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Mark Scheme (Results)

October 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)	An answer that makes reference to the following points: • test • colour	**(1)** **(1)**	Flame test Allow description of a flame test Ignore burning Red / crimson Allow scarlet Do not award brick red / yellow red / orange Allow sulfate (solution) added **and** forms cloudy solution/white ppt for 1 mark Marks are independent	**(2)**

Question Number	Answer		Additional Guidance	Mark
1(b)	An answer that makes reference to the following points: • correct result for barium chloride • correct result for silver nitrate	**(1)** **(1)**	No visible change / no reaction Allow no results / no observation / no change / no precipitate formed Do not award "nothing" alone White **and** precipitate/ppt/solid/crystals Ignore darkens in sunlight Ignore dissolves in dilute ammonia Ignore insoluble in acid Do not award "soluble in excess" Do not award gas formed / effervescence	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)	• suitable suggestion relating to the high temperature required	e.g. Bunsen burners will not be hot enough, better equipment will be required to reach the correct temperature, etc. Allow temperature cannot be reached (by school equipment) / temperature is **too** high Allow a **very high** temperature is needed Ignore references to energy/heat/power Ignore mention of toxic gas Ignore mention of expense Ignore references to safety Ignore "lack of supplies" alone Do not award "will catch fire"	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(d)(i)	An answer that makes reference to the following points: • heat (and reweigh) to constant mass	 Allow "no more brown gas given off" Allow "no more NO_2 given off" Allow "no longer relights a glowing splint" Ignore "no more gas/O_2 given off" Ignore "heat very strongly" Ignore references to high temperatures Ignore references to mass/volume of gas Do not award references to burning	**(1)**

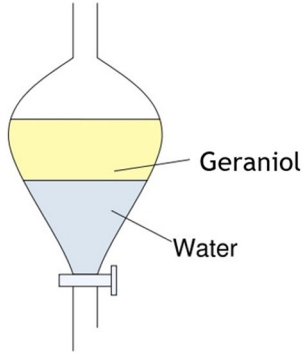
Question Number	Answer	Additional Guidance	Mark
1(d)(ii)	• colour of NO_2	Brown	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(d)(iii)	• correct procedure and result	(Re)lights a glowing splint Allow "rekindles" or "ignites" Allow "smouldering" Allow splinter / stick / spill /description of a splint Do not award "pops" NB There must be some reference to the splint having been recently extinguished and containing embers.	**(1)**

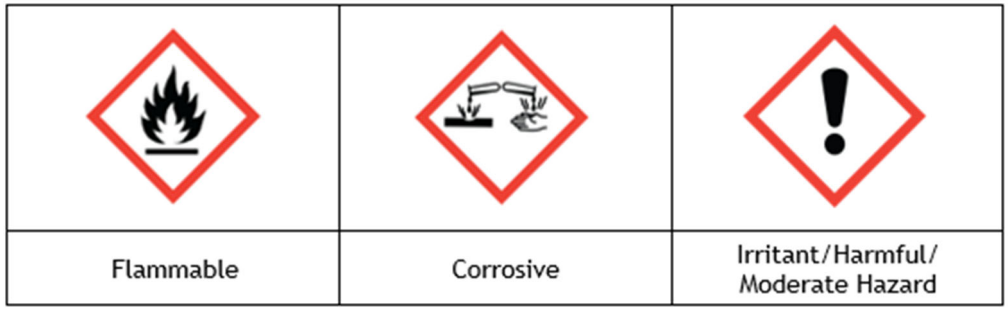
Question Number	Answer		Additional Guidance	Mark
1(d)(iv)	An answer that makes reference to the following points:			**(2)**
	• observation	**(1)**	Solid dissolves / forms a colourless solution Allow solid disappears Allow gets warmer Allow steam given off Allow sizzling sound Ignore bubbles/effervescence/fizzing	
	• product	**(1)**	Strontium hydroxide / $Sr(OH)_2$ If name and formula given both must be correct Do not award hydrogen / oxygen Marks are independent	

