GCE

Chemistry B (Salters)

H433/03: Practical skills in chemistry

Advanced GCE

Mark Scheme for Autumn 2021

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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.

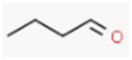
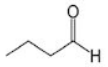
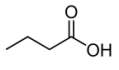
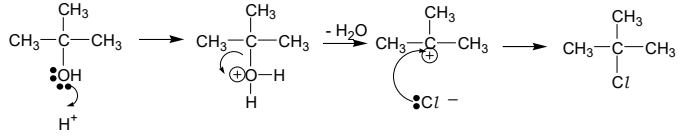
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

1. Annotations available in RM Assessor

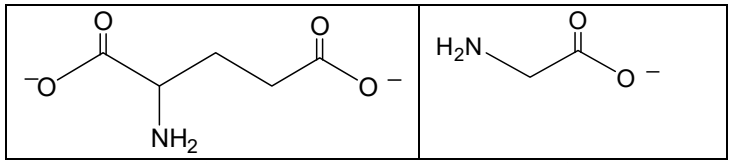
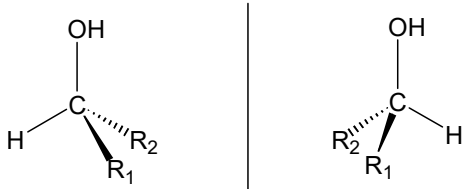
Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

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

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
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

Question			Answer	Mark	AO	Guidance
1	(a)		Tollens' reagent/Ammoniacal silver (nitrate) ✓  or  ✓  ✓ red / orange (precipitate/solid) ✓	4	1.2 2.1,2.1 2.3	**ALLOW misspellings that are clearly meant to be Tollens e.g. Tollings** **Not** silver nitrate alone, **but** allow ammoniacal silver nitrate/silver nitrate + ammonia **ALLOW one** mark if two correct structural (but not skeletal) formulae used **ALLOW** colour change on its own
1	(b)		(butan-2-ol is) secondary; ✓ Secondary: two 'R' groups/ carbon atoms **OR** (only)1 hydrogen attached to the C with the OH ✓	2	2.5 1.2	
1	(c)		 Each arrow ✓✓	2	 2 x 2.1	Arrows should start at bond/lone pair and finish at + ve charge. If extra arrows any extra are a **CON** of one mark.

1	(d)		*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5 – 6 marks)** Detailed instructions on how to separate chloroalkane and remove all impurities. Including most of fine detail *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3 – 4 marks)** Detailed instructions (with most of fine detail) on two of main procedural techniques **OR** general instructions on at least three (i.e. little fine detail but all main procedures discussed) *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1 – 2 marks)** General instructions on at least one area with little or no fine detail *There is some attempt at a logical structure with a line of reasoning. The information present is in the most part relevant.* **Level 0 (no marks)** *No response or no response worthy of credit*	**6**	**3.3(x3)** **3.4(x3)**	**Indicative scientific points may include:** **Main points and (*fine detail*)** **Separation** • transfer to separating funnel • *(chloroalkane will form top layer)* • run off lower aqueous layer • **ALLOW** pipette off top organic layer **Removal of acid impurities** • shake organic product with sodium hydrogen carbonate solution (ALLOW sodium carbonate solution) • *(add small volumes at a time)* • *(release pressure of CO_2)* • *(keeping adding until no effervescence)* **Removal of water** • transfer upper/organic layer to conical flask • add anhydrous sodium sulfate/calcium chloride/magnesium sulfate/other suitable drying agent • *(swirl mixture)* • *(decant off liquid)* **Obtaining pure chloroalkane** • distillation • collect liquid at boiling point of product
			Total	**14**		

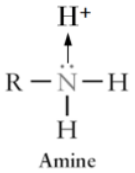
Question			Answer	Mark	AO	Guidance
2	(a)		**primary** - sequence/order of amino acids ✓ **secondar**y (folding of 1^{y} structure into) {β} (sheet) and {α} (helices) ✓ **tertiary** - folding of secondary structure/ sheets and helices ✓	3	3 x 1.1	**NOT** chain Mention of α and β - BOD mark **ALLOW** 3D structure of (entire) protein / overall structure
2	(b)	i	dashed line is bond/part of molecule going behind/into plane of paper/faces backwards wedge bond/part of molecule coming out/in front of plane of paper/faces forwards ✓	1	1.1	Both explanations required to score mark
2	(b)	ii	 ✓ ✓	2	2 x 2.7	
2	(c)	i	a part of a molecular structure that is responsible for a particular biological or pharmacological/medicinal activity/AW ✓	1	1.1	
2	(c)	ii	 ✓ chiral - asymmetric/a part of structure giving rise to asymmetry ✓ enantiomers - non-superimposable <u>mirror</u> images ✓	3	1.1 2.1 2.2	**ALLOW** any correct object and mirror image. **ALLOW** dotted lines instead of dotted wedges. **ALLOW**  etc If there are two ordinary lines (as opposite) they **<u>must not</u>** <u>be at 180^{o} to each other.</u> **ALLOW** carbon with 4 <u>different</u> groups/atoms attached. Read other as different. **<u>NOT</u>** just cannot be superimposed

