Mark Scheme (Results)

October 2019

Pearson Edexcel International Advanced Level
In Chemistry (WCH06)
Paper 01 Chemistry Laboratory Skills II

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	Ammonia / NH_3 / NH_3(g)	Ammonium / NH_4^+	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	NH_4^+ / ammonium (ions)	$NH_3^{(+)}$ / ammonia (ion)	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	$Fe^{2+/+2}$ / iron(II) / $[Fe(H_2O)_6]^{2+}$ (ions) IGNORE (aq)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	Iron(III) hydroxide / $Fe(OH)_3$ / $Fe(OH)_3(H_2O)_3$ IGNORE Fe^{3+} / (s)	Fe_2O_3	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(c)	SO_4^{2-} / sulfate((VI)) (ions) IGNORE (aq)	SO_3^{2-} / sulfate(IV) / sulfite	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(d)	$(NH_4)_2Fe(SO_4)_2$ / $Fe(NH_4)_2(SO_4)_2$ / $(NH_4)_2SO_4.FeSO_4$ / $FeSO_4.(NH_4)_2SO_4$ ALLOW $Fe(NH_4SO_4)_2$ OR Any other combination of Fe^{2+}, NH_4^+ and SO_4^{2-} ions that gives a neutral compound e.g. $(NH_4Fe)_2(SO_4)_3$ IGNORE Missing dots Any water of crystallisation		**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(e)	**EITHER** Mass of H_2O = 9.80 – 7.10 = 2.70 (g) **and** Mol of H_2O = $\frac{2.70}{18}$ = 0.15 (mol) **(1)** Mol of H_2O combined with 1 mol of anhydrous solid = $\frac{0.15}{0.025}$ = 6 TE on mol H_2O **(1)** **OR** Molar mass of **A** = $\frac{9.80}{0.025}$ = 392 (g mol^{-1}) **and** Molar mass of anhydrous solid = $\frac{7.10}{0.025}$ = 284 (g mol^{-1}) **(1)** Mass of H_2O = 392 – 284 = 108 **and** Mol of H_2O combined with 1 mol of anhydrous solid **=** $\frac{108}{18}$ = 6 TE on mass H_2O **(1)** Correct answer with no working scores (2) ALLOW Alternative methods IGNORE SF in final answer		**(2)**

(Total for Question 1 = 8 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	(**W** could be an alkene or an) arene / aryl / aromatic (compound) ALLOW Benzene (ring) / phenyl IGNORE Just 'unsaturated' / 'cyclic'		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	(**W** contains) C=C / carbon-carbon double bond / alkene IGNORE phenol	Benzene	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(a)(iii)	(**W** contains) OH / hydroxy(l) (group) ALLOW Alcohol **and** carboxylic acid / OH **and** COOH Alcohol **and** OH Carboxylic acid **and** OH	Hydroxide ion / OH^-	**(1)**

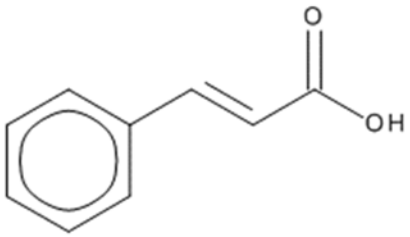
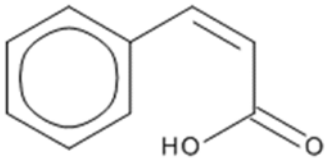
Question Number	Acceptable Answers	Reject	Mark
2(a)(iv)	(Heat W until it melts then add solid) sodium carbonate / Na_2CO_3 / potassium carbonate / K_2CO_3 / sodium hydrogencarbonate / $NaHCO_3$ / potassium hydrogencarbonate / $KHCO_3$ **(1)** (**W** contains carboxylic) acid / COOH (group) ALLOW Carboxylic (group) **(1)** IGNORE carboxy / carboxyl / carboxylate	Just 'carbonate' Or 'hydrogen carbonate'	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	(A peak occurs at *m/e* =) 77		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	(The peak is due to an ion with the formula) $C_8H_7^+$ ALLOW Symbols in any order i.e. $H_7C_8^+$ $C_6H_5CHCH^+$ Skeletal / displayed / structural formulae IGNORE Formulae as working	Missing + $C_7H_3O^+$	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	(There are) 6 / six (proton environments)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	There are 4 / four protons on their own **and** 2 / two sets of 2 / two protons OR There are four environments each with a single proton **and** two environments each with two protons ALLOW The (relative) number / ratio of hydrogen atoms in each environment OR There are eight protons two pairs of which have equivalent environments OR The ratio of protons / proton environments is 1:1:1:1:2:2 OR The number of protons in the peaks with relative area 2 is double that in the peaks with relative area 1 or reverse argument OR There is 1 proton in the peaks with (relative) area 1 and 2 protons in the peaks with (relative) area 2 IGNORE References to splitting		**(1)**

