OXFORD

INTERNATIONAL
AQA EXAMINATIONS

International A-Level **Chemistry**

CH04 – Unit 4: Organic 2 and Physical 2

Mark scheme

9620

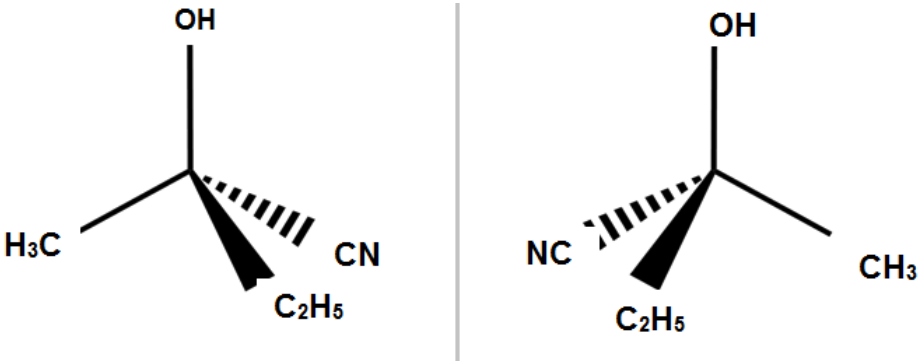
June 2018

Version/Stage: 1.1 Final

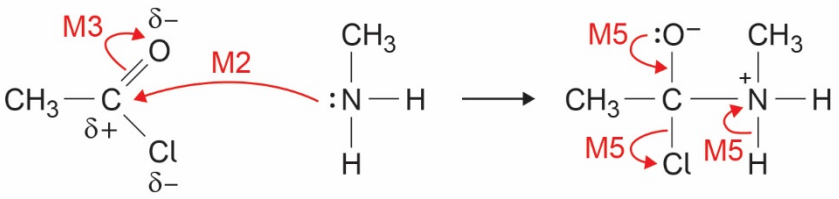
Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this 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.

Further copies of this mark scheme are available from aqa.org.uk

Question	Marking guidance	Mark	Comments
01.1	(B) Butanal (C) But-2-en-1-ol	1 1	
01.2	(Mechanism) Nucleophilic addition (Enantiomers) or 2D equivalent mirror images. 	1 2	
01.3	(Test) Add bromine water (Observation) decolourises with C and no visible change with A	1 1	Allow addition of acidified/H^+ potassium dichromate(VI) (orange to) green with C and no visible change with A
	Total	**7**	

Question	Marking guidance	Mark	Comments
02.1	Any two of: • Reactions less vigorous – easier to control • Reaction less exothermic • Product formed not poisonous or corrosive • Cheaper • Less vulnerable to hydrolysis • Anhydride safer to store • Anhydride is less corrosive	2	
02.2	(Step 1) dissolve in <u>minimum</u> (volume of) <u>hot</u> solvent (Step 3) cool (to crystallise) (Step 5) wash with cold solvent	1 1 1	
02.3	melts sharply value agrees with data book value.	1 1	Either order Allow correct answers relating to named spectroscopy technique

02.4	(mechanism) nucleophilic addition-elimination	1	
	M2 arrow from lone pair on N to (δ+) C	1	
	M3 curly arrow from C=O to O	1	
	M4 correct intermediate <u>and</u> charges	1	
	M5 three correct curly arrows to eliminate Cl^- & H^+ and reform C=0	1	Can be over two intermediates
			

02.5	(reaction 1)		Reactions can be in either order
	C_2H_5CN/propanenitrile	1	
	Nickel <u>and</u> hydrogen catalyst or $LiAlH_4$ <u>and</u> dry ether	1	Ignore heat/pressure
	(reaction 2)		
	bromopropane/chloropropane	1	
	<u>excess</u> ammonia	1	

