Pearson Edexcel

Mark Scheme (Results)

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

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	A description that makes reference to the following points: **M1** – nichrome wire **(1)** **M2** – use of (concentrated) hydrochloric acid/HCl((aq)) **(1)** **M3** – transfer of sample to wire **and** placement in (hot/roaring/colourless/blue/non-luminous) **flame** **(1)** **M4 (standalone)** – lilac (flame colour of potassium) **(1)**	Allow loop or rod for wire Accept nickel-chromium (alloy)/NiCr wire Allow platinum/Pt wire Allow silica rod Do not award just nickel/Ni or chromium/Cr wire Do not award inoculating loop / sterilising wire / wooden splint Allow any reasonable use of HCl((aq)), eg in cleaning of wire / in making a paste/solution Do not award any other acid Allow solid/potassium sulfate/K_2SO_4/salt/compound/ substance/powder/paste/solution for sample Allow any suitable method of transferring sample to the wire, eg dipping wire in sample Ignore spray solution in flame Allow on/over/under/near/show/above for "in" flame Do not award safety/yellow flame Do not award fire for flame Do not award burn in flame Ignore violet/mauve/lavender Do not award pink Do not award purple	**4**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that makes reference to the following points: • colour of precipitate **(1)** • ionic equation with state symbols **(1)**	 white Ignore shades, eg pale/bright/dull Do not award any other colour, eg creamy-white Ba^{2+}**(aq)** + SO_4^{2-}**(aq)** → $BaSO_4$**(s)** Allow multiples Ignore full equations as working, even if incorrect Do not award uncancelled Cl^-, K^+ or H^+ spectator ions	**2**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	An explanation that makes reference to the following points: • (gas turned litmus) blue **(1)** • (showing formation of) ammonia/NH_3 **(1)**	 Allow (litmus showed) production of alkaline/basic gas Ignore purple for blue Ignore effervescence Ignore pungent smell Ignore universal indicator paper Ignore litmus turned blue by ammonium ions/NH_4^+ Do not award litmus turned blue by solution/sodium hydroxide Do not award other incorrect observations, eg rotten-egg smell Allow any indication of production of ammonia/NH_3, eg (NH_4^+ + OH^- →) NH_3 (+ H_2O)	**2**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to the following points: • formula of gas evolved **(1)** • formula of precipitate that dissolved in dilute nitric acid **(1)** • formula of precipitate that dissolved in concentrated ammonia solution **(1)**	Penalise use of names for formulae once only Ignore state symbols, even if incorrect CO_2 Ag_2CO_3 AgBr	**3**

(Total for Question 1 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)	An answer that makes reference to the following points: **M1** • moles magnesium added **(1)** **M2** • moles hydrochloric acid required **or** volume of hydrochloric acid required **or** moles of magnesium required **or** mass of magnesium required **(1)** **M3 – dependent on M1 and M2** • HCl is in excess **or** Mg is limiting **(1)**	<u>Examples of calculation</u> = 0.030 ÷ 24.3 = 0.0012346 / 1.2346 × 10^{-3} (mol) Allow 0.00125 / 1.25 × 10^{-3} (mol) from A_r = 24 = 0.0012346 × 2 = 0.0024692 / 2.4692 × 10^{-3} (mol) = 0.0012346 × 2 = 0.0024692 / 2.4692 × 10^{-3} (mol) and = 0.0024692 ÷ 2.0 = 0.0012346 dm^3 = 1.2346 cm^3 = 0.05 ÷ 2 = 0.025 (mol) = 0.05 ÷ 2 = 0.025 (mol) and = 0.025 × 24.3 = 0.6075 (g) Allow just moles HCl added = 2.0 × 0.025 = 0.05 in M2 (which is allowed to be given to 1SF) Allow any indication that HCl is in excess, eg 0.05 / moles of HCl > 0.0024692 / twice moles of Mg eg 25 (cm^3) / added volume > 1.2346 (cm^3) / required volume Allow any indication that Mg is limiting, eg 0.0012346 / moles of Mg < 0.025 / half moles of HCl eg 0.03 (g) / added mass < 0.6075 (g) /required mass	**3**