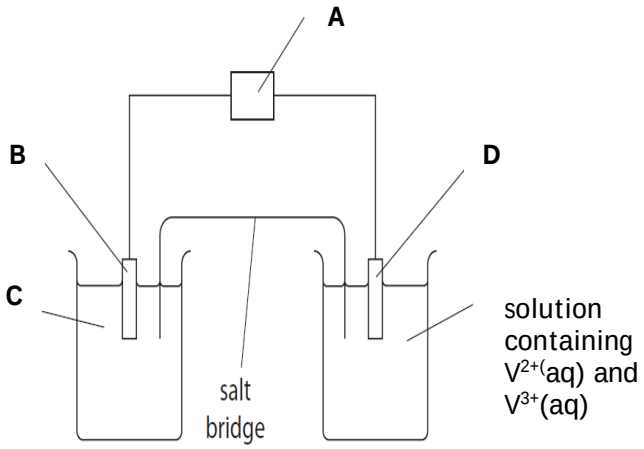
Question Number	Acceptable Answers	Reject	Mark
2(d)	 OR  Any structure containing benzene ring, alkene and carboxylic acid **(1)** One of the correct structures shown above ALLOW Kekule structure / Structural / displayed formula or any combination of these e.g. $C_6H_5CH=CHCOOH$ **(1)** IGNORE Bond lengths and bond angles in skeletal formula	Any additional functional groups e.g. OH	**(2)**

(Total for Question 2 = 11 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)(i)	<table><tr><td>Rough</td><td>1</td><td>2</td><td>3</td></tr><tr><td>(21.10)</td><td>(41.30)</td><td>(19.85)</td><td>(20.10)</td></tr><tr><td>(0.50)</td><td>(21.10)</td><td>(0.25)</td><td>(0.00)</td></tr><tr><td>20.60</td><td>20.20</td><td>19.60</td><td>(20.10)</td></tr><tr><td></td><td>✓</td><td></td><td>✓</td></tr></table> Volumes completed in the table ALLOW 20.6, 20.2 and 19.6 **(1)** Indication of which titres used to calculate mean **and** mean titre = 20.15 (cm^3) ALLOW 20.2 (cm^3) ALLOW Titres used to calculate mean shown in an expression e.g. $\frac{20.20 + 20.10}{2}$ **(1)**	Penalise incorrect units once only in (a)(i) and (ii)	**(2)**

Question Number	Acceptable Answers	Reject	Mark
3(a)(ii)	Mol MnO_4^- = $\frac{20.15 \times 0.0400}{1000}$ = 8.06×10^{-4} / 0.000806 (mol) TE on mean titre in (a)(i) **(1)** Mol V^{3+} = $8.06 \times 10^{-4} \times 5/2$ = 2.015×10^{-3} / 0.002015 (mol) TE on mol MnO_4^- **(1)** Concentration V^{3+} = $2.015 \times 10^{-3} \times \frac{1000}{10.0}$ (= 0.2015) = 0.202 / 2.02×10^{-1} (mol dm^{-3}) **(1)** TE on mol V^{3+} Final answer must be to 3 SF Correct answer with no working scores (3)		**(3)**

Question Number	Acceptable Answers	Reject	Mark
3(a)(iii)	$\frac{0.05 \times 2 \times 100}{20.10}$ = 0.49751 / 0.4975 / 0.498 / 0.50 / 0.5 (%) Correct answer with no working scores (1) IGNORE SF including 1 SF / ± symbol	0.24876(%) 0.496(%)	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	 Allow name or formula but if both are given, both must be correct (**A**) (high resistance) voltmeter ALLOW just V / voltage meter **(1)** (**B**) zinc / Zn (electrode) **(1)** (**C**) (solution containing) Zn^{2+} / zinc ions ALLOW zinc sulfate / $ZnSO_4$ / zinc nitrate / $Zn(NO_3)_2$ / zinc chloride / $ZnCl_2$ (solution) **(1)** (**D**) platinum / Pt (electrode) **(1)** IGNORE Any conditions / state symbols / cathode / anode	Battery / ammeter / voltameter Zn / zinc / Any additional ions e.g. H^+ Vanadium electrode	**(4)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	(Potassium hydroxide / hydroxide ions) will form a precipitate / solid with the cations / metal ions (in the beakers) ALLOW A precipitate / solid is formed with one or more of the specific ions in the solutions - Zn^{2+} / V^{2+} / V^{3+} OR It reacts to form zinc hydroxide / $Zn(OH)_2$ / vanadium(II) hydroxide / $V(OH)_2$ / vanadium(III) hydroxide / $V(OH)_3$ OR It reacts with Zn^{2+} to form a complex (ion) / $Zn(OH)_4^-$ OR It reacts with Zn^{2+} / V^{2+} / V^{3+} OR It forms a precipitate with the ions (in the beakers) IGNORE Reference to potassium hydroxide is corrosive / alkaline OR Just 'it reacts with the solutions (in the beakers)' OR It reacts with H^+ ions OR Reference to zinc		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(iii)	$Zn + 2V^{3+} \rightarrow Zn^{2+} + 2V^{2+}$ ALLOW Multiples $\rightleftharpoons$ provided equation is written in the direction shown Equation with cancelled electrons e.g. $Zn + 2V^{3+} + 2e^- \rightarrow Zn^{2+} + 2V^{2+} + 2e^-$ IGNORE State symbols even if incorrect	Any equation with uncancelled electrons	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(iv)	(+0.44 = E – (–0.76)) E = –0.32 (V) Negative sign and value are needed No TE on incorrect equation		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(v)	-0.32 = -0.26 + 0.059 log[V^{3+}(aq)] **(1)** TE on (b)(iv) log [V^{3+}(aq)] = −1.0169 / −1.017 / −1.02 / −1.0 / −1 [V^{3+}(aq)] = 0.096172 / 0.09617 / 0.0962 / 0.096 / 0.1 (mol dm^{-3}) ALLOW 0.095 from log [V^{3+}(aq)] = -1.02 TE on (b)(iv) for M1 only as final answers will be too high or too low (+0.32 V gives 6.77 x 10^{9} +1.2 V gives 5.57 x 10^{24} −1.2 gives 1.17 x 10^{-17}) **(1)** IGNORE SF including 1SF Correct answer with no working scores (2)		**(2)**

