

GCE

Chemistry B

Unit **H433/03**: Practical skills in chemistry

Advanced GCE

Mark Scheme for June 2018

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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.

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Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	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**

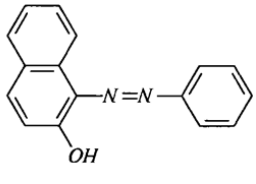
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

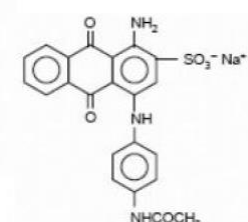
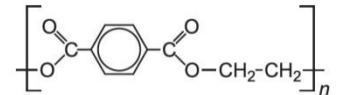
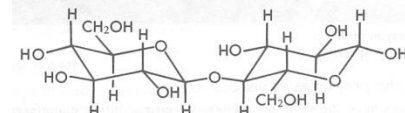
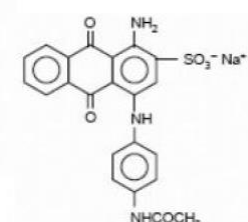
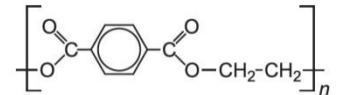
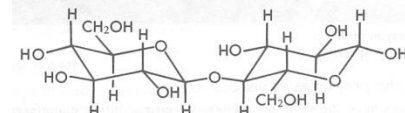
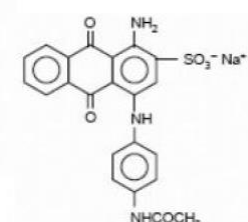
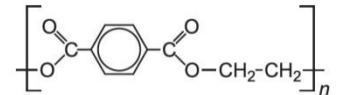
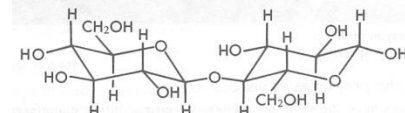
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

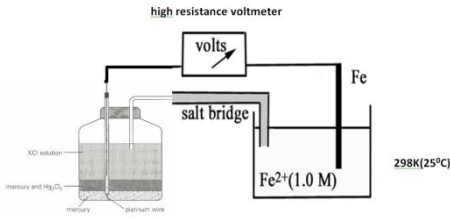
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New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

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

Question	Answer	Marks	Guidance
1 (a)	(conc) Hydrochloric acid / sulphuric and sodium nitrate(III)/nitrite ✓ Phenylamine / aminobenzene ✓ Below 5°C/ice cold (solution) ✓	3	ALLOW nitrous acid for first mark name or formula IGNORE nitric acid If acid named with oxidation state it must have correct oxidation state i.e. III ALLOW hydrochloric acid under 'Conditions' for <u>first</u> mark Alkaline conditions CON
(b) (i)	 ✓	1	 ALLOW
(ii)	alternating double and single bonds OR conjugated system OR delocalisation of <u>electrons</u> ✓ split into different electronic energy levels OR electron(s) promoted OR excited from lower to higher level OR electron(s) excited to a higher energy level ✓ can absorb <u>visible/coloured</u> light (causing electrons to be promoted to upper level) ✓ reflected/transmitted light complimentary colour ✓	4	The idea of split (electronic) energy levels needed for this mark (energy gap on <u>own</u> not good enough) NOT energy states Emit colour/light is CON ALLOW opposite colour

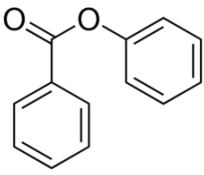
Question			Answer	Marks	Guidance																
	(c)	(i)	Colour	1	ALLOW the chromophore. IGNORE any reference to specific colour. For (c)(i) and (c)(ii) must talk about a dye property IGNORE references to bonding possibilities																
	(c)	(ii)	Solubility OR <u>more</u> soluble	1	LESS soluble is a CON																
	(d)		<table><tr><th>Type of fabric</th><th>Structure/features of fibre polymer molecule.</th><th>Structure/features of dye molecule</th><th>Strongest type of attachment</th></tr><tr><td>Wool</td><td>A protein chain with --NH_3^+ groups at the end of side chains when dyed in acid solution</td><td></td><td><i>ionic</i></td></tr><tr><td><i>polyester</i></td><td></td><td>Few polar groups on dye molecule</td><td>Permanent dipole/Permanent dipole</td></tr><tr><td>Cotton</td><td></td><td>Several --NH_2 groups. Linear molecule</td><td>H (bonding)</td></tr></table>	Type of fabric	Structure/features of fibre polymer molecule.	Structure/features of dye molecule	Strongest type of attachment	Wool	A protein chain with --NH_3^+ groups at the end of side chains when dyed in acid solution		<i>ionic</i>	<i>polyester</i>		Few polar groups on dye molecule	Permanent dipole/Permanent dipole	Cotton		Several --NH_2 groups. Linear molecule	H (bonding)	2	Number of ticks must match mark given. 2 marks for all correct 1 mark for 2 or 3 out of four ALLOW id/id, pd/id or pd/pd
Type of fabric	Structure/features of fibre polymer molecule.	Structure/features of dye molecule	Strongest type of attachment																		
Wool	A protein chain with --NH_3^+ groups at the end of side chains when dyed in acid solution		<i>ionic</i>																		
<i>polyester</i>		Few polar groups on dye molecule	Permanent dipole/Permanent dipole																		
Cotton		Several --NH_2 groups. Linear molecule	H (bonding)																		
			Total	12																	

