) = 65.4+48+6+64 = 183.4g

Mass of H_2O removed on heating = 5.00g – 4.18g = 0.82g

$Zn(CH_3COO)_2$	H_2O
4.18g	0.82g
1mol = 183.4g	0.82g x $^{183.4}/_{4.18}$
	=36.0 g = 2mol H_2O

6b(iii) Part C — One answer from:

Impurities present	Not fully dry/ not heated to a constant mass	Wrong product/side reactions
Sample decomposed	Reabsorbed water/ not cooled in desiccator	Different form of hydrated Zinc hydroxide used

7a(i) — Answer:

1	2	3	4
Minimum/small volume	Hot solvent/hot ethanol	Filter (to remove impurities)	Cool

All four parts required for 2 marks, two or three required for 1 mark

7a(ii) — Melting Point

Other acceptable answers:

Infra-red IR spectroscopy	Nuclear-magnetic resonance (NMR)	Mass Spectroscopy	Chromatography/TLC

7b — 0.84g

$$\text{Phenol no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.96\text{g}}{94\text{g mol}^{-1}} = 0.0102\text{mol (available)}$$

$$\text{Phthalic anhydride no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1.05\text{g}}{148\text{g mol}^{-1}} = 0.00709\text{mol (available)}$$

$$\underset{\substack{2\text{mol}\\0.0102\text{mol}\\\text{(limiting factor)}}}{2C_6H_6O} + \underset{\substack{1\text{mol}\\0.0051\text{mol}\\\text{(excess)}}}{C_8H_4O_3} \longrightarrow \underset{\substack{1\text{mol}\\0.0051\text{mol}\\\text{(theoretical 100\% yield)}}}{C_{20}H_{14}O_4} + H_2O$$

Phenolphthalein **m**ass = **n**o. of mol x **gfm** = 0.0051mol x 318g mol^{-1} = 1.62g

100% Yield = 1.62g ∴ 58% Yield = $^{58}/_{100}$ x 1.62g = 0.94g

8a(i) — $C_6H_{12}O_6$

Carbohydrate	Glucose	Fructose	Maltose	Sucrose	Starch
Formula	$C_6H_{12}O_6$	$C_6H_{12}O_6$	$C_{12}H_{22}O_{11}$	$C_{12}H_{22}O_{11}$	$(C_6H_{10}O_5)_n$
Reaction with Benedict's Solution	Blue→brick red	Blue→brick red	Blue→brick red	no reaction	no reaction

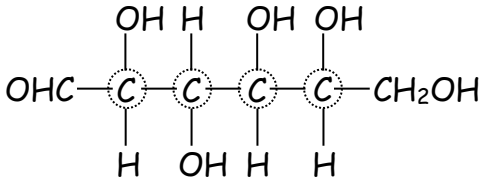
8a(ii) — One answer from:

Different number of peaks/ protons/hydrogen environments	Different shift patterns	Different splitting patterns/number of sub peaks	Different peak area/ heights/integrals

8b — Ring structure restricts rotation

Whilst there is no C=C double bond for geometric isomerism in these sugars, the ring structure prevents the rotation of the other bonds. This allows the trans-isomer (-OH groups are on opposite sides of the ring in glactose) and the cis-isomer (-OH groups are on same side of the ring in glucose)

8c(i) — 4

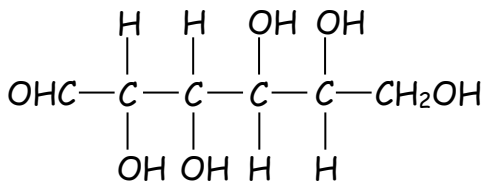


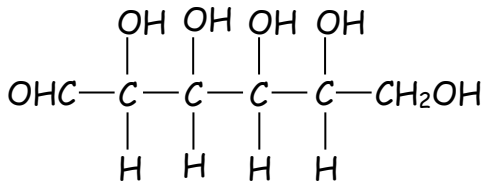
Four carbons have four different groups attached to them.
Chiral Carbons are carbons with four different groups attached to it.

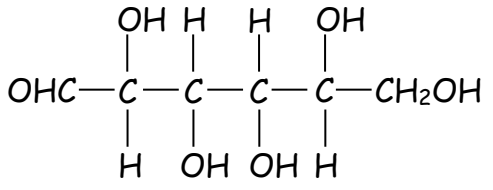
8c(ii) — One answer from:

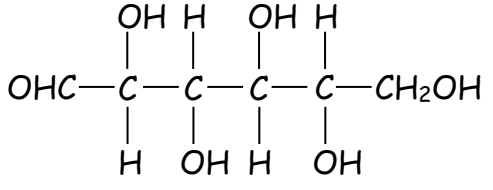
These diagrams show two groups on each chiral centre being reflected.

Other correct answers can have more than one chiral centre reflected.





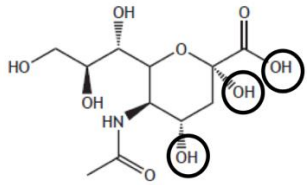




8d(i) — Hydrogen Bonding

Hydrogen bonding occurs between molecules which contain –NH, -NH_2 and -OH groups. It also occurs between H-F molecules.

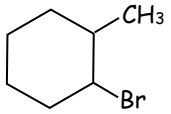
8d(ii)



(any 2 circles from 3)

The enzyme active site binds to parts of the molecule that have the ability to form hydrogen bonds (i.e. $-NH_2$ or $-OH$ groups)
There are three $-OH$ groups on the right of the molecule which would have the ability of bind to the active site (any two required in answer for 1 mark)

9a(i)



H-Br adds across the C=C double bond in an addition reaction.

