GradeMax



Mark Scheme (Results)

Summer 2021

Pearson International Advanced Subsidiary Level
In Chemistry (WCH13)
Paper 01: 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.

Question number	Answer	Additional Guidance	Mark
1(a)(i)	An answer that makes reference to the following points: • identification of material **(1)** • justification of use **(1)**	 nichrome / nickel-chromium (alloy) / NiCr / platinum / Pt Do not award just “nickel” or “chromium” inert / does not react / does not give a flame colour Allow does not react with HCl Allow high melting temperature / does not melt in the flame Ignore does not burn	**2**

Question number	Answer	Additional Guidance	Mark
1(a)(ii)	A description that makes reference to the following points: • use of hydrochloric acid **(1)** • description of method **(1)** • flame colour of sodium **(1)** • flame colour of potassium **(1)**	Ignore reference to incorrect wires Allow any mention of HCl(aq) e.g. cleaning the wire or mixing solid and acid or making a paste/solution Ignore dilute HCl instead of HCl(aq) (wire then) dipped in solid / paste / solution **and** placed in (hot / roaring / colourless / blue-cone) (Bunsen) **flame** Allow salt / compound / substance / paste /sample / solution for 'solid' on / over / under / near / show / above for 'in' yellow / gold / golden Allow orange Allow combinations of allowed colours such as yellow-orange Ignore persistent / bright Lilac Do not award purple If both correct colours are given without assigning to the correct metal/compound award 1 mark out of the 2. If colours are reversed award 1 mark out of 2.	**4**

Question number	Answer		Additional Guidance	Mark
1(b)	A description that makes reference to the following points:		Tests can be in either order. Penalise unspecified acid once only in the two tests For both tests the second mark depends on the first mark being scored, or a near miss.	**4**
	• test for a sulfate	**(1)**	barium chloride (solution) / $BaCl_2$((aq)) **and** hydrochloric acid / HCl((aq)) or barium nitrate (solution) / $Ba(NO_3)_2$((aq)) and nitric acid / HNO_3((aq)) Do not award sulfuric acid / H_2SO_4	
	• result of test for a sulfate	**(1)**	white precipitate Allow solid / suspension /ppt / ppte	
	• test for a carbonate	**(1)**	addition of hydrochloric acid / HCl((aq)) Allow any named acid	
	• result of test for a carbonate	**(1)**	effervescence / fizzing / bubbles Allow gas given off which turns limewater cloudy/milky Ignore just "gas"	

(Total for Question 1 = 10 marks)

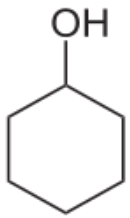
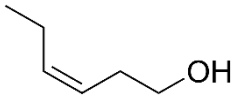
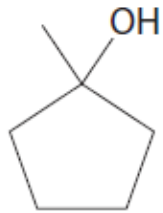
Question number	Answer	Additional Guidance	Mark
2(a)	An answer that makes reference to the following points: • (add a few crystals / small amount of) phosphorus(V) chloride / phosphorus pentachloride / PCl_5 **(1)** • steamy / misty fumes (of HCl) **(1)**	Allow thionyl chloride / $SOCl_2$ / Ester formation / reaction with Na Do not award PCl_3 Allow white fumes Do not award white smoke Allow the formation of an ester M1 Addition of a carboxylic acid / named carboxylic acid and any identified strong acid Or Addition of an acyl chloride / named acyl chloride M2 Fruity / glue / characteristic smell of product Allow for addition of sodium M1 Addition of sodium / Na M2 formation of bubbles / fizzing / formation of a gas which burns with a squeaky pop Ignore just formation of gas / hydrogen	**2**

Question number	Answer	Additional Guidance	Mark
2(b)(i)	An answer that makes reference to one of the following pairs of points: • bromine water / aqueous bromine / bromine solution / bromine in organic solvent / Br_2(aq) **(1)** • orange / yellow / brown to colourless **(1)** **OR** • potassium manganate(VII) / $KMnO_4$ and sulfuric acid / H_2SO_4 **(1)** • purple to colourless **(1)**	In the results of both tests ignore "clear" Allow bromine / Br_2((l)) Allow just decolourises Do not award red / red-brown with aqueous bromine but allow with bromine Allow potassium permanganate Allow acidified potassium manganate(VII) Allow just decolourises	**2**