Question Number	Acceptable Answers	Reject	Mark
3(c)	The V^{2+} and V^{3+} solutions are mixed together in equal volumes OR The volume is doubled (when the solutions are mixed) ALLOW The V^{3+} solution is diluted by the V^{2+} solution or vice versa IGNORE Different volumes are used in the two different methods Different conditions are used / not standard conditions	Water is added to dilute the solution	**(1)**

(Total for Question 3 = 16 marks)

Question Number	Acceptable Answers	Reject	Mark
4(a)	**Reagents** Sodium nitrite / sodium nitrate(III) / $NaNO_2$ **and** hydrochloric acid / HCl((aq)) ALLOW Nitrous acid / nitric(III) acid / HNO_2 **and** hydrochloric acid / HCl((aq)) **(1)** IGNORE Concentration of hydrochloric acid **Condition** Temperature of 0 – 10 ^{o}C ALLOW Any temperature or range of temperatures within the given range / less than 5 ^{o}C / less than 10 ^{o}C / use of an ice bath **(1)**	Just 'sodium nitrate / sodium nitrate(V) / $NaNO_3$ / any other acid Just 'nitric acid' Reference to reflux or heat	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(b)(i)	The reaction is exothermic / releases heat ALLOW Reaction is vigorous / to prevent a vigorous reaction IGNORE Violent Volatile Diazonium salt is unstable / would decomposes Highly reactive To avoid splashing	Explosive	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(b)(ii)	**A** (boiling) water / H_2O **(1)** **B** reaction mixture OR benzenediazonium chloride / $C_6H_5N_2Cl$ (and potassium iodide) ALLOW Iodobenzene / C_6H_5I (and water) **(1)** IGNORE Phenylamine **C** water / H_2O out **and** **D** water / H_2O in **(1)**	Steam	**(3)**

Question Number	Acceptable Answers	Reject	Mark
4(b)(iii)	Prevents pressure building up ALLOW To prevent an explosion To allow gases / (water) vapour / air to escape As an (air) vent Prevents gases building up in the apparatus To maintain / control / release / reduce / decrease pressure	To create a vacuum	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(b)(iv)	Use of a separating funnel **(1)** Collect iodobenzene in the lower layer / iodobenzene is the lower layer **(1)** IGNORE Just 'iodobenzene has a higher density than water'	Comparison with phenylamine Collect lower layer if it is the aqueous layer	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(b)(v)	Add (anhydrous) calcium chloride / sodium sulfate / magnesium sulfate / calcium sulfate ALLOW Silica gel Correct formulae – $CaCl_2$ / Na_2SO_4 / $MgSO_4$ / $CaSO_4$ IGNORE 'add a drying agent '	Conc sulfuric acid / anhydrous copper(II) sulfate / sodium hydroxide	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(b)(vi)	185 – 189 (^oC) / 185 – 190 (^oC) / 185 – 191 (^oC) / 186 – 189 (^oC) / 186 – 190 (^oC) / 186 – 191 (^oC) / 187 – 189 (^oC) / 187 – 190 (^oC) / 187 – 191 (^oC)	Any single number Any range including 188 as one of the stated numbers Incorrect units e.g. K	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(c)	Mass of iodobenzene = 25.0 x 1.83 **(1)** = 45.75 (g) Mol of iodobenzene = $\frac{45.75}{203.9}$ **(1)** = 0.22437 (mol) TE on mass iodobenzene Mol of phenylamine = $\frac{0.22437}{0.7}$ **(1)** = 0.32054 (mol) TE on mol iodobenzene Mass of phenylamine = 0.32054 x 93.0 = 29.81 (g) **and** Volume of phenylamine = $\frac{29.81}{1.02}$ = 29.225 (cm^3) TE on mol and mass phenylamine **(1)** IGNORE SF except 1SF Correct answer with no working scores (4) ALLOW Alternative methods		**(4)**

(Total for Question 4 = 15 marks)

(Total for Paper = 50 marks)

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