Question			Answer	Marks	Guidance
2	(a)	(i)	advantage: portable/no gas involved disadvantage: mercury toxic/poisonous ✓	1	one mark for both correct Ignore references to cost Harmful too vague
	(a)	(ii)	+1 ✓	1	sign needed NOT 1+
	(b)		FIRST CHECK ANSWER ON THE ANSWER LINE If answer = 2.93 or 2.94 (dm³) award 3 marks Moles (n) assuming $\text{Hg}_2\text{Cl}_2 = 25.0/472.2 = 0.0529/0.053$ ✓ Volume = $\frac{nRT}{P}$ and substitution of correct values i.e. n (0.0529/0.053), R(8.314), T(673), p(101000), ✓ evaluation including conversion to $\text{dm}^3 = 2.93/2.94 (\text{dm}^3)$ ✓	3	N.B. 0.0529 gives 2.93, 0.053 gives 2.94 ALLOW ecf's from marking points one and two (the latter likely to be wrong units) Any appearance, stated or not, of 25/472.2 OR 0.0529/0.053 Look for any ecf on marking points 1 and 2
	*(c)		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 set-up the apparatus including the conditions <u>and</u> some justification of the apparatus used. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3 – 4 marks) Learners present a workable setup of the apparatus including the conditions but little or no justification of the apparatus used. <i>The information presented is relevant and supported by some evidence.</i>	6	Indicative scientific points may include: Set up • make sure reading on voltmeter is positive • electrode/half-cell connected to positive terminal of voltmeter is the positive electrode • discussion of how E_{cell} can be used to find electrode potential of iron half cell Description of the apparatus used and why • high resistance voltmeter so negligible current is taken (so concs of ions stay the same) • salt bridge to keep the charge in each beaker constant. • both the above correctly connected to <u>both</u> cells • iron electrode and $\text{Fe}^{2+}(\text{aq})$ solution in beaker so the reaction $\text{Fe}(\text{s}) \rightleftharpoons \text{Fe}^{2+}(\text{aq})$ can take place

Question	Answer	Marks	Guidance
	Level 1 (1 – 2 marks) Learners present a partial set-up OR a simple labelled diagram with some relevant labels. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> Level 0 (no marks) No response or no response worthy of credit		Conditions/concentrations • 298K/25°C • 1.00 mol dm⁻³ Fe²⁺(aq) solution as E⁰ is changed with higher temp and conc Note: some of the above points may be scored from a suitably labelled diagram, such as the one below 
(d)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = $1.6 \times 10^{-18} \text{ mol}^3 \text{dm}^{-9}$ award 5 marks Molar mass of Hg₂Cl₂ = 472.2 ✓ Solubility Hg₂Cl₂ in moldm⁻³ = $3.5 \times 10^{-4} \div 472.2 = 7.41 \times 10^{-7}$ ✓ $K_{sp} = (7.41 \times 10^{-7}) \times (2 \times 7.41 \times 10^{-7})^2$ ✓ $= 1.6 \times 10^{-18}$ ✓ Units = mol³dm⁻⁹ ✓ irrespective of answer BUT if MASS concentration is used in the calculation the ecf on the units must be in terms of grammes see Guidance	5	Figure of 7.41×10^{-7} is worth 2 marks alone The x2 is commonly missed giving an answer of 4.1×10^{-19} and with correct units this answer should be awarded 4 marks. Calculations must be carried out on number of moles and NOT mass, but can allow sig fig mark and units mark if units are g³ dm⁻⁹. Look for ecf on units off K_{sp} equation. Must be 2 sig figs to score this mark (ecf off last marking point e.g. from above)
	Total	16	

