Mark Scheme (Results)

January 2020

Pearson International Advanced Subsidiary Level In Chemistry (WCH13)
Paper 01 Practical Skills in Chemistry

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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)	• (colourless sodium chloride) becomes brown / orange / yellow / darker Or • bromine water turns lighter in colour (due to dilution) **(1)** • (Sodium iodide) solution turns darker/brown/orange **(1)**	Standalone marks Do not award additional incorrect observations Ignore reference to layers Allow No change / no (visible) reaction or Remains brown/orange / yellow Do not award any indication of a reaction any other colour Allow black or grey **solid** Do not award purple (vapour, solution, solid)	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	• Test: Flame Test **(1)** • Observation: Yellow **(1)**	 Allow Orange or yellow-orange Ignore persistent / golden/ bright (yellow)	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	• Ammonium sulfate White precipitate /solid **(1)** • Ammonium nitrate No change / no reaction **(1)**	Allow ppt for precipitate Do not award if any additional observations are made such as bubbles/fumes Allow no precipitate / no observation Ignore any formulae even if incorrect	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	• Test: (add) (aqueous) sodium hydroxide (heat) **(1)** • Result: **Gas** evolved which turns (damp) red litmus blue **(1)**	Allow any hydroxide Accept white smoke with HCl Allow **Gas** turns litmus blue / **Gas** turns universal indicator blue pungent smelling **gas** Ignore NH_3 / alkali gas / steamy fumes The result mark is dependent on the correct test or just 'heat' for the test with no sodium hydroxide.	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	• (Turns) green **(1)** • No change/no reaction/remains orange **(1)**	Allow blue / blue-green / green-blue / Grey-green Ignore smell Do not award if additional observations are made e.g. bubbles Allow no observation Colours reversed scores one mark If wrong starting colour stated max 1	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	• Test: phosphorus(V)chloride/ PCl_5 **(1)** • Result: Steamy fumes/ white fumes/misty fumes **(1)** OR • Test: sodium/Na **(1)** • Result: effervescence / bubbles/fizzing **(1)** OR • Test: add any named carboxylic acid and (conc) sulfuric acid (and warm) **(1)** • Result: (product has) sweet/fruity/ester smell **(1)**	The result mark depends on a correct test or near miss Allow phosphorus pentachloride / thionyl chloride / $SOCl_2$ / PCl_3 Do not award white smoke Ignore effervescence/gas turns litmus red/gas forms white smoke with NH_3 Accept gas given off burns with a squeaky pop Allow white solid / sodium dissolves Allow just carboxylic acid and any named strong acid	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(d)	• Hexane: (forms two layers and the lower layer) remains pink/purple **(1)** • Hexene: (potassium manganate(VII)) turns colourless **(1)**	Allow no change / no reaction / no observation Ignore shades of pink / purple Allow 1 mark if the observations are reversed Do not award if the wrong colour is stated	**(2)**

(Total for Question 1 = 14 Marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	• **M1** Mass of 10 cm length of Mg ribbon **(1)** • **M2** Converting mass of Mg ribbon to moles **(1)**	Penalise rounding errors once only in 2a and 2bi and nowhere else in the paper. Example of calculation 0.86/10 = 0.086 (g) 0.086/24.3 = 3.5391 x 10^{-3} / 0.0035391 (mol) =3.54 x 10^{-3} (mol) / 0.00354 (mol) Do not award rounding error, e.g. 3.53 x 10^{-3} TE on any incorrect mass in M1 Ignore SF except 1SF Use of 24 gives 3.5833 x 10^{-3} scores (2) Correct answer with or without working scores(2)	**(2)**

Question Number	Answer		Additional Guidance	Mark
2(a)(ii)			Example of calculation	(4)
	• **M1** Calculates temp change	**(1)**	29.2 – 21.4 = 7.8 (°C)	
	• **M2** Calculates energy change	**(1)**	50 x 4.2 x 7.8 = 1638 (joules) / 1.638 kJ Ignore minus sign	
	• **M3** energy/moles	**(1)**	1638/3.5391 x 10^{-3} (= 462830)	
	• **M4** Completion of calculation, correct sign and units and 1, 2 or 3SF	**(1)**	−463 / −460/−500 kJ mol^{-1} Or −463000 / −460000 /−500000 J mol^{-1} Correct answer with or without working scores all marks Use of 24 gives −457 kJ mol^{-1}scores (4) Allow TE from (a)(i) and M1 to M3.	