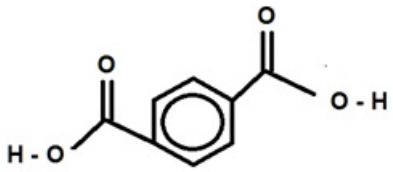
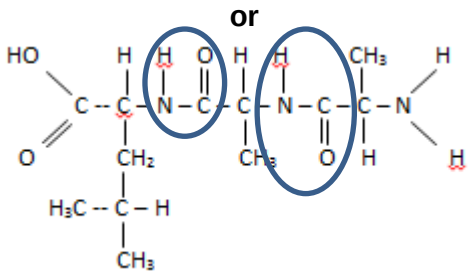
	Total	**16**	

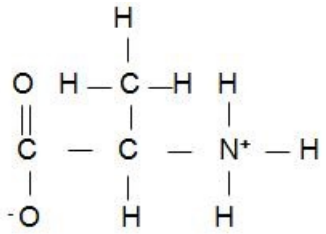
Question	Marking guidance	Mark	Comments
03.1	the time taken for a component to travel through the coiled tube OR the time taken for a component to travel between the injection point and the detector	1	Allow time taken to travel through the apparatus
03.2	(two) areas under peaks are the same	1	
03.3	(nitrogen) is inert/unreactive/less reactive (than oxygen)/would not react with components OR (oxygen) is more reactive/would react with components/would cause combustion	1	
03.4	Aluminium oxide	1	
03.5	oxygen is more electronegative than carbon/O-C bond is polar the molecule is not symmetrical so bond polarities do not cancel	1 1	

03.6	(compound) E or trichloroethanoic acid or Cl_3CCOOH	1	
	(reason) E has the most polar bonds/is the most polar compound	1	

03.7	(increasing the column temperature) decreased	1	In all cases, accept equivalent wording such as shorter/smaller/lower/longer/bigger/greater
	(decreasing the column length) decreased	1	Allow faster/slower
	(decreasing the carrier gas flow rate) increased	1	

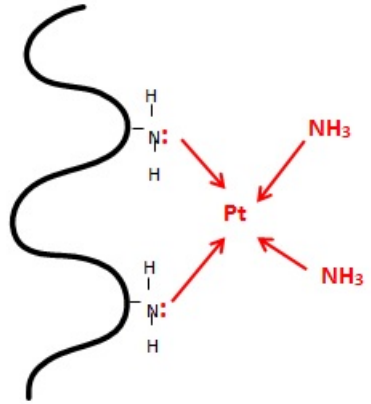
	Total	**11**	

Question	Marking guidance	Mark	Comments
04.1		1	Must show all O-H bonds If not skeletal formula – max 1
		1	
04.2	Ester / C=O bonds are polar	1	
	(polar bonds) will hydrolyse / react with water	1	
	C-C bonds are non-polar / harder to break	1	
04.3	circle around one -NH-CO- 	1	

04.4		1	

04.5	Secondary	1	

04.6	N and O both very electronegative or C=O and N–H are polar Lone pair on O attracted to the $^{\delta+}$H of N-H hydrogen bond formed	1 1 1	

04.7		1	

04.8	Distorts the shape Prevents replication	1 1	

	Total	**14**	

Question	Marking guidance	Mark	Comments
05.1	Benzene is <u>more stable than cyclohexatriene</u>	1	more stable than cyclohexatriene must be stated or implied If benzene more stable than cyclohexene, then penalise M1 but mark on If benzene less stable: can score M2 only
	Expected $\Delta H^{\ominus}$ hydrogenation of C_6H_6 is 3(–120) = –360 kJ mol^{-1}	1	Allow in words eg expected $\Delta H^{\ominus}$ hydrogenation of benzene is three times the $\Delta H^{\ominus}$ hydrogenation of cyclohexene
	Actual $\Delta H^{\ominus}$ hydrogenation of benzene is (152 kJ mol^{-1}) less than expected	1	Ignore energy value
	Because of delocalisation **or** electrons spread out **or** resonance	1	

05.2	Concentrated HNO_3 Concentrated H_2SO_4	1 1	If either or both concentrated missing, allow one mark

05.3	Mass of benzene (at start) Mass of phenylamine (produced)	1 1	

05.4	Lone or electron <u>pair on N</u> **Either** Less available in phenylamine due to delocalisation **OR** More available in hexylamine due to inductive effect of alkyl group	1 1	