(Total for Question 1 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)	An answer that makes reference to the following points: • alkene with correct test **(1)** • correct colour change for alkene **(1)** • alcohol with correct test **(1)** • correct result **(1)**	Alkene **and** (shake with) bromine (water) Ignore C=C Decolourises OR (brown / orange / yellow) to colourless Allow acidified (potassium) manganate (VII), (pink/purple) to colourless Alcohol **and** add PCl_5 / phosphorus(V) chloride **(or other accepted test for M3 and observation for M4, see below)** Allow phosphorous pentachloride Allow hydroxy(l) Ignore -OH Do not award hydroxide Do not award PCl_3 Misty fumes Allow white fumes / steamy fumes Allow fumes turn damp blue litmus red Accepted tests <u>with</u> named alcohol group: Heat with acidified potassium dichromate((VI)) (Orange) to green / blue Add sodium Bubbles / effervescence Add a carboxylic acid and a strong acid A fruity smell M2 and M4 are dependent on the correct test for each being given in M1 and M3 even if the mark is not awarded	**(4)** **Expert**

Question Number	Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to the following points: • separating funnel **(1)** • diagram of separating funnel **(1)** • layers **and** the right way around **(1)**	Example of a diagram: Allow separatory/separation funnel  Diagram should show a tap - but it does not need to be labelled - and a narrow top of the vessel, capable of being stoppered Ignore stoppers/closed top Do not award M2 if tap is labelled as a stopper Geraniol labelled as the top layer Allow organic layer / alcohol layer	**(3)** **Expert**

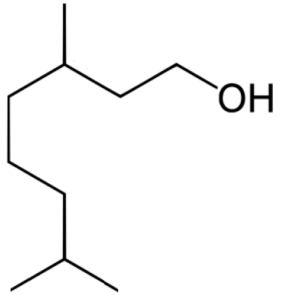
Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to the following points: • drying agent **(1)** • description of drying: mixing **(1)** • description of drying: separating **(1)**	Ignore distillation Named substance / formula (Anhydrous) calcium chloride / $CaCl_2$ (Anhydrous) sodium sulfate / Na_2SO_4 (Anhydrous) magnesium sulfate / $MgSO_4$ Allow silica gel / $CaSO_4$ Do not award anhydrous $CuSO_4$ / $NaHSO_4$ / $CaCO_3$ / NaOH / KOH / SiO_2 / Na_2CO_3 / $NaHCO_3$ If name and formula are given both must be correct Mix / shake / swirl / wait until it goes clear Allow until drying agent stops lumping together Ignore "adding to mixture" Ignore "allow to react" Ignore "leave for a period of time" Decant (the liquid) Allow pour off (the liquid) Allow filter (off the solid) Do not award "dry between filter paper" or "blot" Marks are independent	**(3)**

Question Number	Answer		Additional Guidance	Mark
2(d)(i)	• All three correct scores 2	**(2)**	 Two correct labels in boxes scores 1 mark Allow inflammable / highly flammable Ignore “burning”, “fire” Ignore damage to skin Allow “hazardous” for exclamation mark symbol Ignore “caution” Do not award the labels for other hazard symbols e.g. “health hazard”	**(2)**