Question Number	Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to one of the following points: • (Mg is) not in contact with hydrochloric acid/HCl((aq)) **or** hydrochloric acid/HCl((aq)) has not yet diffused (down burette)	Accept (Mg is) only in contact with water Allow (Mg) does not react / reacts slowly with water Allow (Mg is) not in contact with reactant(s) Ignore just water is at the top (of the burette) Ignore (Mg has) magnesium oxide coating / (Mg) does not react until magnesium oxide coating removed Ignore slow rate Do not award small surface area (of Mg) Allow contents of burette are not mixed / homogeneous Allow takes time for acid/mixture to reach Mg Ignore takes time for the liquids to switch places Ignore takes time for the reaction to start Ignore hydrochloric acid/HCl((aq)) is too dilute Ignore hydrochloric acid is more dense than water Do not award hydrochloric acid is less dense than water	**1**

Question Number	Answer	Additional Guidance	Mark
2(c)	• burette reading in Step 4 **and** burette reading in Step 5 **(1)** • volume of hydrogen gas **(1)**	Ignore units, even if incorrect 46.25 **and** 10.7(0) Do not award any other answers (= 46.25 – 10.70 =) 35.55 TE on M1 provided answer is to 2 d.p.	**2**

Question Number	Answer	Additional Guidance	Mark
2(d)	• moles (of hydrogen = moles Mg) **(1)** • volume of 1 mol of hydrogen gas in cm^3 **(1)**	<u>Example of calculation</u> = 0.030 ÷ 24.3 = 0.0012346 / 1.2346×10^{-3} (mol) Allow 0.00125 / 1.25×10^{-3} from $A_r = 24$ Do not award moles of HCl = 2 × 0.0012346 = 0.0024691 = 35.55 ÷ 0.0012346 = 28796 (cm^3) / 2.8796×10^4 (cm^3) Allow 28.796 dm^3 / 28.796 L Ignore SF except 1SF TE on 2(c) TE on M1 Correct answer with some working scores (2)	**2**

Question Number	Answer	Additional Guidance	Mark
2(e)	An explanation that makes reference to the following points: • moles of magnesium/Mg (reacting) would be smaller **or** moles of hydrogen (used in calculation) would be too high **(1)** • (cannot account for difference and) effect on (calculated) volume of 1 mole of hydrogen gas **(1)**	Allow mass for moles Allow just less magnesium/Mg (reacting) Allow moles/mass of magnesium/Mg used **in calculation** would be too high Allow actual mass of magnesium could be (as low as) 0.0294 (g) Allow actual moles of magnesium could be (as low as) 0.0012099 Allow less hydrogen produced (in reaction) Do not award can account for difference (calculated molar) volume would be (even) higher Allow (calculated molar) volume could be (as high as) 29383 (cm^3) Allow answer for volume If no other marks awarded, (cannot account for difference and) difference between calculated and Data Book values is greater than 2% scores (1)	**2**

Question Number	Answer	Additional Guidance	Mark
2(f)(i)	• percentage uncertainty in mass	Example of calculation (= $\frac{(2 \times 0.0025)}{0.030}$ × 100 =) 16.667 (%) Ignore SF except 1SF Correct answer with no working scores (1) Do not award any other answer	**1**

Question Number	Answer	Additional Guidance	Mark
2(f)(ii)	An answer that makes reference to the following point: • volume of hydrogen/gas (produced) would be greater than burette volume	Allow volume of hydrogen/gas (produced) too large Allow just too much hydrogen/gas produced Allow titre too large / cannot be measured by burette / capacity of burette too small Allow not enough space (in burette) for hydrogen/gas Allow 71.1(0) cm^3 is greater than 50 cm^3/burette (volume) Do not award hydrogen/gas produced too quickly Do not award any reference to magnesium being in excess / hydrochloric acid being limiting	**1**

(Total for Question 2 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	An answer that makes reference to the following point: • (solution of accurately) known concentration	Allow known mass/amount (of solute) **and** volume (of solution) Allow specific/stated for known Ignore constant/fixed/uniform/precise/exact for known Ignore solution prepared from a primary standard Ignore any reference to standard conditions	**1**

Question Number	Answer	Additional Guidance	Mark
3(b)	A description that makes reference to the following points: **M1** – molar mass of ethanedioic acid dihydrate **(1)** **M2** – required mass of ethanedioic acid dihydrate **(1)** **M3** – use of volumetric flask (as final piece of apparatus) **(1)** **M4** – use of distilled/deionised water (to make solution) **(1)** **M5** – complete transfer of required mass of solid (to final piece of apparatus with washings if needed) and dissolving **(1)** **M6** – making (solution) up to the mark / a total volume of 100 cm^3 **and** mixing **(1)**	<u>Example of calculation</u> = 2×1 + 2×12 + 4×16 + 2×18 = 126(.0) (g mol^{-1}) n = 0.0500 × 0.1000 = 0.005(00) (mol) mass = 0.005(00) × 126(.0) = 0.63(0) (g) TE on M1 Allow standard flask / graduated flask Do not award conical flask Do not award round-bottomed flask Do not award beaker Allow use of distilled/deionised water anywhere in the preparation **Ignore volume of water in M4 and M5** eg dissolve in beaker and transfer with washings eg transfer solid, dissolve and add washings from container eg weigh into flask and dissolve Do not award any method that would result in only partial transfer of the required mass of solid, eg some remaining in the weighing container Do not award any method that would lead to a solution volume greater than 100 cm^3 Allow any indication of mixing, eg shaking/swirling/stirring/inverting	**6**

