GCE

Chemistry B (Salters)

H433/03: Practical skills in chemistry

Advanced GCE

Mark Scheme for June 2019

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

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

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

Subject-specific Marking Instructions

INTRODUCTION

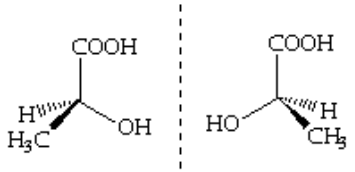
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

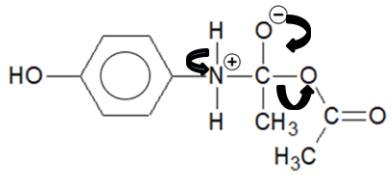
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Mark	AO element	Guidance
1	(a)		(A molecule that has) non-superimposable mirror images ✓ correct **3D** structural formula shown $CH_3CH(OH)COOH$ ✓ correct use of wedges (dots) and dashes to show mirror images✓	3	1.1 2.1 x2	Ignore references to C has four different groups.  would score MS2 and 3 **One mark scored for one of above structures** **Don't worry about reflections of –OH, -COOH and etc.** **DO NOT ALLOW** two 'lines' at 180
1	(b)	(i)	ester ✓ hydrolysis ✓	2	1.1 2.5	**DO NOT ALLOW** Polyetser **DO NOT ALLOW** Hydration
1	(b)	(ii)	permanent dipole – permanent dipole ✓ difference in electronegativity between C and O cause permanent dipole to be present AW ✓	2	2.1 x2	**ALLOW** omission of one 'permanent' but not abbreviations **ALLOW** 'O is more electronegative than C' / implied if C, O δ^+ δ^- electronegative point is implied DO NOT ALLOW general references to electronegativity e.g. Oxygen has a high electronegativity - must be compared to C
1	(c)		1. Adsorption of reactant(s) (molecules) on catalyst surface 2. Bonds break (within reactants/ intramolecular bonds break) 3. <u>New</u> bonds form 4. Desorption/diffusion/release off surface of catalyst of product(s) (molecules)/leaves catalyst surface **All correc**t 2 marks ✓✓ **Three correct** 1 mark ✓	2	1.1 x2	**ALLOW** reactants/molecules form bonds with <u>surface of catalyst</u> **DO NOT** allow catalyst adsorbed to reactant's surface Ignore bonds weaken **DO NOT** allow bonds **between** reactants/intermolecular bonds Don't worry about where <u>new</u> bonds form Ignore references to activation energy If discussion in terms of enzymes – max 1 mark Remember not ticks for each step – colour dot

Question			Answer	Mark	AO element	Guidance
2	(a)		phenol ✓ (secondary) amide ✓	2	1.2 x2	**ALLOW** hydroxyl group **NOT** alcohol
2	(b)		electrophilic substitution ✓ reduction ✓	2	2.3 x2	**ALLOW** nitration
2	(c)		Keep away from flames ✓ **AW** Use in fume cupboard/well ventilated lab ✓ Wear (protective) gloves ✓	3	3.2 x3	**Allow** (lit) Bunsen burners/sparks **IGNORE goggles**
2	(d)		 ✓	1	2.5	Curly arrows must start at any point on the correct bond or negative charge and point to the correct atom or bond.
2	(e)	(i)	vacuum filtration/filtration under reduced pressure/suction filtration ✓ **AND** **Any two from:** Moisten/damp(en) filter paper /wash paper with water✓ wash solid/paracetamol with water ✓ suck dry / sucks to remove water/solvent✓ crude paracetamol/solid left (on filter paper/in funnel) ✓	3	2.7 3.4 x2	Allow the word “pull” rather than “suck” In flask is a **CON**
2	(e)	(ii)	much quicker/faster ✓	1	3.2	

