Pearson Edexcel

Mark Scheme (Results)

January 2021

Pearson Edexcel International Advanced Subsidiary Level
In Chemistry (WCH13)
Paper 1 Practical Skills in Chemistry I

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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.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Additional Guidance	Mark
1 (a)(i)	• (Solution **A** is) nitric acid	Accept HNO_3/ HNO_3(aq) **Ignore** dilute and concentrated If both name and formula given, both must be correct	**1**

Question Number	Answer	Additional Guidance	Mark
1 (a)(ii)	• (Solution **C** is) sodium carbonate	Accept Na_2CO_3/ Na_2CO_3(aq) **Ignore** dilute and concentrated If both name and formula given, both must be correct	**1**

Question Number	Answer	Additional Guidance	Mark
1 (a)(iii)	• $CO_3^{2-}(aq) + 2H^+(aq) \longrightarrow CO_2(g) + H_2O(l)$ **(2)**	1 mark for correct species and balancing 1 mark for correct state symbols If one species is omitted then the state symbols mark can still be awarded for correct states for the three species given **Ignore** any non-ionic equations that may have been used to derive the ionic equation Award the state symbols mark for a balanced non-ionic equation Allow $CO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2CO_3(aq)$ for 1 mark	**2**

Question Number	Answer	Additional Guidance	Mark
1(a)(iv)	• (Solution **B** is) potassium bromide (1) • (Solution **D** is) barium chloride (1) • (Solution **E** is) silver nitrate (1)	Accept KBr / KBr(aq) Accept $BaCl_2$ / $BaCl_2$(aq) Accept $AgNO_3$ / $AgNO_3$(aq) If both name and formula given, both must be correct	**3**

Question Number	Answer	Additional Guidance	Mark
1(b)	• Ba^{2+} **and** (apple) green **(1)** • K^+ **and** lilac **(1)** • Na^+ **and** orange/yellow **(1)**	Accept answers in any order **Ignore** modifiers e.g. pale / persistent **Allow** mauve **Ignore** purple **Do not award** violet or lilac/violet **Allow** gold If both name and formula given, both must be correct but penalise use of cation name, compound name or incorrect charge once only	**3**

(Total for Question 1 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	An answer that makes reference to one of the following points • All the acid/reactant/solid/solution/substance weighed out should be added / transferred (to the flask) (1) **Or** none of the acid/reactant/solid/solution/substance weighed out/solution should be left behind (in the beaker) **Or** the solution remaining in the beaker will contain some dissolved ethanedioic acid/ (if washings not added) the solution concentration will be lower **Or** to ensure the amount of acid in the solution is known accurately	**Allow**"so that all of the solution is transferred" **Ignore** just "transfer losses" just "to ensure accuracy"	**1**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	• calculation of moles ethanedioic acid in solution (1) • calculation of concentration in mol dm^{-3} to 2/3 SF (1)	<u>Example of calculation</u> $2.40 \div 90 = 0.0267/0.027$ (mol) $0.0267 \times \frac{1000}{250} = 0.1066 = 0.107/0.11$ (mol dm^{-3}) If moles rounded to 0.027 then 0.108 mol dm^{-3} to 3 SF Allow TE on incorrect moles Penalise incorrect units in final answer only	**2**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	An answer that makes reference to • to prevent dilution of the acid Or so the burette only contains acid Or to remove (remaining) water	**Ignore:** • affect or change the concentration • any references to pH • **Do not award:** "removing impurities"	**1**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An answer that makes reference to • the bottom of the meniscus should be on the mark (1) • the reading should be taken level with the mark/meniscus (to reduce parallax error) (1)	**Allow** • correctly drawn/amended diagrams throughout • minimum point of curve/ bottom of the curve OWTTE • reverse argument e.g. bottom of the meniscus/curve is not on the mark/top of the meniscus/curve is on the mark **Allow** • eye level should be horizontally/ parallel (to the meniscus)/bottom of the liquid/ perpendicular (to the burette) • reverse argument e.g. the reading is not level with the meniscus/ taken at an angle **Ignore** other errors e.g. "room temperature is not 20 C"	**2**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	An answer that makes reference to • there will be more/too much sodium hydroxide / solution **J** (than expected in the conical flask) (1) • (so) the value of the titre will increase (1)	**Do not award:** the concentration of sodium hydroxide would change. M2 depends on M1 or near miss **Ignore** any reference to accuracy An answer that implies that the pipette should be emptied completely to deliver 25cm^3 scores 0. An answer that states the titre will decrease scores 0	**2**