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	An answer that makes reference to the following point: • (25.0 cm^3 volumetric) pipette	Ignore graduated/adjustable Ignore pipette filler Do not award incorrect volume, eg 50.0 cm^3 Do not award Pasteur/dropping/teat pipette Do not award burette Do not award syringe	**1**

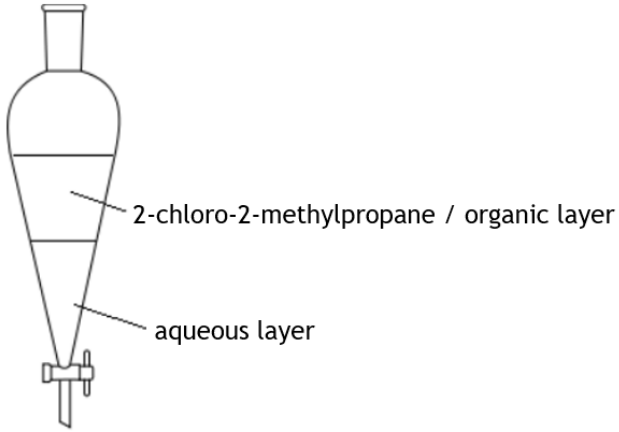
Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	An answer that makes reference to the following points: • (from) colourless **(1)** • (to pale) pink **(1)**	Ignore clear Do not award purple Do not award red Reverse colour change scores (1)	**2**

Question Number	Answer	Additional Guidance	Mark
3(c)(iii)	An answer that makes reference to the following point: • BaC_2O_4 / barium ethanedioate	If name and formula given then both must be correct Accept $Ba(COO)_2$ / barium oxalate Allow $Ba(HC_2O_4)_2$ / barium hydrogenethanedioate Do not award $BaCO_3$ / barium carbonate Do not award $Ba(HCO_3)_2$ / barium hydrogencarbonate Do not award $BaSO_4$ / barium sulfate	**1**

Question Number	Answer		Additional Guidance	Mark
3(c)(iv)	**M1** • moles of $H_2C_2O_4$ / $Ba(OH)_2$	**(1)**	Example of calculation $= \frac{0.0500 \times 25}{1000} = 0.00125 = 1.25 \times 10^{-3}$	**3**
	M2 and M3 – method 1 • concentration of $Ba(OH)_2$ (in mol dm^{-3})	**(1)**	$= \frac{0.00125 \times 1000}{31.55} = 0.039620$ (mol dm^{-3}) TE on M1	
	• concentration of $Ba(OH)_2$ (in g dm^{-3}) **and** to 2SF or 3SF	**(1)**	(= 0.039620 × 171.3 = 6.7868) 6.8 / 6.79 (g dm^{-3}) TE on M2	
	M2 and M3 – method 2 • mass of $Ba(OH)_2$	**(1)**	= 1.25 × 10^{-3} × 171.3 = 0.21413 (g) TE on M1	
	• concentration of $Ba(OH)_2$ (in g dm^{-3}) **and** to 2SF or 3SF	**(1)**	(= 0.21413 ÷ 0.03155 = 6.7868) 6.8 / 6.79 (g dm^{-3}) TE on M2	
			Correct answer **to 2SF or 3SF** with some working scores (3)	

(Total for Question 3 = 14 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	An answer that makes reference to one of the following points: • (to prevent) acid spray **or** (to prevent production of) toxic fumes (of HCl) **or** (to prevent mixture getting) too hot **or** (to prevent) build up of pressure	Ignore just vigorous/violent/aggressive reaction Ignore just to control rate Allow (to prevent) splashing/spilling of acid due to vigorous/violent/aggressive reaction Ignore just splashing/spilling of acid Allow (to prevent production of) corrosive fumes (of HCl) Allow vapour(s)/gas(es) for fumes Ignore just hydrochloric acid/HCl is toxic/corrosive Do not award incorrect identification of fumes, eg Cl_2 Allow (to prevent) boiling (over) Ignore just exothermic Ignore just to control temperature Allow (to prevent) stopper shooting off Do not award (to prevent) explosion	**1**