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	• Calculation of percentage uncertainty	Example of calculation $\frac{(+/-)\ 0.1 \times 2}{7.8} \times 100 = 2.56\ (\%)$ Allow TE for wrong temperature change Do not award if either temp used Ignore SF	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An explanation that makes reference to the following points: **M1** • Use greater mass of magnesium **Or** • Smaller volume of hydrochloric acid **(1)** **M2** (So the) temperature **change** will be greater/temperature will **increase** more **(1)**	Standalone marks. Even if the answer to M1 would not produce a temperature rise M2 can be scored. Allow More magnesium Allow Less hydrochloric acid Ignore increase the concentration of hydrochloric acid Do not award reduce the concentration of the hydrochloric acid Do not award temperature cooling curve or any other changes to the procedure to reduce heat loss	(2)

Question Number	Answer	Additional Guidance	Mark
2(c)	An explanation that makes reference to the following points: **M1** • The enthalpy change will be less negative / less exothermic **(1)** **M2** • The heat loss will be greater Or • (Because) polystyrene is a better insulator Or • More energy is used to heat the container/ glass Or • (Because) the polystyrene cup has a low heat capacity **(1)**	Allow reverse arguments for **M2** Allow lower/smaller Allow glass absorbs heat Ignore references to the mechanism of heat loss No TE on incorrect **M1**	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(d)	An explanation that makes reference to the following points: • **M1** To remove magnesium oxide **(1)** • **M2** The two enthalpy changes would be different **(1)**	Allow The magnesium is oxidised / corroded / tarnished Ignore just impurities Do not award rust Allow The enthalpy change will be less exothermic / less negative Allow Only Mg is being weighed / reacted Or So the Mg is pure Or the mass of Mg would be lower if the layer were not removed. Ignore any references to rate of reaction	**(2)**

(Total for Question 2 = 13 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	• (From) Yellow **(1)** • (to) orange **(1)**	Do not award red Colours correct in reverse order scores (1)	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b) (i)	4 correct values (1) correct calculation using concordant values (1)	Example of calculation (26.10 + 26.20= 52.30/2) = 26.15 (cm^3) TE on incorrect subtractions as long as the values chosen are concordant.	**(2)**

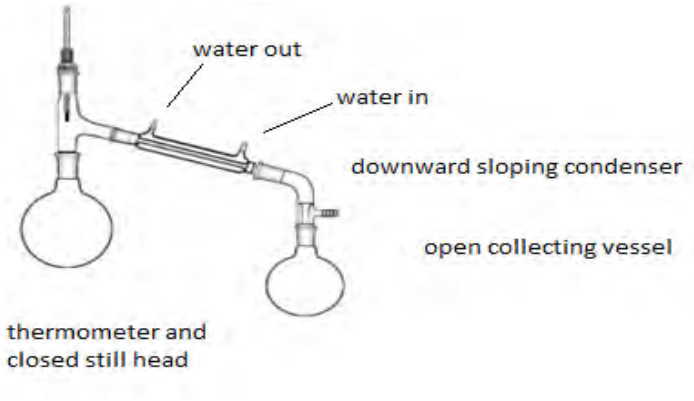
Number of titration	1	2	3	4
Burette reading (final) / cm^3	27.55	26.25	28.30	26.15
Burette reading (start) / cm^3	0.00	0.05	1.05	0.05
Volume of HCl used / cm^3	**27.55**	**26.2(0)**	**27.25**	**26.1(0)**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	Possible route through the calculation • **M1** Calculation of the amount of hydrochloric acid (1) • **M2** Calculation of the amount of sodium carbonate in 25 cm^3 (1:2 ratio) (1) • **M3** M_r Na_2CO_3 (1) • **M4** Mass of Na_2CO_3 in 250 cm^3 (1) • **M5** Calculation of the percentage purity of Na_2CO_3 (1)	Example of calculation TE on mean titre from (b)(i) Mol of HCl = 26.15 x 0.200/1000 = 5.23 x 10^{-3}/ 0.00523 (mol) Mol of Na_2CO_3 = 5.23 x 10^{-3}/2 = 2.615 x 10^{-3} / 0.002615 (mol) 106 or allow correct value used in a calculation = 2.615 x 10^{-3} x 10 x 106 = 2.7719 (g) 2.7719/4.89 x100 = 56.685 = 56.7 (%) TE at each stage IGNORE SF except 1 % impurity 43.315 % scores (4) Correct answer with or without working scores (5) marks Ignore rounding errors	**(5)**