Question			Answer	Marks	Guidance
3	(a)	(i)	(pale) yellow precipitate ✓	1	
		(ii)	$\text{Ag}^+(\text{aq}) + \text{I}^-(\text{aq}) \rightarrow \text{AgI}(\text{s})$ ✓	1	All correct, allow IAg. Allow multiples.
	(b)	(i)	$2\text{I}^- \rightarrow \text{I}_2 + 2\text{e}^-$ ✓ loss of electrons	1	one mark for both correct ALLOW description of oxidation in terms of oxidation state of iodine increasing (from -1 to 0)
	(b)	(ii)	Sulfur ✓ +2, +2½ ✓	2	Sign needed NO ecf for iodine or oxygen
	(b)	(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 130 (µg) award 4 marks Mole of thio = $0.0053 \times 0.010 = 5.30 \times 10^{-6}$ and moles of iodine = half above 2.65×10^{-6} ✓ Mass of iodine = above $\times 253.8 = 6.72 \times 10^{-4}$ ✓ Mass of iodine in 120g = above $\div 5 = 1.345 \times 10^{-4}\text{g}$ ✓ 130(µg) (2 sig figs) ✓	4	ALLOW calculation method (and appropriate progress marks) where moles of I_2 in a 120g sample are calculated first, then mass. Look for any ecfs. This value has to be calculated from correct conversion to microgrammes
	(b)	(iv)	% error = $\frac{0.1}{5.3} \times 100 = 1.886/1.9(\%)$ ✓	1	1.89
		(v)	Dilute/lower concentration of thiosulphate solution OR increase mass of cod used OR increase volume of iodine solution used ✓	1	IGNORE answers which suggest more repeats needed, / “bigger”/“larger” sample
	*(c)		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 practical procedure and explains clearly how to process the results. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i>	6	indicative scientific points may include: Procedure • make a range of iodine solutions of different concentrations in hexane • minimum of 5 different concentrations • select filter showing maximum absorbance/complimentary colour • zero colorimeter using pure solvent (hexane) • measure absorbance for each of known concentrations of iodine solution

Question			Answer	Marks	Guidance
			Level 2 (3 – 4 marks) Learners present a workable practical procedure and some explanation of analysis but some detail lacking. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1 – 2 marks) Learners present a partial practical procedure, with some relevant points. OR Learners present some detail on the analysis/processing of results. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> Level 0 (no marks) <i>No response or no response worthy of credit</i>		Processing of results Use of calibration graph - plot a calibration curve of concentration against absorbance - measure absorbance of unknown sample and use calibration curve to determine concentration of unknown solution Arriving at mass of iodine in sample - convert mole concentration to mass ($\times 253.8$) $\div 50$ (or $\times 20/1000$) and convert to μg ($\times 10^6$)
			Total	17	

Question			Answer	Marks	Guidance
4	(a)	(i)		1	ALLOW formulae of benzene rings using circle (and showing hydrogens) the key for the mark is the ester bonding correct. Benzene structure is needed NOT cycloalkane NOT C ₆ H ₅
	(a)	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 39.65/40(%) award 3 marks Reacting mass ratio = 94 : 198 ✓ Theoretical mass of phenyl benzoate formed = $\frac{198}{94} \times 4.91$ = 10.34 ✓ % yield = $\frac{4.10}{10.34} \times 100 = 39.65/40(\%)$ ✓	3	ALLOW range of answers allowing for early rounding 39.65 – 41.41% ALLOW Moles phenol = $4.91/94 = 0.05223$ ✓ Moles phenyl benzoate = $4.1/198 = 0.0207$ ✓ % yield = $0.0207/0.05223 \times 100 = 39.65$ ✓ If candidate has simply used the two calculated masses and has 83.5% (84%) allow one mark ALLOW ecfs from marking points 1 and 2
	(b)	(i)	C ₆ H ₅ COCl + H ₂ O → C ₆ H ₅ COOH + HCl ✓	1	ALLOW correct structural formulae or correct mixtures of formulae
	(b)	(ii)	Test used to see whether any (unreacted) phenol (left), (would go purple if some remained) ✓	1	Both ideas needed
	(b)	(iii)	Seal/melt end of melting point/capillary tube (in Bunsen) ✓ Tap/tip/pack a small amount of solid to bottom of tube ✓ Put tube in mp apparatus, allow temperature to rise <u>slowly</u> until solid melts OR record when it first starts to melt and when it finishes ✓	3	If unusual methods used please contact team leaders e.g. Siwoloboff's method, melting point bench
	(b)	(iv)	Indicates the presence of impurities / purity ✓	1	ALLOW simply- indicates purity of product
	(b)	(v)	Solute must have high solubility(in solvent) when hot, but low when cold/ AW ✓	1	DO NOT allow doesn't react with the product
	(c)		if more than one spot shows up on tlc ✓ phenyl benzoate impure ✓ ORA for mp 1 and 2 however cannot assess overall purity/cannot tell how pure or impure it is ✓ not quantitative / is qualitative ✓	4	Diagrams can be used here ALLOW 'quantity' or references to % by mass of product
			Total	15	

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