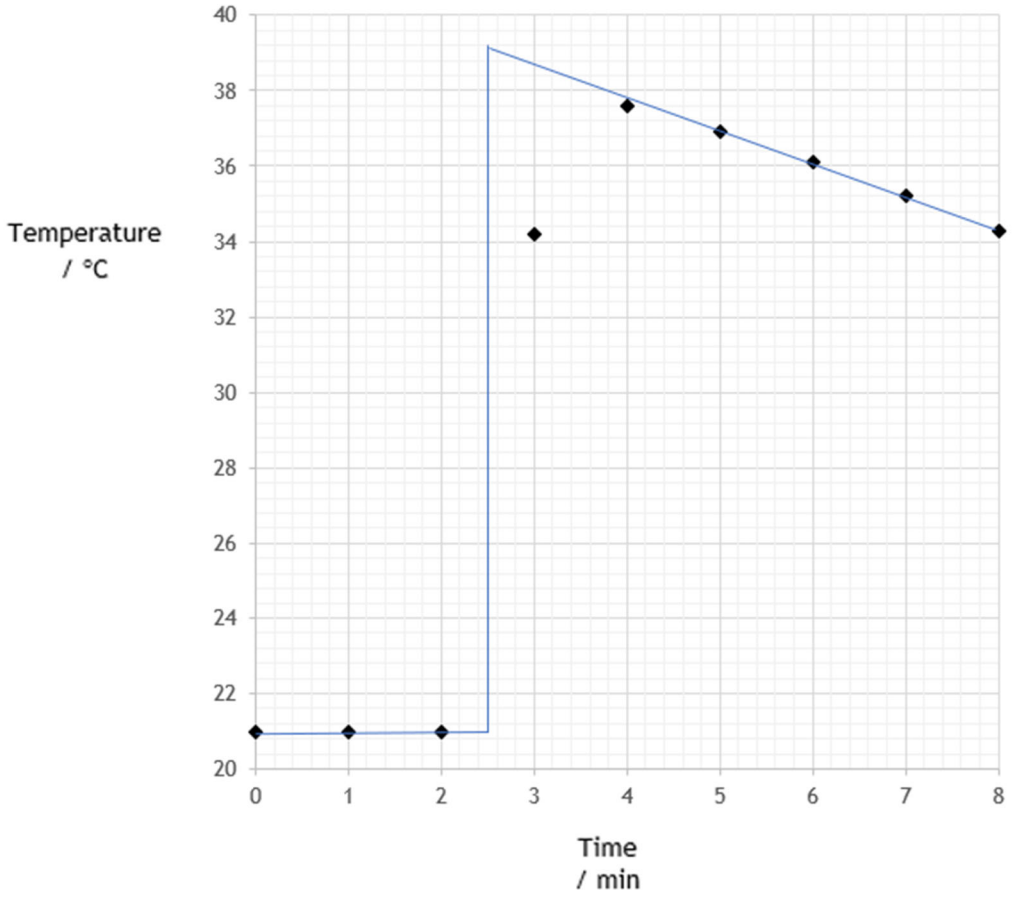
Question Number	Answer	Additional Guidance	Mark
2(d)(ii)	• a suitable precaution	e.g. Wear gloves Allow use small amounts Allow use a test tube rack/holder Allow keep lids on corrosive liquids (when not in use) Allow positive actions to prevent drips getting on bench e.g. place used pipettes in beaker, keep geraniol container in large beaker Ignore using a fume cupboard / wearing a face mask / lab coat / safety spectacles / clamps Ignore labelling of container Do not award dilution / decrease concentration	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(e)	• a suitable observation	Smoky / sooty flame Allow yellow / orange flame Allow black smoke Ignore black solid Do not award any other colours Ignore comments on size or luminosity of flame	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(f)(i)	• nickel / Ni (catalyst at 170°C)	Platinum / Pt OR palladium / Pd (at room temperature) Ignore temperature/heat/reflux Ignore pressure Do not award distil	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(f)(ii)	• skeletal formula	 Ignore bond lengths and angles Ignore other products and labels	**(1)**

(Total for Question 2 = 16 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	• axes correct way round **and** linear scales allow data to occupy more than half of each axis **(1)** • axes labelled with units **(1)** • all points plotted correctly **(1)**	An example of a graph:  Allow T for temperature and t for time for M2, but not T and T NB Lines not needed for (a)	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(b)	An answer that makes reference to the following points: • two correct extrapolated lines drawn **(1)** • correct value for ΔT **(1)**	(see graph above for lines) One line is horizontal 0 to 2.5 mins, the other line is diagonal through the final points and extrapolated back to 2.5 mins. Vertical line is not required. Ignore longer extrapolated lines ΔT = 38.6 – 21.0 = 17.6 (°C) **M2 dependent on the temperature difference being measured at 2.5 mins** (Allow answers in the range 17.1 – 18.2) Allow TE from graph for M2	**(2)**

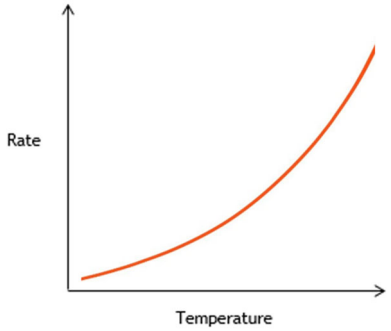
Question Number	Answer	Additional Guidance	Mark
3(c)	• reason for lower value	Heat loss (to the surroundings) Heat loss (to the apparatus) Mass of solution is more than 25 g Density is more than 1 g cm^{-3} Specific heat capacity is not 4.2 / 4.18 J g^{-1} °C^{-1} Heat capacity of the polystyrene cup assumed to be 0 Allow energy loss in place of heat loss Ignore heat loss to the thermometer Ignore non-standard conditions Do not award incomplete reaction Do not award transfer errors	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(d)(i)	• –44.6 (kJ mol^{-1})	Example of a calculation: – 39.0 – (+5.6) = –44.6 (kJ mol^{-1}) Ignore units even if incorrect	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(d)(ii)	• suitable suggestion	e.g. It is hard to add the correct amount of water e.g. Some crystals would be dissolved whilst others may not be (fully) hydrated e.g. It is hard to measure the temperature (change) of a solid Ignore copper sulfate is soluble in water "Because it is a solid" is not enough Ignore standard conditions Ignore "it is not possible to measure it"	**(1)**

