OCR
Oxford Cambridge and RSA

GCE

Chemistry B (Salters)

Unit **F332:** Chemistry of Natural Resources

Advanced Subsidiary GCE

Mark Scheme for June 2014

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

1. These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning
BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
BOD	Benefit of doubt
CON	Contradiction
	Cross
ECF	Error carried forward
I	Ignore
NAQ	Not answered question
NBOD	Benefit of doubt not given
NGE	Not good enough
RE	Rounding error
REP	Repeat
SEEN	Noted but no credit given
SF	Error in no. of significant figures
	Tick
^	Omission mark

2. **Subject-specific Marking Instructions**

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

All questions must be annotated with a tick where the mark is given (please refer to Scoris Annotations document from your Team Leader).

Additional objects: You **must** annotate the additional objects for each script you mark. If no credit is to be awarded for the additional object, please use a suitable annotation (either ^ or SEEN).

Subject-specific Marking Instructions that apply across the whole question paper to be included here.

Question			Answer	Mark	Guidance
1	a		<table><tr><th>Element</th><th>Initial oxidation state</th><th>Final oxidation state</th></tr><tr><td>Mn</td><td>+4</td><td>+2</td></tr><tr><td>I</td><td>-1</td><td>0</td></tr></table> All correct ✓✓ Two or three correct ✓	2	**ALLOW** 1 mark if all correct, but some or all signs wrong side of numbers (e.g.: 4+, 2+, 1-, 0).
1	b		$2I^- \rightarrow I_2 + 2e^-$ ✓	1	**ALLOW** multiples in balancing. **ALLOW** $2I^- - 2e^- \rightarrow I_2$ **ALLOW** e for electron (i.e.: no – charge). **IGNORE** state symbols.
1	c		Iodide (ions) **OR** I^- ✓ **EITHER:** The oxidation number / state of the given reducing agent increases **OR** (the reducing agent) causes the reduction of the oxidation number / state of the Mn (in MnO_2) (AW) ✓	2	**ALLOW** $2\ I^-$ **DO NOT ALLOW** iodine Mark independently. **EITHER: IGNORE** oxidation number values, as long as the answer says there is an increase. Answer must say increase / becomes more positive (for iodine) not just 'goes from -1 to 0' or similar **OR:** Answer must say decrease / becomes more negative (for manganese). The OR in MP2 can only be scored if the reducing agent named in MP1 is different to the chemical whose oxidation number is quoted as decreasing in MP2 (i.e.: allow chemical x in MP1, as ox. no. of chemical y goes down, but not x because x goes down).

Question			Answer	Mark	Guidance
1	d		**Grey solid** ✓	1	Both colour and 'solid' needed for mark **ALLOW** 'black' or, any combination of black and grey, but no other colours. **ALLOW** 'powder' or 'crystals' for solid **IGNORE** shades of colour, like dark or pale, and shiny etc.
1	e		Medicines / nutrient / photography / dyes / animal feeds / catalysts / antiseptic / disinfectant / table salt / printing inks / halogenoalkanes ✓	1	**ALLOW** uses of iodine and iodine compounds, including: radioactive tracer, radiation treatment, thyroid treatment, goitre treatment, water treatment / purification, sterilising, developing chromatography plates, testing for starch, etc
1	f	i	Silver nitrate / $AgNO_3$✓	1	**DO NOT ALLOW** correct name with incorrect formula **DO NOT ALLOW** just Ag^+ **ALLOW** acidified, but do not allow any other reagent, except nitric acid
1	f	ii	White precipitate / white solid / white suspension ✓ Silver chloride ✓	2	**DO NOT ALLOW** off white / cream or combinations with yellow **IGNORE** cloudy **IGNORE** changes of colour on standing **ALLOW** minor spelling errors or ppt **ALLOW** AgC*l* but not from an equation Mark independently