Question Number	Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following points:	<u>Example of labelled diagram:</u>  	**2**
	• diagram of separating funnel **(1)**	Diagram should show a tap with stem below (neither of which need to be labelled), and a narrow top that is capable of being stoppered Ignore stoppers/closed top Do not award if tap is labelled as a stopper	
	• labelled layers **and** in the correct order **(1)**	Allow (concentrated) water/hydrochloric acid/alcohol/ 2-methylpropan-2-ol/non-organic for aqueous layer Allow two layers with correct labelling of one layer Do not award single layer or more than two layers Do not award if no clear separation between the layers	

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to one of the following points: • reacts with organic product/layer **or** reforms alcohol **or** acts as a nucleophile	Ignore cannot tell when neutralisation/reaction is complete Ignore more hazardous, eg (more) corrosive Accept reacts with 2-chloro-2-methylpropane/$(CH_3)_3CCl$ Ignore damages/destroys/decomposes for reacts Ignore just too reactive / to prevent vigorous reaction Ignore side reactions Ignore reacts with hydrochloric acid Do not award reacts with water/alcohol Accept reforms 2-methylpropan-2-ol/$(CH_3)_3COH$ Allow forms alkene/2-methylpropene/$CH_2C(CH_3)_2$ Allow hydrolyses (organic product) Allow (causes) elimination (reaction) Do not award reference to incorrect reaction type Do not award other incorrect reasons, eg build up of pressure	**1**

Question Number	Answer	Additional Guidance	Mark
4(d)	An answer that makes reference to the following point: • drying agent	Ignore any reference to making clear Allow to remove/absorb water Allow drying reagent Allow just to dry Ignore to react with water Do not award dehydrating agent Do not award any other reason	**1**

Question Number	Answer	Additional Guidance	Mark
4(e)	An answer that makes reference to the following points: **M1 (first change)** – reverse (condenser) water flow **(1)** **M2 (reason for first change)**– to fill (condenser) with water **(1)** **M3 (second change)** – stopper/seal (still head with thermometer) **(1)** **M4 (reason for second change)** – to prevent escape of gas/ vapour/product **(1)**	Accept changes given in either order Allow changes to be shown on the diagram Ignore any reference to a heat source Ignore any reference to adding (more) water to the ice-water mixture Allow any indication, eg water should enter at bottom / leave at top / "swap tap and sink" **M2 must relate to (condenser) water flow** Allow to remove air/bubbles (from condenser) Allow for more efficient/better cooling Allow block Allow just bung/cork Ignore lid Ignore just thermometer Do not award stopper/seal conical flask Do not award diagrams showing thermometer with gap in still head / bulb in the organic liquid **M4 must relate to stopper/thermometer (in still head)** Allow thermometer to measure temperature	**4**

Question Number	Answer		Additional Guidance	Mark
4(f)			Allow TE throughout Ignore SF except 1SF Correct answer with some working scores (4)	**4**
	M1 • mass of 2-methylpropan-2-ol	**(1)**	<u>Examples of calculation:</u> = 0.78 × 9.0 = 7.02 (g)	
	M2 to M4 – method 1 • theoretical moles for 100% yield	**(1)**	= 7.02 ÷ 74.0 = 0.094865 (mol)	
	• theoretical mass for 100% yield	**(1)**	= 0.094865 × 92.5 = 8.775 (g)	
	• mass of 2-chloro-2-methylpropane for 70% yield	**(1)**	= 0.70 × 8.775 = 6.1425 (g)	
	M2 to M4 – method 2 • theoretical moles for 100% yield	**(1)**	= 7.02 ÷ 74.0 = 0.094865 (mol)	
	• theoretical moles for 70% yield	**(1)**	= 0.70 × 0.094865 = 0.066405 (mol)	
	• mass of 2-chloro-2-methylpropane for 70% yield	**(1)**	= 0.066405 × 92.5 = 6.1425 (g)	
	M2 to M4 – method 3 • theoretical mass for 70% yield	**(1)**	= 0.70 × 7.02 = 4.914 (g)	
	• theoretical moles for 70% yield	**(1)**	= 4.914 ÷ 74.0 = 0.066405 (mol)	
	• mass of 2-chloro-2-methylpropane for 70% yield	**(1)**	= 0.066405 × 92.5 = 6.1425 (g)	

(Total for Question 4 = 13 marks)
Total for Paper = 50 marks