(Total for Question 3 = 8 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An answer that makes reference to the following points: • calculation of rate **(1)** • answer to 1 or 2 SF **(1)** • units **(1)**	Example of a calculation: Time read from graph = 33 seconds 1 ÷ 33 = 0.0303 Allow answer left as fraction 0.030 / 0.03 TE from M1 for values between 32.5 and 33.5 s^{-1} Allow "per second" Allow sec^{-1} / $seconds^{-1}$ Allow "/s" Marks are independent	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	• line that shows rate increasing with temperature **AND** line is curved with the gradient increasing	Example of a graph:  Allow a graph starting from the origin	**(1)**

Question Number	Answer		Additional Guidance	Mark
4(b)	An explanation that makes reference to the following points: • all but one point is on the best fit line / there is one anomaly (at 40°C) / a clear trend can be seen • it is not necessary to repeat the experiment as the anomaly has been identified (and excluded from the line of best fit)	**(1)** **(1)**	Allow all but one point follow a pattern Allow reference to point at 40° not being correct Allow outlier in place of anomaly Allow not necessary to repeat the experiment as the pattern between rate and temperature is clear Allow not necessary to repeat as results are consistent Ignore comments about accuracy	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to the following points: • reduce the concentration (of one or more of the reactants)	Allow specific suggestions e.g. doubling/increasing volume, use a thinner/paler cross, dilute the solution Allow amount for volume Ignore pressure Ignore suggestions related to maintaining temperature at 22°C Do not award "reduce the concentration of the opaque solution" Do not award "use a different type of opaque solution"	**(1)**

(Total for Question 4 = 7 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)	• table completed correctly	Example table: <table><tr><td></td><td colspan="5">Titration number</td></tr><tr><td></td><td>Rough</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Final reading / cm^3</td><td>24.90</td><td>21.25</td><td>42.85</td><td>21.80</td><td>43.15</td></tr><tr><td>Initial reading / cm^3</td><td>2.30</td><td>0.00</td><td>21.25</td><td>0.50</td><td>21.80</td></tr><tr><td>Titre / cm^3</td><td>22.6(0)</td><td>21.25</td><td>21.6(0)</td><td>21.3(0)</td><td>21.35</td></tr></table>	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	• not concordant OR more than (±)0.20 / 0.10 (cm^3) from results 1, 3 and 4	Accept "Only 1, 3, and 4 are concordant / within 0.2 / 0.1 (cm^3)"	**(1)**

Question Number	Answer		Additional Guidance	Mark
5(b)(ii)	• calculation of mean	**(1)**	An example of a calculation: $\frac{21.25 + 21.30 + 21.35}{3} = 21.3(0)\ (\text{cm}^3)$	**(4)**
	• calculation of moles of hydrochloric acid	**(1)**	n = c × v = (21.30÷1000) × 0.5 = 0.01065 / 1.065 x 10^{-2}	
	• calculation of moles of sodium hydroxide solution	**(1)**	0.01065 / 1.065 x 10^{-2} (1:1 stoichiometry)	
	• calculation of concentration of sodium hydroxide solution	**(1)**	c = 0.01065 ÷ 0.025 = 0.426 / 0.43 (mol dm^{-3}) Ignore SF except 1SF TE throughout Correct answer with no working scores (4) 0.587 (mol dm^{-3})/ 0.59 (mol dm^{-3}) scores (3) Ignore units even if incorrect	

Question Number	Answer		Additional Guidance	Mark
5(c)	• (±)0.468% / (±)0.47% / (±)0.5%		An example of a calculation: ((0.05 × 2) ÷ 21.35) × 100 = (±)0.468% Allow 1, 2 or 3SF Ignore missing percentage sign Do not award 4SF Penalise incorrect rounding	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(d)	An answer that makes reference to the following points: • correct start colour **(1)** • correct end colour **(1)**	(Pale) pink Do not award purple Colourless Allow 1 mark for colours in reverse order	**(2)**

(Total for Question 5 = 9 marks)

TOTAL FOR PAPER = 50 MARKS

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