Question			Answer	Mark	Guidance
1	f	iii	Water may contain low concentration of chloride ions OR no chloride ions ✓ which would not give a precipitate ✓ **OR** The water may contain: iodide ✓ which would give a yellow precipitate ✓ **OR** bromide ✓ cream precipitate ✓ **OR** chromate ✓ red precipitate ✓ **OR** hydroxide / sulphide ✓ black precipitate ✓	2	**ALLOW** 'small amount' AW for concentration **ALLOW** a general comment like 'there may be other ions / salts / compounds / substances present that would give a precipitate of a different <u>colour</u>' (must have colour – or named colour – not just different precipitate) for 1 mark. Second mark depends on first, except 1 mark for: Incorrectly give iodine – allow yellow precipitate Incorrectly give bromine – allow cream precipitate
1	g	i	$1s^2 2s^2 2p^6 3s^2 3p^5$ ✓	1	**ALLOW** upper or lower case letters but numbers must be superscripts **ALLOW** [Ne] $3s^2 3p^5$
1	g	ii	$5p^5$ ✓	1	**ALLOW** upper or lower case letters but numbers must be superscripts, except **ALLOW** ecf for subscript numbers if used in (g)(i) and (g)(ii) **DO NOT ALLOW** $5s^2 5p^5$ or any other more detailed answers.
1	g	iii	Gain of electrons ✓	1	**IGNORE** references to oxidation state

Question			Answer	Mark	Guidance
1	h	i	(28.40 / 1000) x 0.200 = 5.68 x 10^{-3} ✓	1	**ALLOW** 2 or more sf
1	h	ii	Answer to (h)(i) / 2 and evaluate ✓ **OR** 2.84 x 10^{-3} ✓	1	
1	h	iii	Mass of I_2 = answer to (h)(ii) x 253.8 = 0.72(0792) g ✓ % purity = (mass of I_2 / 0.92) x 100 = 78.34(69…) % ✓ **OR** Moles of I_2 = 0.92/253.8 = 0.0036(24) ✓ % purity =(answer to (h)(ii) /moles of I_2) x 100 = 78.34(69…)% ✓	2	**ALLOW** use of 254 (=0.72g) gives final answer of 78.4% **ALLOW** final answer with 2 sf or more. 1 mark is for conversion of units, the other for % purity. If unit conversion is incorrect, mark for % purity can still be awarded. If answer to (h)(ii) is 2.84 x 10^{-3}, allow a final answer in the range 78 to 79%, which is obtained if numbers have been rounded at various stages. If answer is completely correct, except that it uses 126.9 in place of 253.8, award 1 mark (answer in range 39 – 39.5).
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Question			Answer	Mark	Guidance
2	a	i	Propan-2-ol ✓	1	**ALLOW** without dashes
2	a	ii	Ethanal ✓	1	**ALLOW** formula CH_3CHO or correct structure **IGNORE** aldehyde
2	a	iii	There is no peak/trough/absorbance between 3200 to 3640 ✓ indicating there is no O-H <u>bond</u> ✓ Two marks for: There is no peak between 3200 to 3600 that would indicate an OH bond ✓✓	2	**ALLOW** any number or range at, or above, 3200 **ALLOW** OH <u>bond,</u> but not –OH bond Ignore references to other peaks/troughs Mark independently.
2	b		Phosphoric acid / H_3PO_4 ✓ Water / steam / H_2O ✓ High temperature and pressure / 300°C and 60 atm ✓	3	**IGNORE** inert catalyst supports such as alumina **DO NOT** give the mark for phosphoric acid if answer also gives other incorrect chemicals. **ALLOW** temps 200-400°C and pressure above 1 atm **DO NOT ALLOW** if reflux also mentioned. **MP3** depends on **MP2**

Question			Answer	Mark	Guidance
2	c		1. Propanone and ethanol form hydrogen bonds / H bonds ✓ *Description of how intermolecular bonds form:* 2. Lone pair on oxygen ✓ 3. hydrogen with δ+ charge (in ethanol) **OR** partially positive charge on hydrogen (in ethanol) ✓ 4. Methylbenzene and hexane form instantaneous (dipole)-induced dipole ✓ *Description of how intermolecular bonds form:* 5. Electron movements create an uneven distribution of charge **OR** Electron movements create δ+ **AND** δ- ✓ 6. A dipole is induced in a neighbouring molecule ✓ *QWC f*or either: Linking lone pair on oxygen and δ+ H to attraction between molecules	**6** **1**	**Please use annotations in the answer in appropriate places** Throughout answer, can refer to intermolecular forces rather than intermolecular bonds **MP 2 :IGNORE** lone pair on oxygen in ethanol **MP 2 & 3: NOT** reference to hydrogen or oxygen molecules **MP 2 & 3: ALLOW** marks from a diagram, **MP 3: NOT** H is electropositive **NOT** just 'positive hydrogen' **MP2 & 3:** Can be awarded if MP1 is incorrect. **MP 4: ALLOW** van der Waals' forces but **IGNORE** id - id. **MP 5:** Both parts are needed for the mark (i.e.: e^- movement and uneven distribution of charge). **MP 5: ALLOW** 'dipole/polar' for 'uneven distribution of charge'. Does not score if it just mentions negative (or +ve) charge. **NOT** 'electron density changes' or 'electrons are orbiting / spinning / swirling' for movement (must have electrons moving, not just 'for an instant there are more electrons on one side of the molecule than the other'). **MP 5 & 6: ALLOW** references to atoms rather than molecules **MP 5 & 6:** Can be awarded if MP4 is incorrect. **Please indicate QWC using green tick or red cross on the right of the pencil icon on the answer screen**