	Total	**10**	

Question	Marking guidance	Mark	Comments
06.1	(only) slightly dissociated / ionised	1	Ignore 'not fully dissociated'. Allow low tendency to dissociate or to lose/donate a proton. Allow shown equilibrium well to the left.
06.2	M1 $[OH^-] = 2 \times 0.0120 = 0.0240$	1	If ×2 missed or used wrongly can only score M3 for correct calculation of pH from their $[H^+]$.
	M2 $[H^+] = (1x10^{-14} \div 0.240 =) = 4.166 \times 10^{-13}$ OR pOH = 1.62	1	
	M3 pH = <u>12.38</u>	1	pH must be to 2dp
06.3	M1 $K_a = \frac{[H^+]^2}{[C_6H_5COOH]}$ **OR** with numbers	1	
	M2 $[H^+] = \sqrt{(6.31 \times 10^{-5} \times 0.0120)} = 8.70 \times 10^{-4}$ OR $= \sqrt{(K_a \times [C_6H_5COOH])}$ $(= \sqrt{(7.572 \times 10^{-7})}$ $(= 8.70 \times 10^{-4})$	1	
	M3 pH = <u>3.06</u>	1	pH must be to 2dp

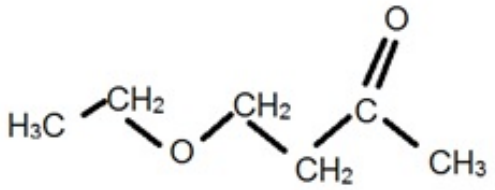
06.4	M1 $[H^+] = \frac{Ka \times [HA]}{[A]}$	1	May be shown later with numbers
	M2 Moles C_6H_5COONa = 1.09 / 144 = 7.569×10^{-3}	1	
	M3 $[C_6H_5COO^-] = 7.569 \times 10^{-3} / (200/1000)$ = 0.03785	1	
	M4 $[H^+] = 6.31 \times 10^{-5} \times 2.4 \times 10^{-3} / 0.03785$ (= 4.001×10^{-6})	1	
	M5 pH (= $- \log_{10} 4.001 \times 10^{-6}$) = <u>5.40</u>	1	Must be to 2 decimal places

	Total	**12**	

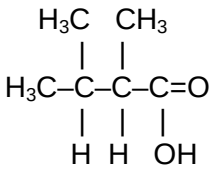
Question	Marking guidance	Mark	Comments
07.1	Any two of • one/single peak/signal OR all H/C in same environment OR 12 equivalent H/4 equivalent C • upfield/to right of other peaks OR well away from other peaks OR does not interfere with other peaks • low boiling point/volatile OR easily removed	2	NOT non-toxic (in stem) NOT inert (in stem)
07.2	CH_3–C=O | OR R–C=O | H –C– H | H	1	Ignore any group joined on other side of CO/missing trailing bond

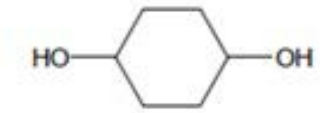
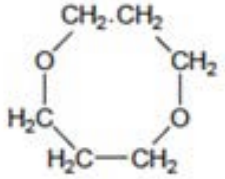
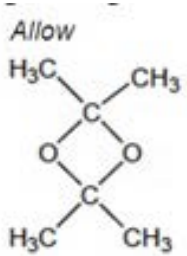
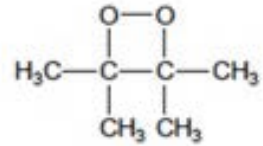
07.3	$CH_3–CH_2–O–$	1	Ignore any group joined on other side of O/missing trailing bond

07.4	$–O–CH_2–CH_2–C(=O)–$	1	Ignore any group joined on other side of CO/missing trailing bond

07.5		1	

07.6	$H_3C–C(CH_3)(OCH_3)–C(=O)–CH_3$ $H_3C–C(=O)–O–C(CH_3)(CH_3)–CH_3$	1 1	Isomers can be in either order Accept less detailed structural formulae

07.7		1	Accept less detailed structural formulae

07.8	 *OR* 	1	*Allow*  OR 

	Total	**10**	