Question			Answer	Mark	AO element	Guidance
2	(f)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** If answer = 52 (%) award 3 marks 2.1g of 4-aminophenol produces maximum 2.1 x 151/109 = 2.9 (g) ✓ % yield = 1.5/2.9 x 100(= 51.72) ✓ = 52(%) (2 sig figs.) ✓	**3**	**2.8 x3**	**ALLOW** ecf **ALLOW** 3 or more sf for second mark **OR** 2.1 g of aminophenol = 0.0193 mols (from 2.1 g/109) 1.5 g of paracetamol = 0.010 mols (from 1.5 g/151) % = 0.010/0.0193 x 100 (51.81) = 52(%) An answer of 51% can be achieved by not rounding - lookout
2	(g) *		*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)** Majority of indicative scientific points used as evidence from each spectrum to identify the compound as paracetamol. *There is a well-developed line of reasoning which is clear and logically structured.* **Level 2 (3-4 marks)** Some evidence from each spectrum used to identify the compound as paracetamol. **OR** Detailed evidence from two of the spectra used to identify the compound as paracetamol. *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)**	**6**	**3.1 x 4** **3.2 x 2**	**Indicative scientific points include:** **Information from IR** • absorption at ~ 1650 suggests C=O present (cannot be 4-aminophenol) • big absorption around ~3300+ suggests presence of phenolic OH and/or NH (cannot be ethanoic anhydride or ethanoic acid) **Information from ^{1}Hnmr** • 5 unique proton environments (so cannot be other structures which have 4, 2 and 1 proton environments) • number of protons in ratio 3;2;2;1;1 • representing CH_3 two sets of 2 H's on ring and a single OH and NH on paracetamol (can be shown on annotated structure) **Information from ^{13}Cnmr** • 6 unique carbon environments • cannot therefore be reactants or ethanoic acid (too many carbon) ORA paracetamol • C=O; 4 groups of aromatic Cs

Question			Answer	Mark	AO element	Guidance
			Detailed evidence from one of spectra to identify the compound as paracetamol. **OR** Some evidence used from two of spectra to identify the compound as paracetamol. **OR** Evidence from all spectra but compound not identified as paracetamol. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant*. **0 marks** No response or no response worthy of credit.			Look for any evidence on the spectra i.e. annotations At Level 3 it would be expected that explanations of why it cannot be a specific substance would be included If paracetamol not identified (name or structure) can only score L1
	(h)	**(i)**	CH_3COOH/CH_3CO_2H ✓ CH_3CO✓	**2**	**2.2 x2**	**Ignore presence or not of + charge** **DO NOT ALLOW simple molecular formula e.g. C_2H_3O**
	(h)	**(ii)**	peak at 61 is M_r + 1 caused by $^{13}C/C^{13}$ isotope in molecule ✓	**1**	**2.2**	**ALLOW** one carbon in structural formula identified as ^{13}C / C^{13} If ^{2}H is mentioned it isn't wrong i.e. 1 mark

Question			Answer	Mark	AO element	Guidance
3	(a)		solution that resists/opposes/prevents changes in pH / maintains / minimizes pH change✓ on addition of small amounts of acid or alkali ✓	2	1.1	 Allow *and* instead of **or**
	(b)		$[H+] = Ka \times [HA]/[A–]./K_a = [H^+][A^-]/[HA]$ ✓ ([HA] = [A⁻]) to gain the second marking point this has to be shown, words or numbers pH = pKa = 4.8 ✓	2	2.8	Mark independently can be shown with same numbers i.e. 0.1 for both **N.B.** do not give 2 marks for just seeing 4.8
	(c)		$CH_3COO^- + H2O \rightleftharpoons CH_3COOH + OH^-$ ✓ $CH_3COO^- + H^+ \rightleftharpoons CH_3COOH$ ✓ excess OH^- means solution alkaline **AW** ✓	2	2.5	**DO NOT ALLOW** 'irrelevant' equations including $NaCH_3COO \rightarrow Na^+ + CH_3COO^-$ **IGNORE** state symbols **ALLOW** arrow in equation Needs to imply concentration of $OH^- > H^+$
	(d)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 11.7 award 3 marks / 12 award 2 marks unless 12 is rounded from 11.7 in which case still 3 marks** $[H^+] = \frac{K_w}{[OH^-]}$ ✓ / $[H^+] = \frac{10^{-14}}{[OH^-]}$ ✓ $= \frac{1.00 \times 10^{-14}}{0.005}$ $(= 2.00 \times 10^{-12})$ ✓ $pH = -\log(2.00 \times 10^{-12}) = 11.7$ ✓	3	2.4	**ALLOW** ecf **ALLOW** one or more decimal places but see below If answer given as 12 ALLOW two marks
	(e)		• NaOH in burette • Pipette 25 cm^3 ethanoic into beaker/conical flask • measure pH with a pH meter • run in 5cm^3 volumes at a time • smaller / 1 cm^3 volumes when pH starts to change rapidly Any four scores three marks (✓✓✓)	3	3.3 3.4 x2	