Question			Answer	Mark	Guidance
			OR Linking instantaneous dipole and induced dipole to attraction between molecules ✓		**QWC: IGNORE** 'forming a bond' for attraction
2	**d**	**i**	Rate of forward reaction = rate of back reaction / reactants and products are formed at the same rate ✓ Concentrations of reactants and products remain constant / closed system ✓	**2**	**DO NOT ALLOW** 'forwards reaction = backwards reaction'. **DO NOT ALLOW** concentrations of reactants and products are the same/equal. If this is given, do not award MP2, even if closed system is also stated.
2	**d**	**ii**	More (ethyl ethanoate) **AND** because equilibrium has moved to the right / forward direction / products ✓ to counteract / minimise / oppose / (counter)balance (the change) **OR** to restore equilibrium ✓	**2**	Need both parts here for the mark (i.e.: the 'more' and the direction of movement). Mark independently.
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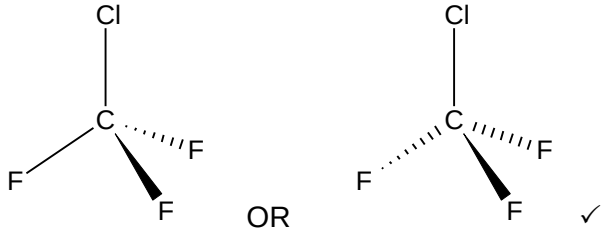
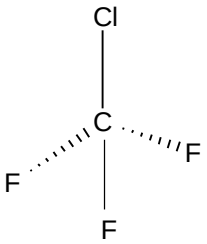
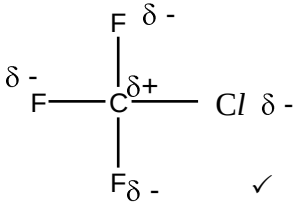
Question			Answer	Mark	Guidance
3	a	i	Chlorotrifluoromethane ✓	1	**ALLOW** trifluorochloromethane **ALLOW** minor spelling error, such as 'fluro', but not 'chlor' without second o. **ALLOW** 1 –chloro-1,1,1-trifluoromethane **OR** 1,1,1-trifluoro-1-chloromethane as only other alternatives. **IGNORE** spaces and dashes.
3	a	ii	 ✓ Bond angle 109 ^{o} ✓	2	Shape must be 3-dimensional, but allow other 3d representations, such as in a pyramid. **ACCEPT** 105 – 110 ^{o} If two bonds are shown in the same plane (as in first example) they **MUST** be next to each other for first mark. So, for example, **DO NOT ALLOW**:  **ALLOW** value in range 105° - 112° Mark independently.
3	a	iii	 ✓	1	