(Total for Question 3 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	An explanation that makes reference to the following points: • the reaction is exothermic **(1)** • prevents the mixture boiling over **(1)**	Allow the reaction gives out heat Ignore the reaction is vigorous Allow To prevent the ethanol evaporating/boiling To prevent bubbling / spitting / spraying / splattering Ignore splashing / explosions / spilling / cracking flasks	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following points: • increases / speeds up the rate of reaction **(1)** • because the surface area (of the potassium bromide) is increased **(1)**	Standalone marks Allow large surface area Ignore goes to completion	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	A diagram that shows the following points: • **M1** Round-bottomed flask, heat and thermometer in the correct position opposite the condenser opening. **(1)** • **M2** Correct downward sloping condenser **and** water flowing in the correct direction **(1)** • **M3** No gaps on the LHS and open collecting vessel or vent **(1)**	Allow Pear-shaped flask, arrow for heat / **hot** water bath / electric heater / Bunsen burner The bulb of the thermometer anywhere above the flask One-piece apparatus Do not award conical flask Ignore lack or presence of anti-bumping granules Ignore fractional distillation column Ignore lines between apparatus  Reflux apparatus can only score one mark for correct flask, heat and condenser with the correct correct water flow	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	• Promotes smooth or even boiling or Provides sites for bubbles to form / site for nucleation / promotes (small) bubble formation	Allow to stir the mixture Allow to prevent the formation of large bubbles / to break up large bubbles Ignore to prevent bumping	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(d)(i)	Any 2 of the following • The density of bromobutane is great**er** (than the aqueous layer) **(1)** • Bromoethane is immiscible (with water) **(1)** • Bromoethane is a liquid (at room temperature) **(1)**	Allow water/ 1 g cm^{-3} reverse argument Allow does not mix / insoluble (in water) / bromoethane is non polar	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(d)(ii)	A description that makes reference to the following points: • (open the tap and) run off the bromobutane layer into a beaker (and discard the aqueous layer) or Remove the aqueous layer with a (teat) pipette/ syringe	Do not award Just pouring off/decant the aqueous layer from the top	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(e)	• To neutralise the acid / H^+ ions / H_3O^+	Allow Remove the acid Hydrobromic acid / sulfuric acid Ignore reference to impurities	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(f)(i)	• (solid) (anhydrous) calcium chloride/sodium sulfate/calcium sulfate/magnesium sulfate	Name or correct formula. Allow silica gel Do not award Conc H_2SO_4 / anhydrous copper sulfate If a list is given all must be suitable drying agents to score. If name and formula given both must be correct.	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(f)(ii)	• (Bromoethane) becomes less cloudy/ goes clear	Do not award just colourless Ignore any stated colour as long as it does not change.	**(1)**

(Total for Question 4 = 14 Marks)
Total for the paper = 50 Marks