OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL CHEMISTRY

(9620)

PAPER 2
Mark Scheme

Specimen 2018

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

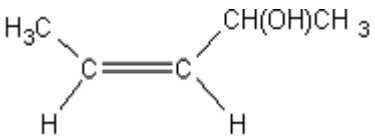
Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Marking guidance	Total marks	Comments
01.1	Pentan-2-one	1	*ONLY but ignore absence of hyphens*
01.2		1	*Award credit provided it is obvious that the candidate is drawing the Z / <u>cis isomer</u>* *The group needs to be $CHOHCH_3$ but do not penalise poor C–C bonds or absence of brackets around OH* *Trigonal planar structure not essential*
01.3	Restricted <u>rotation</u> (about the C=C) OR No (free) <u>rotation</u> (about the C=C)	1	

01.4	<table><tr><td>**M1** Tollens' (reagent) *(Credit ammoniacal silver nitrate OR a description of making Tollens')* *(Do not credit Ag^+, $AgNO_3$ or $[Ag(NH_3)_2^+]$ or "the silver mirror test" on their own, but mark M2 and M3)*</td><td>**M1** Fehling's (solution) / Benedict's *(Penalise $Cu^{2+}(aq)$ or $CuSO_4$ but mark M2 and M3)*</td></tr><tr><td>**M2** <u>silver mirror</u> OR <u>black solid or black precipitate</u></td><td>**M2** <u>Red solid/precipitate</u> *(Credit <u>orange</u> or <u>brown solid</u>)*</td></tr><tr><td>**M3** (stays) colourless OR no (observed) change / no reaction</td><td>**M3** (stays) blue OR no (observed) change / no reaction</td></tr></table>	3	If **M1** is blank CE = 0, for the clip Check the partial reagents listed and if M1 has a <u>totally incorrect</u> reagent, CE = 0 for the clip Allow the following alternatives **M1** (acidified) potassium dichromate(VI) (solution); mark on from incomplete formulae or incorrect oxidation state **M2** (turns) green M3 (stays) orange / no (observed) change / no reaction OR **M1** (acidified) potassium manganate(VII) (solution); mark on from incomplete formulae or incorrect oxidation state **M2** (turns) colourless **M3** (stays) purple / no (observed) change / no reaction In all cases for **M3** Ignore "nothing (happens)" Ignore "no observation"
01.5	**Spectrum is for Isomer 1** or named or correctly identified	1	The explanation marks in (e)(ii) depend on correctly identifying Isomer 1. The identification should be

			unambiguous but candidates should not be penalised for an imperfect or incomplete name. They may say “the alcohol” or the “alkene” or the “E isomer”

01.6	**If Isomer 1 is correctly identified, award <u>any two</u> from** • Absorption / peak in the range **<u>3230 to 3550</u>** cm^{-1} or specified value <u>in this range</u> or marked <u>correctly</u> on spectrum **and** **<u>OH</u>** group /<u>alcohol</u> group • No absorption / peak in range **<u>1680 to 1750</u>** cm^{-1} or absence marked <u>correctly</u> on spectrum **and** No absorption / peak for a **<u>C=O</u>** group / <u>carbonyl</u> group / <u>carbon-oxygen double bond</u> • Absorption / peak in the range **<u>1620 to 1680</u>** cm^{-1} or specified value <u>in this range</u> or marked <u>correctly</u> on spectrum **and** **<u>C=C</u>** group / <u>alkene</u> / <u>carbon-carbon double bond</u>	2	If 6(e)(i) is incorrect or blank, CE=0 Allow the words “dip” OR “spike” OR “trough” OR “low transmittance” as alternatives for absorption. Ignore reference to other absorptions e.g. C-H, C-O

02.1	$C_{16}H_{34} + 24.5O_2 \rightarrow 16CO_2 + 17H_2O$	1	Allow multiples Ignore state symbols in equation

02.2	Equation $N_2 + O_2 \rightarrow 2NO$ Condition Spark/(very) high temp/2500 °C – 4000 °C	1 1	Allow multiples/Ignore state symbols in equation Ignore pressure/catalyst/low % of oxygen Not just heat/hot Apply list principle eg if high temp 150 °C = 0

02.3	Equation $2CO + 2NO \rightarrow 2CO_2 + N_2$ ***OR*** $C_8H_{18} + 25NO \rightarrow 8CO_2 + 12.5\ N_2 + 9H_2O$ ***OR*** $C + 2NO \rightarrow CO_2 + N_2$ ***OR*** $2NO \rightarrow N_2 + O_2$ Catalyst Pt/Pd/Rh/Ir	1 1	Allow multiples/Ignore state symbols in equation Allow other alkane reacting with NO in correctly balanced equation Penalise contradiction of name and symbol

02.4	$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$	1	Allow multiples/Ignore state symbols in equation