Question			Answer	Mark	Guidance
3	a	iv	*Two marks can be awarded for:* Fluorine and chlorine are more <u>electronegative</u> than carbon (ORA) ✓✓ *One mark for:* Mention of <u>electronegativity</u> ✓ Fluorine and chlorine have a **greater** ability to attract <u>bonding</u> electrons than does carbon (*ORA*) *AW* ✓	2	Electronegativity/ electronegativities / electronegative must be correctly spelled once for the first mark to be scored. **DO NOT ALLOW** carbon is electropositive, or if F or C*l* molecules being considered. **ALLOW** 'halogens' for 'fluorine and chlorine' If electronegativity mark is not scored, **ALLOW** 1 mark for 'fluorine and chlorine have **different** ability to attract <u>bonding</u> electrons than does carbon'.
3	a	v	C–F bond is more polar than C–C*l* bond **OR** C-F bond is of different polarity to C–C*l* bond ✓ (Molecule is) polar because, one of: the charges do not balance / do not cancel out the dipoles do not balance / do not cancel out <u>centre of</u> +/- charge do not coincide one side of molecule is more negative than the other ✓	2	**ALLOW** '(partial) charge on F greater than (partial) charge on C*l*' or 'F and C*l* have different electronegativities' or 'halogens have different electronegativities' **MP2**: Need both molecule is polar and reason. **ALLOW** 'polar because molecule is asymmetric' **IGNORE** 'polarities do not cancel out' *AW*
3	b		C–Br / CBr / carbon bromine ✓	1	
3	c	i	Homolytic / homolysis ✓ one electron (from the bond) goes to each atom **OR** <u>two</u> radicals form ✓	2	**IGNORE** 'photochemical dissociation' and photolysis. Must have two radicals, not just 'radicals'. **ALLOW** 'to form Br and CBr_3', but not if radicals are incorrect (e.g.: to form Br and C radicals) Mark independently.

Question			Answer	Mark	Guidance
3	c	ii	$7.14 \times 10^{14} \times 6.63 \times 10^{-34}$ ✓ $= 4.73 \times 10^{-19}$ (J) ✓	2	Completely correct answer on its own scores both marks Second mark depends on first, except **ALLOW** ecf only if the sole error is a mis-copy of one of the number values **ALLOW** 2sf or more but rounding must be correct **ALLOW** 4.73×10^{-22}, if also has kJ on answer line
3	c	iii	= answer to (c) (ii) $\times 6.02 \times 10^{23}$ ✓ /1000 (= (+) 284.7 kJ mol^{-1}) ✓ Answer correct to 3 s.f. (= +285 kJ mol^{-1}) ✓	3	One mark for multiplying answer to (c)(ii) by 6.02×10^{23} (Avogadro's constant) Second mark for converting the answer from J to kJ, i.e.: dividing by 1000 **ALLOW** 1 mark here if conversion has been done in cii, but not if repeated here (i.e.: do not allow ÷ 1000 twice). Calculation marks can be scored in either order, but must be correctly evaluated to score both marks Completely correct answer on its own scores all 3 marks. Award sf mark for an answer that is the correct 3sf value of a correctly evaluated calculation.
3	d		Discovery that C*l* / chlorine radical / chlorine atom can affect ozone ✓ Spectroscopic measurements showed ozone levels depleted/ lower than expected ✓ (results overlooked because) they were so low / depletion so high ✓	3	**ALLOW** 'prediction' or 'research' for 'discovery' Must be lower, not different, not just low Must mention 'spectroscopic' or one particular spectroscopic method (e.g.: IR) Must imply 'very low' or 'too low' and not just 'anomalous' or different

Question			Answer	Mark	Guidance
3	e	i	(Greenhouse gas) absorbs IR from Earth ✓ more IR absorbed ✓	2	Mark independently **MP1: ALLOW** 'absorbs IR reflected from Earth' **MP2: ALLOW** 'more IR is transferred to KE' or 'more IR is transferred to heat' *AW*
3	e	ii	There is a relationship / correlation between models of gas and models of temperature **OR** models of gas and temperatures *AW* **OR** gas concentrations and temperatures *AW*✓	1	**NOT** 'global warming' for 'temperature'. **ALLOW** amount for concentration. **DO NOT ALLOW** 'increase in concentration causes or leads to temperature increase'.
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Question			Answer	Mark	Guidance
4	a		Incomplete combustion of hydrocarbons / organic compounds (AW) ✓	1	**ALLOW** fossil fuel or named fossil fuel / carbon in the fuel / organic fuel **DO NOT ALLOW** just 'fuel' or carbon as the fuel
4	b		Toxic / poisonous / reduces the capacity of blood to carry oxygen around the body AW ✓ causes <u>photochemical</u> smog ✓	2	**ALLOW** respiratory problems, but **IGNORE** breathing problems. **IGNORE** harmful /dangerous and comments about oxidising to CO_2
4	c	i	(A particle) with one (or more) <u>unpaired</u> electron(s) ✓	1	Answer must be in the context of an electron as part of some sort of particle **IGNORE** 'free' or 'lone' or single electron **NOT** 'a radical is an unpaired electron'
4	c	ii	Propagation ✓ one radical is used and replaced by another AW ✓	2	**ALLOW** there is a radical on both sides of the equation. Mark independently.
4	c	iii	The frequency of radiation / uv is not high enough (to break the bond) **OR** Energy of radiation / uv is not high enough (to break the bond) **OR** Energy required to break bond is filtered out by the stratosphere ✓	1	**DO NOT ALLOW**: 'there is not enough high frequency uv / radiation' (i.e.: the position of the word 'enough' is key here). **DO NOT ALLOW** just 'high frequency uv is not found in the troposphere'.
4	c	iv	The concentrations of the CO and/or OH are low **OR** low abundance of the CO and/or OH **OR** few particles of the CO and/or OH **OR** few collisions of the CO and OH ✓	1	**ALLOW** 'particles' or 'molecules' for CO and/or OH **ALLOW** 'the CO and OH particles are far apart'. **NOT** just 'reactants' for 'reacting particles'. **IGNORE** comments about temperature and pressure. **IGNORE** 'less' or 'fewer' for 'few'