Question number	Answer	Additional Guidance	Mark
2(b)(ii)	An answer that makes reference to one of the following points: • orange / yellow / brown colour still present **OR** • purple colour remains	Allow TE on colours from b(i), e.g red-brown with bromine water Allow no change Allow does not decolourise Allow no reaction	**1**

<table>
<tr><th>Question number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>2(c)</td>
<td>

any two correct (1)
third correct (1)

</td>
<td>
<table>
<tr><th>Compound</th><th>Colour change</th></tr>
<tr><td></td><td>orange to green</td></tr>
<tr><td></td><td>orange to green</td></tr>
<tr><td></td><td>no change / stays orange</td></tr>
</table>
Award orange to blue

three correct scores 2
any two correct scores 1

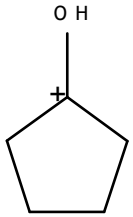
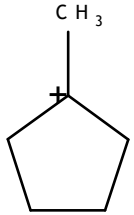
All three with the colours reversed (green to orange, green to orange and stays green) scores 1

Penalise the omission of the start colour once only
Penalise yellow as the start colour once only
</td>
<td>2</td>
</tr>
</table>

Question number	Answer	Additional Guidance	Mark
2(d)(i)	An answer that makes reference to the following points: • O-H bond **and** 3750–3200 (cm^{-1})	In d(i) and d(ii) penalise a single value or a range within the range once only Allow 3200-3750 (cm^{-1}) Do not award –OH / -O-H	**1**

Question number	Answer	Additional Guidance	Mark
2(d)(ii)	An answer that makes reference to the following points: • C=C bond **and** 1669–1645 (cm^{-1})	Allow 1645-1669 (cm^{-1}) If no other mark awarded in (d)(i) and (d)(ii) allow (1) **in (d)(ii)** for identification of both bonds or both ranges	**1**

Question number	Answer	Additional Guidance	Mark
2(d)(iii)	• all three molecular ions have a m/z = 100 / all three compounds have a molar mass of 100 (g mol^{-1})	Allow this is the molecular ion peak of all three compounds Allow this is the molecular mass of all three compounds Allow the three compounds are isomers Allow the compounds have the same molar mass Allow the compounds are $C_6H_{12}O$ / have the same molecular formula Do not award the compounds have the same molecular ion	**1**

Question number	Answer	Additional Guidance	Mark
2(d)(iv)	An answer that makes reference to the following points: •  **(1)**	Allow the + anywhere including outside of brackets around the structure Allow displayed formula Allow $CH_2CH_2CH_2CH_2COH^+$ showing linked carbons in ring Do not award structures with extra –H on C–OH Do not award structures which do not contain a ring Ignore $C_5H_9O^+$ / $C_5H_8OH^+$ / $CH_2CH_2CH_2CH_2OH^+$	**2**
	• CH_3• / CH_3 (radical) **(1)**	Allow displayed formula Allow methyl (radical) Allow CH_3^+ Allow (1) for  and OH• / OH / OH^+	

(Total for Question 2 = 12 marks)

Question number	Answer	Additional Guidance	Mark
3(a)	• (from) yellow **(1)** • (to) orange **(1)**	Correct colours reversed scores (1) Allow peach for orange Ignore modifiers e.g. pale Do not award to red or to pink	**2**

Question number	Answer	Additional Guidance	Mark
3(b)(i)	• two correct values	3 | 4 23.05 | 45.1(0) 1.25 | 23.20 21.8(0) | 21.90	**1**

Question number	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to the following points: • it is not concordant / not within 0.2 (cm^3)	Allow not within 0.1 (cm^3) Allow just 'it is rough / a trial / a rangefinder' Do not award uncertainty e.g. ±0.1 / ±0.2 (cm^3)	**1**