Question Number	Answer	Additional Guidance	Mark
2 (b)(iv)	• (from) pink (1) • (to) colourless (1)	**Do not award** purple or red Award one mark for colours the wrong way around	**2**

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	An answer that includes the following • all subtractions correct (1) • titres 2 and 3 chosen and correctly averaged (1)	25.05, 24.6(0), 24.5(0) $\frac{24.60 + 24.50}{2} = 24.55(cm^3)$ TE on incorrect subtraction	**2**

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	• calculation of moles ethanedioic acid in titre (1) • moles sodium hydroxide in 25 cm^3 aliquot (1) • calculation of sodium hydroxide concentration (1)	Example of calculation: $\frac{24.55 \times 0.0900}{1000}$ = 0.0022095/0.00221/2.2095 x 10^{-3}(mol) 0.0022095 x 2 = 0.004419/0.00442/4.419 x 10^{-3} (mol) $\frac{0.004419}{25}$ x 1000 = 0.17676/ 0.177/ 0.18 (mol/dm^3) TE from (i) TE throughout Ignore SF except 1SF	**3**

(Total for Question 2 = 15 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	An answer that makes reference to one of the following • to prevent "suck back" (of the water/liquid) **Or** • so that the water/liquid does not move/flow back into the tube	 **Allow** to stop the test tube breaking/cracking **Do not award** explosion any references to gases sucking back/ escaping/entering the tube	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	• calculation of moles carbon dioxide (1) • calculation of mass of Group 2 metal (1) • calculation of mass number **and** identity of Group 2 metal (1)	Example of calculation: $95 \div 24000 = 0.0039583 / 3.9583 \times 10^{-3}$ moles $0.33 - (0.0039583 \times 60) = 0.33 - 0.2375 = 0.0925$ g $0.0925 \div 0.0039583 = 23.368$ **and** magnesium/Mg **First Alternative method** M2 M_r (MCO_3) = 0.33 / 0.0039583 = 83.4 M3 M_r (CO_3^{2-}) = 60 83.4 - 60 = 23.4 **and** magnesium/Mg **Second Alternative method** M2 Mass of Group 2 metal oxide 0.33 – (0.0039583 x 44) = 0.15583 g M3 Ar = (0.15583 ÷ 0.0039583) – 16 =39.3685 -16 = 23.368 **and** magnesium/Mg TE at all stages, but do not award TE for M3 non Gp 2. Ignore SF except 1 SF COMMENT Mg **and** 23/23.4/23.37/23.368 scores 3	**3**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to • the increase in mass would reduce the (percentage) uncertainty/error (in the mass/volume measurement) (1) • (so) the volume of gas given off would be greater/ would exceed the volume of the measuring cylinder (1)	Ignore references to Just "accuracy/precision" explosions changes to rate of reaction CO_2 dissolving in the water incomplete reaction gas leak modifications e.g. larger measuring cylinder/ gas syringe Allow gas would escape	**2**

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	• calculation of the heat energy change $Q = m \times C_p \times \Delta T$ **(1)** • calculation of the enthalpy change, ΔH_1 with sign **(1)**	Example of calculation: $Q = 60 \times 4.18 \times 6 = 1504.8 = 1505$ (J) or 1.505 (kJ) $\Delta H_1 = 1.505 \div 0.05 = -30.096$ (kJ mol^{-1}) Penalise incorrect units only once in c(i) and c(ii) Allow TE Ignore SF except 1 SF Correct answer no working scores 2 marks	**2**

Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	ΔH_1 (answer to (i)) − (−150)	Example of calculation: −30.1 + 150 = (+)119.9/ (+)120 (kJ mol^{-1}) TE from c(i) if using same units or if no units are shown. Ignore SF Penalise incorrect units only once in c(i) and c(ii)	**1**