Question			Answer	Mark	Guidance
4	d		*SiO_2*: giant covalent / giant structure / network solid / giant lattice / whole structure held together by covalent bonds, e.g.: every silicon atom is bonded to 4 oxygen atoms **OR** diagram showing at least 2 Si with all surrounding Os ✓ *CO_2*: simple molecular / molecules / O=C=O *AW* ✓ (covalent) bonds in SiO_2 are stronger than intermolecular bonds in CO_2 (ORA) **OR** (covalent) bonds in SiO_2 need more energy to break than intermolecular bonds in CO_2 ✓	3	**NOT** giant ionic structure **IGNORE** giant molecule and references to intermolecular bonds Reference to 'oxygen molecules' **CON**s this mark **IGNORE** 'covalent' **MP3: DO NOT ALLOW** if answer is referring to SiO_2 having any type of intermolecular bond or breaking of weak covalent bonds in CO_2 **MP3**: Must be a comparison
4	e	i	80/300 x 100 = 26.7 % ✓	1	**ALLOW** any number of sf, correctly rounded
4	e	ii	ppm CO = 1.2×10^{-5} % = 0.12 ✓ 380/ppm CO (= 3.167×10^3 times more) ✓ **OR** % CO_2 = 380 ppm = 3.8×10^{-2} % ✓ % CO_2 /1.2×10^{-5} (= 3.167×10^3 times more) ✓	2	**ALLOW** any number of sf, correctly rounded 1st mark is for converting units. 2nd mark is for comparing the two concentrations. Award the second mark for a correct comparison, even if conversion is incorrect.
4	f	i	*(Problem tropospheric):* <u>photochemical</u> smog / breathing problems / respiratory problems / lung damage / toxic / greenhouse gas / weakens immune system / irritates eyes **OR** damages: rubber / paint / fibres / plants / crops ✓	2	**DO NOT ALLOW** forms smog, which is toxic

Question			Answer	Mark	Guidance
			(Benefit stratospheric): It filters/ removes/ screens/ absorbs/ blocks/ shields / (AW) uv **OR** prevents uv getting through / protects us from uv ✓		**ALLOW** prevents skin cancer
4	**f**	**ii**	Molecules are split by uv / bonds in molecules are broken AW / molecules photodissociate ✓ to form O and O_2 / oxygen radical and oxygen molecule **OR** $O_3 \rightarrow O + O_2$ ✓ **OR** (Ozone) reacts with an oxygen radical ✓ forming two oxygen molecules / $O_3 + O \rightarrow 2\ O_2$ ✓ **OR** Two from: 1. (Ozone) reacts with C*l* / Br / NO / HO 2. which catalyse ozone breakdown 3. **EITHER** $O_3 + Cl \rightarrow ClO + O_2$ **OR** $O_3 + Br \rightarrow BrO + O_2$ **OR** $O_3 + NO \rightarrow NO_2 + O_2$ **OR** $O_3 + HO \rightarrow HO_2 + O_2$ ✓✓	**2**	**ALLOW** MP1 for uv on reaction arrow or uv on LHS of reaction equation **ALLOW** 'dissociate' for 'photodissociate' **ALLOW** atom for radical. In this option, if marks come from points 1 and 3, equation must be for chemicals given in 1. **IGNORE** source of radicals – e.g.: C*l* from CFCs.