Question number	Answer	Additional Guidance	Mark
3(b)(iii)	• calculation of mean titre **(1)** • calculation of moles of hydrochloric acid **(1)**	Example of calculation: $\frac{21.85 + 21.80 + 21.90}{3}$ = 21.85 (cm^3) $\frac{21.85 \times 0.200}{1000}$ = 0.00437 / 4.37×10^{-3} (mol) Correct answer with some working scores (2) Allow TE on incorrect volumes in (b)(i) and on incorrect calculation of mean titre. Ignore SF except 1SF	**2**

Question number	Answer	Additional Guidance	Mark
3(b)(iv)	• calculation of moles of barium hydroxide in 10 cm^3 **(1)** • calculation of moles of barium hydroxide in 1 dm^3 **(1)** • calculation of concentration in g dm^{-3} to 2 or 3 SF **(1)**	Example of calculation: moles of $Ba(OH)_2$ in 10 cm^3 = ans(b)(iii) / 2 = 0.002185 / 2.185 x 10^{-3} (mol) (ans(1)) moles of $Ba(OH)_2$ in 1 dm^3 = ans(1) x 100 = 0.2185 / 2.185 x 10^{-1} (mol) (ans(2)) = ans(2) x 171.3 = 37.429 g = 37 / 37.4 (g dm^{-3}) to 2 or 3 SF Do not award 37.0 Correct answer with some working scores (3) Use of 171 gives 37.4 / 37.364 ALLOW TE throughout	**3**

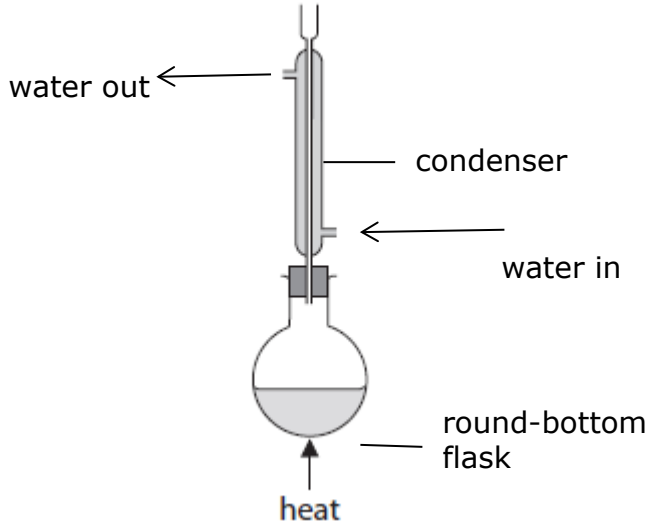
Question number	Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to the following points: • use of a fume cupboard	 Allow (face) mask Ignore laboratory coat / goggles / gloves / well ventilated laboratory Comment: Allow respiratory equipment	**1**

Question number	Answer	Additional Guidance	Mark
3(d)	An answer that makes reference to the following points: • oxidising (agent) / oxidiser / oxidant	 Do not award flammable	**1**

(Total for Question 3 = 11 marks)

Question number	Answer	Additional Guidance	Mark
4(a)	An answer that makes reference to the following points: • gives a reason for cooling **(1)** • gives a reason why this causes a reduction in yield **(1)**	 reaction is exothermic / vigorous / gives off heat / Do not award Explosive Ignore violent / quick reaction mixture may boil causing reactant / product to escape / butan-1-ol /reactant or 1-bromobutane / product might evaporate or reaction may bubble / fizz / effervesce and overflow the round bottom flask (causing loss of reactant / product) Allow alkene formation / charring Ignore reference to equilibrium / rate / side reactions Do not award transfer losses	**2**

Question number	Answer	Additional Guidance	Mark
4(b)(i)	• anti-bumping granules	Allow description of anti-bumping granules Allow other names: anti-bumping chips / beads boiling stones broken porcelain boiling chips	**1**