02.5	$C_{16}H_{34} \rightarrow C_6H_{14} + 2C_4H_8 + C_2H_4$ ***OR*** $C_{16}H_{34} \rightarrow C_6H_{14} + C_4H_8 + 3C_2H_4$	1	<u>Do not</u> allow multiples/Ignore state symbols in equation

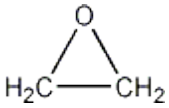
02.6	Polymers/plastics/named polymer	1	Allow polyesters or polyamides Ignore object made from polymer

Question	Marking guidance	Total Marks	Comments
03.1	**Award in either order for curve** **M1** curve is shallower than original and starts at the origin **M2** curve levels at the first line on the graph	2	"Shallower" requires line to be on the right of the original line, starting from the origin
03.2	**M1** curve would be steeper than original **M2** curve levels at the same original volume of O_2	2	""Steeper" requires line to be on the left of the original line, starting from the origin
03.3	**M1** The (concentration / amount of) H_2O_2 or reactant falls / decreases / used up ***OR*** The number of H_2O_2 or reactant molecules/ particles falls / decreases **M2** The rate of reaction / rate of decomposition / rate of formation of oxygen / frequency of collisions / (effective) collisions in a given time decreases / is slower	2	Mark independently

Question	Marking guidance	Total marks	Comments
04.1	**M1** The peak of the new curve is displaced to the right. **M2** All of the following are required • The new curve starts at the origin • The peak of the new curve is lower than the original • and the new curve only crosses the original curve once • and an attempt has been made to draw the new curve correctly towards the energy axis but not to touch the original curve • the new curve must not start to diverge from the original curve	2	M1 is low demand M2 is higher demand
04.2	**M1** Increase in the number/proportion of molecules with $E \geq E_a$ OR more molecules have $E \geq E_a$ OR more molecules have sufficient energy to react **M2** More effective/productive/successful collisions	2	Ignore "molecules have more energy" Ignore "more energetic collisions" Ignore "molecules gain activation energy" Ignore "more collisions" Accept "particles" for "molecules" but NOT "atoms" Ignore "chance of collision"; this alone does not gain M2
04.3	Iron ***OR*** Fe	1	
04.4	**M1** Catalysts provide an alternative route/pathway/mechanism ***OR*** (in this case) surface adsorption/surface reaction occurs.	2	For M1, not simply "provides a surface" alone

	M2 that has a lower activation energy ***OR*** lowers the activation energy		For M2, the candidate may use a definition of activation energy without referring to the term

05.1	Equation $2\ CH_2CH_2 + O_2 \rightarrow 2\ CH_2CH_2O$ Catalyst Silver or Ag Hazard Product is toxic Explosive / risk of explosion	 1 1 1 1	Allow multiples/Ignore state symbols in equation Accept carcinogenic / poisonous Accept highly flammable

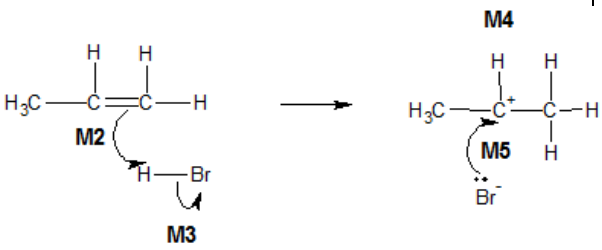
05.2	Structure  Explanation Strained bond angles / structure OR bonding pairs in the ring of atoms in the molecule are forced very close together	1 1	 Accept the bond angles are about 60° rather than about 109.5°

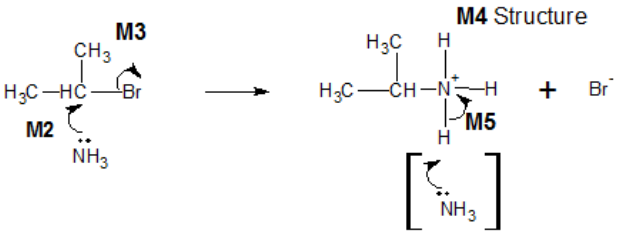
Question	Marking guidance	Total Marks	Comments
06.1	**M1** (free-) radical substitution (mechanism) **M2** $Br_2 \longrightarrow 2Br\bullet$ **M3** $Br\bullet + CH_4 \longrightarrow \bullet CH_3 + HBr$ **M4** $Br_2 + \bullet CH_3 \longrightarrow CH_3Br + Br\bullet$ **M5** **Condition** ultra-violet / uv / sun light ***OR*** high temperature ***OR*** 125 °C ≤ T ≤ 600 °C ***OR*** 400 K ≤ T ≤ 870 K	1 1 1 1 1	M1 both words required Penalise absence of dot once only. Penalise + or – charges every time Accept dot anywhere on methyl radical Accept a correct termination step for 1 mark if neither M3 nor M4 are scored; otherwise ignore termination steps Mark independently NB If Cl_2 is used, penalise every time (this may be for M2, M3 and M4) If cyclohexane is used, penalise every time (this may be for M3 and M4) For M5 ignore “heat”
07.1	A mixture of liquids is heated to boiling point for a prolonged time Vapour is formed which escapes from the liquid mixture, is changed back into liquid and returned to the liquid mixture Any ethanal and ethanol that initially evaporates can then be oxidised	1 1 1	
07.2	$CH_3CH_2OH + H_2O \rightarrow CH_3COOH + 4H^+ + 4e^-$	1	