Question			Answer	Mark	Guidance
4	f	iii	Oxygen molecules are split / the bond in the O_2 molecule is broken / oxygen molecule photodissociates AW **OR** $O_2 \rightarrow 2\ O$✓ by uv radiation ✓ The O atoms react with O_2 (forming ozone) **OR** $O + O_2 \rightarrow O_3$ ✓	**3**	Mark all 3 points independently **MP2**: **ALLOW** MP2 if oxygen radical is given, but from an incorrect source (e.g.: 'breakdown of H_2O by uv gives O radical' gets MP2, but not MP1). **ALLOW** uv if given on reaction arrow of equation in MP1. **ALLOW** radicals for atoms
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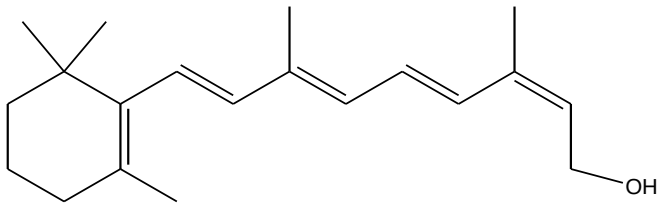
Question			Answer	Mark	Guidance
5	a		Ethanoic acid ✓	1	**ALLOW** CH_3CO_2H or CH_3COOH, but not less structured formula. **IGNORE** vinegar
5	b	i	C_8H_xO ✓ x = 14 ✓	2	C, H and O can be in any order, but answer must be a molecular formula. Mark independently
5	b	ii	Alkene ✓ Ketone ✓	2	**ALLOW** C=C **OR** 'carbon-carbon double bond' **ALLOW** carbonyl
5	b	iii	Redox ✓	1	Any clear indication scores the mark (e.g.: underlined) More than one indicated scores zero
5	b	iv	Ether ✓	1	**ALLOW** alkoxy, but not methoxy
5	c	i	 Correct orientation of molecule on C=C nearest OH ✓ Completely correct ✓	2	**MP1:** To award this mark, the diagram must show either $-CH_2OH$ as trans to the methyl group or cis to the rest of the chain (i.e.: mark can be awarded if $-CH_3$ on relevant C=C is missing, or rest of molecule is missing). 1st mark should be awarded, even if incorrect bond angles shown 2nd mark dependent on the first **ALLOW** other types of structure (e.g.: showing CH_3 groups, as in article) Diagram may show right-hand C=C pointing up and methyl down, with groups still in correct configuration.
5	c	ii	(From) red/brown (to) colourless ✓	1	Any combination of these colours, but no others **DO NOT ALLOW** 'clear' for 'colourless' **ALLOW** red/brown decolourises. **IGNORE** 'solution'

Question			Answer	Mark	Guidance
5	c	iii	$C_{20}H_{30}O + 5Br_2 \rightarrow C_{20}H_{30}OBr_{10}$ LHS of equation✓ RHS of equation✓	2	C, H, O and Br can be in any order in the formulae. **ALLOW** 1 mark for balanced equation with fewer than 5 Br_2s, provided it is added (i.e.: there is only one product)
5	c	iv	*Any two from:* Ascorbic acid / vitamin C Glucose Fructose Retinol / vitamin A ✓✓	2	
5	d		1. Malolactic fermentation **OR** conversion of malic acid to lactic acid ✓ 2. Buttery taste / less acidic taste ✓ 3. Polymerisation of flavanols ✓ 4. to proanthocyanidins **OR** to tannins ✓ 5. Reduces bitter flavour ✓ 6. QWC: relating 1 to 2 **AND** 3 to 5 ✓	5 1	**IGNORE** descriptions of initial stages of fermentation **MP1**: **ALLOW** 'malolactic acid fermentation' **MP1: NOT** 'malolactic acid to lactic acid' **MP2: ALLOW** 'less sour' for 'less acidic' **MP5**: **IGNORE** has no effect on astringent/sharp taste **QWC:** Must have both links for the mark
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