Question number	Answer	Additional Guidance	Mark
4(b)(ii)	A diagram that • contains a round bottom flask with contents and any indication of heating **(1)** • contains a vertical condenser with water jacket and correct water flow **(1)** • is a working apparatus: not stoppered, no gaps, a joint between flask and condenser **(1)**	Example of diagram:  Allow apparatus unlabelled but must have correct water flow for M2 Allow pear shaped flask Allow an arrow pointing upward as an indication of heat Ignore thermometers which do not seal the apparatus M1 is available for a distillation apparatus	**3**

Question number	Answer	Additional Guidance	Mark
4(c)(i)	An answer that makes reference to the following points: • to neutralise (excess sulfuric) acid	Allow to remove (excess sulfuric) acid Allow hydrobromic acid / HBr / sodium hydrogensulfate / $NaHSO_4$ / H^+ Do not award just 'to neutralise' without mention of acid	**1**

Question number	Answer	Additional Guidance	Mark
4(c)(ii)	An explanation that makes reference to the following points: • identifies the problem **(1)** • gives a solution **(1)**	build-up of pressure (in the separating funnel) Ignore causes frothing Ignore formation of CO_2 open / remove the stopper (with the funnel upright) or open the tap (with funnel inverted) Note: Remove the stopper to release the pressure would score 2. Comment: mark independently	**2**

Question number	Answer	Additional Guidance	Mark
4(c)(iii)	An answer that makes reference to the following points: • drying agent / to remove water	 Do not award dehydration	**1**

Question number	Answer	Additional Guidance	Mark
4(c)(iv)	An answer that makes reference to the following points: • turns from cloudy to clear	Ignore colourless Allow solution becomes clear Allow stops being cloudy Allow is no longer turbid Allow less cloudy / more clear	**1**

Question number	Answer	Additional Guidance	Mark
4(d)	An answer that makes reference to the following points: • integer values of temperature in the ranges lower value 99 / 100 / 101(^{o}C) **and** upper value 103 / 104 / 105(^{o}C)	 Award values to nearest 0.5 ^{o}C Do not award other fractions or decimals of degrees other than nearest 0.5 ^{o}C Do not award single values even if between the two ends of the range, e.g. 102 ^{o}C Allow a value for the size of the range around a stated temperature as long as it is within the given values e.g. 3 ^{o}C around 102 ^{o}C	**1**

Question number	Answer	Additional Guidance	Mark
4(e)(i)	• reason for yield being less than 100%	Example of reasons: reaction incomplete transfer losses side reactions Ignore equilibrium reached Ignore impure reagents / impurities Do not award the cold water bath was not used Do not award the procedure was not followed correctly Do not award spillages	**1**

Question number	Answer		Additional Guidance	Mark
4(e)(ii)	• calculation of mass of 1-bromobutane required	**(1)**	Example of calculation: = 20 x 1.27 = 25.4 (g)	**4**
	• calculation of moles of 1-bromobutane required	**(1)**	= 25.4 ÷ 137 = 0.18540 (mol)	
	• calculation of mass butan-1-ol required	**(1)**	= 0.18540 x 74 = 13.720	
	• calculation of percentage yield assumed	**(1)**	= 100 x 13.720 ÷ 21.0 = 65.332 (%)	
	OR			
	• calculation of moles of butan-1-ol used	**(1)**	= 21 ÷ 74 = 0.28378 mol	
	• calculation of mass of 1-bromobutane for 100 % yield	**(1)**	= 0.28378 x 137 = 38.878 g	
	• calculation of volume of 1-bromobutane for 100 % yield	**(1)**	= 38.878 ÷ 1.27 = 30.613 (cm^3)	
	• calculation of % yield if 20 cm^3 prepared	**(1)**	= 100 x 20 ÷ 30.613 = 65.332 (%) Do not award M4 if yield greater than 100% Use of 0.810 instead of 1.27 gives 41.699 (%) scores (3) Use of transposed M_r values gives 223.9 (%) scores (2) Allow use of 136.9 (giving 65.381(%)) Allow TE throughout Ignore SF except 1SF Correct answer with some working scores (4)	

(Total for Question 4 = 17 marks)

Total for Paper = 50 marks

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