Question			Answer	Mark	AO element	Guidance
			Any three scores two marks (✓✓) Any two scores one mark (✓)			

Question			Answer	Marks	AO element	Guidance
4	(a)		iron compound(s) only gradually coming out of spinach into solution/takes time for iron compounds to dissolve **ORA**	**1**	**3.2**	Look for change in concentration over **time / time** implied
	(b)	**(i)**	Average of 7.95 and 8.05 / concordant titres	**1**	**3.4**	
	(b)	**(ii)**	mol MnO_4^- = 5.0 x 10^{-6} x 8.00 x 10^{-3} = 4.0 x 10^{-8} ✓ mol of 'iron 'in original solution = 4.0 x 10^{-8} x 5 x 10 = 2.0 x 10^{-6} ✓ mass = above x 55.8 =1.12 x 10^{-4} g = 0.112mg ✓ Mass in100g = 0.112 x $\frac{100}{5.1}$ = 2.196mg **AND** 'not high' (ora) ✓	**4** **3.1**	**2.8 x3**	**ALLOW** numbers to 2 or more sf. **ALLOW** ecf throughout For 100/5.1 allow **20** in the calculation The last mark is for the conversion to mg in 100g **AND** not high (ecf would still apply) (However, note some students have converted the mg to a % by mass iron i.e. 0.00219 is less than 0.004 – this fine)
	(c)	**(i)**	tolerance on titre 2 x 0.05cm^3 = 0.10 **AND** %error = $\frac{0.10}{8.05}$ x 100 = 1.24(%) ✓	**1**	**2.8**	**ALLOW** 1.2 (%)
	(c)	**(ii)**	greater mass of spinach ✓ lower concentration of MnO_4^- ✓	**2**	**3.4**	**NOT** bigger leaves **ALLOW** larger/greater volume of iron/spinach solution
	(d)*		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*	**6**	**1.2 x4** **3.1 x2**	**Complex ions:** • Central metal ion

Question			Answer	Marks	AO element	Guidance
			Level 3 (5 – 6 marks) Detailed explanation of the structure of complex ions. **AND** Detailed explanation of the origin of colour and why there are different colours. **AND** Gives at least one example from the titration in the Insert. *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)** An explanation of the structure of complex ions. **AND** An explanation of the origin of colour and why there are different colours. **AND** Gives at least one example from the titration in the Insert. **OR** Detailed explanation of the structure of complex ions. **AND** Detailed explanation of the origin of colour and why there are different colours. **OR** Detailed explanation of the structure of complex ions. **AND** Gives at least one example from the titration in the Insert. **OR** Detailed explanation of the origin of colour and why there are different colours. **AND**			• Ligands • Co-ordinate(dative) bonds to central metal **Colour:** • d-orbitals • splitting of d orbitals • gap of magnitude/right size to allow.. • absorption of energy in visible/light energy…. • causes electrons move to higher/excited level/shell • frequency absorbed $\Delta E = hv$ • colour seen is complementary colour/due to missing wavelength/frequency **Different colours:** • Different gaps in d split orbitals • Different wavelengths/frequency absorbed • Gives different complementary colours *Fine detail* • Gap size affected by different ligands • Gap size affected by central metal ion • Gap size affected by oxidation state **Examples** MnO_4^- /$[Mn(H_2O)_6]^{2+}$/$[Fe(H_2O)_6]^{2/3+}$ References to emission make it difficult to be Level 3

Question			Answer	Marks	AO element	Guidance
			Gives at least one example from the titration in the Insert. *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)** An explanation of the structure of complex ions. **OR** An explanation of the origin of colour. OR An explanation as to why there are different colours. **OR** Gives at least one example from the titration in the Insert. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **Level 0** (0 marks) *No response or response has no merit.*			

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553