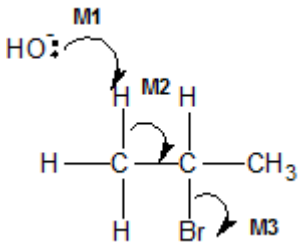
07.3	Mixture heated in a suitable flask / container	1	
	With still head containing a thermometer	1	
	Water cooled condenser connected to the still head and suitable cooled collecting vessel	1	
	Collect sample at the boiling point of ethanal	1	
	Cooled collection vessel necessary to reduce evaporation of ethanal	1	

07.4	Hydrogen bonding in ethanol and ethanoic acid or no hydrogen bonding in ethanal	1	
	Intermolecular forces / dipole-dipole are weaker than hydrogen bonding	1	

07.5	**M1** structure of a correct displayed formula of a secondary alcohol $C_5H_{12}O$	1	
	M2 displayed formula of 2-methylbutan-2-ol	1	
	M3 Observation for secondary alcohol Orange to Green	1	
	M4 Observation for tertiary alcohol Remains the same / stays orange	1	
	M5 $C_5H_{12}O + [O] \rightarrow C_5H_{10}O + H_2O$	1	

Question	Marking guidance	Total marks	Comments
08.1	**M1 <u>electrophilic addition</u>** *For **M1**, both words required*  ***For the mechanism*** ***M2** Ignore partial negative charge on the double bond* M2 must show an arrow from the double bond towards the H atom of the H–Br molecule ***M3** Penalise partial charges on H–Br bond if wrong way and penalise formal charges* **M3** must show the breaking of the H–Br bond **M5** must show an arrow from the lone pair of electrons on the negatively charged bromide ion towards the correct (positively charged) carbon atom ***<u>Maximum any 3 of 4 marks for the mechanism</u>** for wrong (organic) reactant **OR** wrong organic product (if shown) **OR** primary carbocation* **NB These are double-headed arrows**	1 4	Accept phonetic spelling Penalise once only in any part of the mechanism for a line and two dots to show a bond Accept the correct use of sticks
08.2	**M1 <u>Nucleophilic substitution</u>** *For **M1**, both words required*	1	Accept phonetic spelling The second mole of ammonia is not essential for **M5**; therefore ignore any species here Penalise once only for a line and two dots to show a bond

	 ***For the mechanism*** *Penalise **M2** if NH_3 is negatively charged* M2 must show an arrow from the lone pair of electrons **on the nitrogen atom** of an ammonia molecule to the correct C atom M3 must show the movement of a pair of electrons from the C–Br bond to the Br atom. Mark **M3** independently provided it is from <u>their original molecule</u> M4 is for the structure of the alkylammonium ion, which could be a condensed formula. A positive charge **must** be shown on / or close to, the N atom M5 is for an arrow from the N–H bond to the N atom	4	Accept the correct use of "sticks" **<u>Maximum any 3 of 4 marks for the mechanism</u>** for wrong organic reactant **OR** wrong organic product if shown Award full marks for an S_N1 mechanism in which **M2** is the attack of the ammonia on the intermediate carbocation Penalise **M3** for formal charge on C of the C−Br or incorrect partial charges on C−Br Penalise **M3** for an additional arrow from the Br to something else **NB These are double-headed arrows**

08.3	 *Penalise **M1** if covalent KOH* M1 must show an arrow from the <u>lone pair on the oxygen</u> of a negatively charged hydroxide ion <u>to a correct</u> H atom *Penalise **M3** for formal charge on C of C–Br or incorrect partial charges on C−Br.* M2 must show an arrow from a correct C–H bond adjacent to the C–Br bond to the appropriate C–C bond. Only award if an arrow is shown <u>attacking</u> the H atom of a correct C−H bond in **M1** *Ignore other partial charges*	3	Penalise once only in any part of the mechanism for a line and two dots to show a bond Accept the correct use of "sticks" for the molecule except for the C–H being attacked **NB These are double-headed arrows**

	M3 is independent provided it is from their original molecule, but **CE=0 if nucleophilic substitution** ***Maximum any 2 of 3 marks*** *for wrong organic reactant* Award full marks for an E1 mechanism in which **M3** is on the correct carbocation.		