2	(c)	iii	active sites also chiral ✓ cannot interact/fit with receptor/active sites ✓	2	2 x 3.2	Mark separately ORA
2	(d)		first order only initially/lower substrate concentration ✓ because rate proportional to concentration ✓ graph flattens, zero order at high ✓	3	3 x 3.2	CHECK graph, answer sometimes written there
			Total	15		

Question			Answer	Mark	AO	Guidance
3	(a)	i	$Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ ✓	1	2.5	**IGNORE** state symbols; must be balanced
	(a)	ii	purple: solution of iodine in cyclohexane brown: solution of iodine in water/aqueous solution of iodine ✓	1	3.1	Use of ions **CONS** mark ALLOW I_3^- (aq)
3	(b)	i	**CHECK ANSWER ON ANSWER LINE** **If answer = 144 mg, award 4 marks** mole $S_2O_3^{2-}$ = 0.0142 x 0.001 = 1.42 x 10^{-5} ✓ mole I_2 from 25 cm^3 = above ÷ 2 = 0.71 x 10^{-5} total moles of iodide in 25 cm^3 = 0.71 x 10^{-5} x 4 = 2.84 x 10^{-5} ✓ concentration =above x 40 = 1.136 x 10^{-3} mol dm^{-3}✓ mg dm^{-3} = above x 126.9= 0.1442g = 144 mg dm^{-3} to **3sf's** ✓	4	3 x 2.4 3.1	**ALLOW** ecf at all stages Look for /0.025 instead of x 40 If not 3sf - **CON**
3	(b)	ii	S oxidation state changes from +2 to +2½ ✓ increase in oxidation state/number is oxidation ✓	2	2 x 2.8	
3	(c)		Iodine: (diatomic) (small) molecule ✓ Potassium iodide: (giant) ionic (lattice) ✓ Polar water molecules attracted to +ve and -ve ions in KI ✓ Little interaction/id-id with non-polar iodine molecule and water✓	4	1.2 2.1 2.1 2.2	**ALLOW** simple aka 'small'
			Total	12		

Question			Answer	Mark	AO	Guidance
4	(a)	(i)	$[H^+] = \sqrt{Ka} \times [propanoic\ acid]$ $= \sqrt{1.3 \times 10^{-5} \times 0.5} = 2.55 \times 10^{-3}$ ✓ pH = -log above = 2.59/2.6 (not 2.5)✓	2	2 x 3.1	**4(a)(i), 4(a)(ii) and 4(c) need pH as answer**
		(ii)	conc HCl = 20 x 0.05/50 = 0.02 ✓ pH = -log above = 1.7, so correct ✓	2	2 x 3.1	**Second mark dependent on first being scored (ecf based on pH = -log[H^+] only allowed once (i.e. on 4a(i))**
	(b)		$C_2H_5COO^- + H_2O \rightleftharpoons C_2H_5COOH + OH^-$ ✓ $C_2H_5COO^-$ (accepting protons/H^+ therefore) behaving as an base ✓ conjugate acid <u>propanoic acid</u> (molecule) ✓	3	1.2 2.5 2.6	**ALLOW** structural formulae **ALLOW** with Na^+ Must have ⇌
	(c)		amount C_2H_5COONa = 2.4/96 = 0.025 mol ✓ $[H^+] = K_a \times \frac{[acid]}{[salt]}$ (AW) ✓ $[H^+] = 1.3 \times 10^{-5}$ x **either** mole ratio 0.015/0.025 **or** concentration ratio 0.5/0.833 ✓ $= 7.8 \times 10^{-6}$, so pH = 5.1 ✓	4	4 x 3.2	**Do not** allow ecf if already used on 4(a) **Allow** with values in H^+ expression

4	(d)*		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5 – 6 marks)** Selects mixture as buffer (and not other two) with most 'choice' points. Adds most explanation points with most equations. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3 – 4 marks)** Selects mixture (and not other two) as buffer with some choice points and some explanation points *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1 – 2 marks)** Not clear which is buffer but gives some relevant points from choice and explanation/equations **OR** Selects mixture as buffer and gives some other relevant points *There is some attempt at a logical structure with a line of reasoning. The information present is in the most part relevant.* **Level 0 (no marks)** *No response or no response worthy of credit*	**6**	**2 x 3.1** **2 x 1.2** **2 x 2.2**	**Indicative scientific points may include:** **Choice of buffer solution (AO3.1)** • **Mixture/Solution C is buffer** since it resists changes in pH on: • addition of small amounts of acid • addition of small amounts of alkali • dilution • Acid and Base/salt not buffers since vary when changed as above. **Explanation of how a buffer works (AO1.2/2.2)** • C_6H_5COOH reacts with any added hydroxide ions • $C_6H_5COOH + OH^- \rightleftharpoons C_6H_5COO^- + H_2O$ • $C_6H_5COO^-$ reacts with any added H^+ ions • $C_6H_5COO^- + H^+ \rightleftharpoons C_6H_5COOH$ • maintains pH if conc. of conjugate acid and base both large. • $[H^+] = K_a \times \frac{[acid]}{[salt]}$ • All these for mixture, only first two for acid and base separately

	e		amines are proton/H^+ acceptors✓  **OR** lone pair of electrons on N ✓	**2**	**1.1** **2.1**	base as proton acceptor / electron pair donator proton/ H^+ acceptor shown by equation second mark for idea that it is lone pair on N atom that can form (dative) bond to H^+
			Total	**19**		

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