9a(ii)

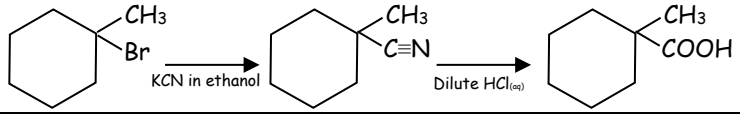
Less stable carbocation

The tertiary carbocation is the more stable carbocation and he major product has the bromine and methyl groups on the same carbon.
The carbocation which forms the minor product is less stable.

9b

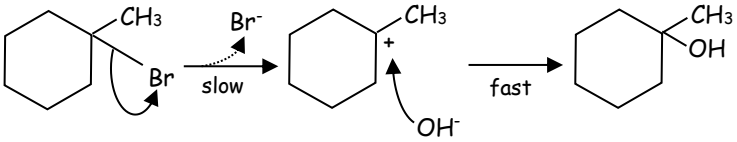
HCl(aq)/Hydrochloric acid
(or any other named dilute acid)

HCl on its own would not be correct as the acid must be dilute.



9c

Mechanism showing:



9d

One from:

1-methoxy-1-methylcyclohexane		1-methyl-1-methoxycyclohexane	
1-methylmethoxycyclohexane	methyl-1-methoxycyclohexane	1-methoxymethylcyclohexane	methoxy-1-methylcyclohexane

10a(i)

1.4×10^{-3}mol

average titre = $\frac{18.5cm^3 + 18.6cm^3}{2} = \frac{37.1cm^3}{2} = 18.55cm^3 = 0.01855$litres

MnO_4^- no. of mol = volume x concentration = 0.01855litres x 0.030mol l^{-1} = 5.565×10^{-4}mol

$$\underset{5.565\times10^{-4}\text{mol}}{\underset{2\text{mol}}{2MnO_4^-}} + \underset{1.391\times10^{-3}\text{mol}}{\underset{5\text{mol}}{5H_2O_2}} + 6H^+ \longrightarrow 2Mn^{2+} + 5O_2 + 8H_2O$$

10a(ii)

1.4

$20cm^3$ diluted stain remover $\longleftrightarrow$ 1.4×10^{-3} mol H_2O_2
$100cm^3$ diluted stain remover $\longleftrightarrow$ 7.0×10^{-3} mol H_2O_2
$5cm^3$ undiluted stain remover $\longleftrightarrow$ 7.0×10^{-3} mol H_2O_2

$$\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{7.0\times10^{-3}\text{mol}}{0.005\text{ litres}} = 1.4 \text{ mol } l^{-1}$$

10a(iii)

One answer from:

Titrate with (named) standard solution/solution of known concentration	Carry out colorimetry with a standard solution/solution of known concentration

10b

Open Question to include:

3 mark answer	2 mark answer	1 mark answer
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.	Demonstrates a **reasonable understanding** of the chemistry involved, making some statement(s) which are relevant to the situation, showing that the problem is understood.	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.

11a(i)

One answer from:

Similar polarities Both non-polar Similar intermolecular forces	Volatile Low boiling point Evaporates easily	Inert Unreactive Does not react

11a(ii)

One answer from:

To prevent vapours escaping	To allow extended heating	More vigorous heating	To dissolve/extract maximum	More efficient

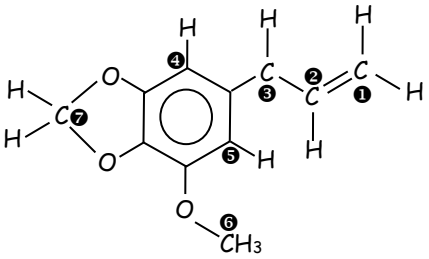
11b(i)

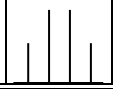
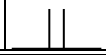
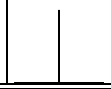
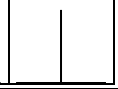
value between 4.5-6.0
(inclusive)

Proton environment 1 corresponds to $-CH=CH_2$ grouping
From Data booklet: Chemical shift at 6.0-4.5

11b(ii) — 1 or 3

Skeletal Formula ↓ Full Structural Formula



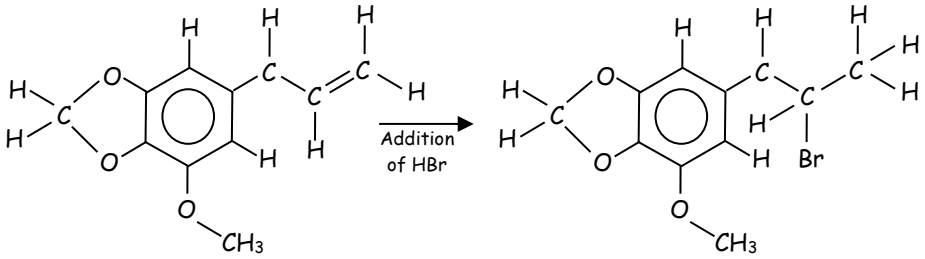
Carbon	❶	❷	❸	❹	❺	❻	❼
Number of Adjacent H	1	3	1	0	0	0	0
Peak No	Doublet	Quadruplet	Double	Singlet	Singlet	Singlet	Singlet
Diagram							

Step 1
(electrophilic) addition

Step 2
(nucleophilic) substitution

Step 1:

Addition of H-Br across C=C double bond is an electrophilic addition reaction.



Step 2:

Nucleophilic substitution of -NH_2 group for -Br