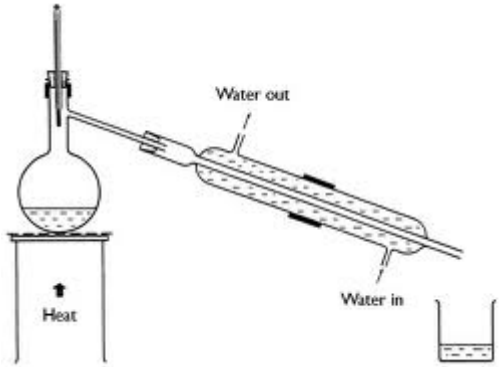
(Total for Question 3 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An answer that makes reference to the following points • (use) gloves (1) • (use a) fume cupboard (1)	**Allow** ensure that the laboratory is well-ventilated	**2**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	An answer that makes reference to the following points • the product (is a chloroalkane which) only has dipole and/or London forces (1) • the chloroalkane cannot disrupt/overcome the strong hydrogen bonding forces of water (1)	**Allow for London forces**: dispersion forces / temporary dipole-induced dipole forces van der Waals (forces) Any mention of the product being non-polar loses M1 **Ignore** just "the product cannot form H bonds" **Allow** just water forms hydrogen bonds / H bonds it/ product cannot form H bonds with water **Ignore** product is insoluble/immiscible different densities hydration energy cannot balance the existing forces	**2**

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	An answer that makes reference to the following point • pressure / gas / CO_2 must be released	**Allow** so that the pressure does not build up **Ignore** references to explosions just to balance pressure **Do not award**: "to release air/water vapour"	**1**

Question Number	Answer	Additional Guidance	Mark
4(a)(iv)	An answer that makes reference to the following point • to remove water / to dry (the product) / as a drying/desiccating agent	**Do not award**: dehydrating agent, to dry the solution	**1**

Question Number	Answer	Additional Guidance	Mark
4(a)(v)	Distillation apparatus that includes • round (bottomed) / pear shaped flask **and** heat (1) • thermometer bulb in the neck of the flask (1) • downward sloping condenser with water in / out correct (1) • a collecting vessel **and** apparatus sealed on the left-hand side **and** open on the right-hand side (1)	Do not award an obviously conical flask The water in/out can be on the same or opposite sides of the condenser Example of diagram  Allow any indication of heat Ignore fractionating column For reflux diagram: allow M1 **and** allow M3 for vertical condenser with water in/out correct and not sealed.	4

Question Number	Answer	Additional Guidance	Mark
4(b)	• calculation of moles of alcohol (1) • calculation of mass of halogenoalkane (1) • calculation of percentage yield (1) **First Alternative method** • calculation of mole ratio (1) • calculation of expected yield (1) • calculation of actual yield (1) **Second Alternative method** • calculation of moles of alcohol (1) • calculation of moles of halogenoalkane (1) • calculation of percentage yield (1)	<u>Example of calculation</u> moles of alcohol = 8 ÷ 74 = 0.10811 mass of halogenoalkane = 0.10811 × 92.5 = 10 percentage yield = 100 × 2.62 ÷ 10 = 26.2 (%) 92.5: 74 = 1.25 8.00 × 1.25= 10.0g (2.62 ÷ 10.0) × 100 = 26.2 (%) moles of alcohol = 8 ÷ 74 = 0.10811 moles of halogenoalkane = 2.62 ÷ 92.5 = 0.028324 percentage yield = $100 \times \frac{0.028324}{0.10811} = 26.2$ (%) Allow TE throughout If final answer >100% no TE for M3 Correct answer with no working scores 3 Ignore SF except 1 SF Note use of 0.108 ➔ 26.226% yield, so we should accept 26.226 and 26.23 (%)	3

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to the following • rate is inversely proportional to time (1) • 2-chloro-2-methylpropane is **tertiary** (and 1-chloro-2-methylpropane is primary) and the tertiary is faster (1) • 1-chloro-2-methylpropane is a chloroalkane / has a carbon chlorine bond) **and** 1-bromo-2-methylpropane is a bromo alkane/ has a carbon-bromine bond **and** bromine compound is faster (1)	**Allow** any indication that a shorter time means a faster rate e.g. 2 chloro-2methylpropane is faster/ quicker than 1 chloro-2methylpropane. This can be scored in M2 and M3 Do not award if they only refer to the times taken for the different halogenoalkanes. **Allow** **tertiary** (2-chloro-2 methylpropane) is faster/ takes less time (than the primary 1-chloro-2 methylpropane) or reverse argument **Ignore** reference to carbocations **Allow** **bromo** alkane (in 1-bromo-2 methylpropane) is faster than/takes less time than **chloro** alkane (in 1-chloro-2 methylpropane) **Allow** C—Br faster than C—Cl **Ignore** reference to bond length/strength chloride Cl^-/bromide Br^- comparisons of reactivity of bromine and chlorine even if incorrect.	**3**

(Total for question 4 = 16 marks)

Total for paper = 50 marks

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