



Mark Scheme (Results)

January 2021

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

Question Number	Answer	Additional Guidance	Mark
1 (a)(i)	<ul style="list-style-type: none"> (Solution A is) nitric acid 	Accept $\text{HNO}_3/\text{HNO}_3(\text{aq})$ Ignore dilute and concentrated If both name and formula given, both must be correct	1

Question Number	Answer	Additional Guidance	Mark
1 (a)(ii)	<ul style="list-style-type: none"> (Solution C is) sodium carbonate 	Accept $\text{Na}_2\text{CO}_3/\text{Na}_2\text{CO}_3(\text{aq})$ Ignore dilute and concentrated If both name and formula given, both must be correct	1

Question Number	Answer	Additional Guidance	Mark
1 (a)(iii)	<ul style="list-style-type: none"> $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ (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 $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{CO}_3(\text{aq})$ for 1 mark	2

Question Number	Answer	Additional Guidance	Mark
1(a)(iv)	<ul style="list-style-type: none"> (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)	<ul style="list-style-type: none"> Ba²⁺ 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)	<p>An answer that makes reference to one of the following points</p> <ul style="list-style-type: none"> All the acid/reactant/solid/solution/substance weighed out should be added / transferred (to the flask) (1) <p>Or</p> <p>none of the acid/reactant/solid/solution/substance weighed out/solution should be left behind (in the beaker)</p> <p>Or</p> <p>the solution remaining in the beaker will contain some dissolved ethanedioic acid/ (if washings not added) the solution concentration will be lower</p> <p>Or</p> <p>to ensure the amount of acid in the solution is known accurately</p>	<p>Allow “so that all of the solution is transferred”</p> <p>Ignore just “transfer losses” just “to ensure accuracy”</p>	1

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	<ul style="list-style-type: none"> calculation of moles ethanedioic acid in solution (1) calculation of concentration in mol dm^{-3} to 2/3 SF (1) 	<p><u>Example of calculation</u> $2.40 \div 90 = 0.0267/0.027 \text{ (mol)}$</p> <p>$0.0267 \times \frac{1000}{250} = 0.1066 = 0.107/0.11 \text{ (mol dm}^{-3}\text{)}$</p> <p>If moles rounded to 0.027 then $0.108 \text{ mol dm}^{-3}$ to 3 SF Allow TE on incorrect moles Penalise incorrect units in final answer only</p>	2

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	<p>An answer that makes reference to</p> <ul style="list-style-type: none"> to prevent dilution of the acid <p>Or</p> <p>so the burette only contains acid</p> <p>Or</p> <p>to remove (remaining) water</p>	<p>Ignore:</p> <ul style="list-style-type: none"> affect or change the concentration any references to pH <p>Do not award: “removing impurities”</p>	1

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	<p>An answer that makes reference to</p> <ul style="list-style-type: none"> the bottom of the meniscus should be on the mark (1) <ul style="list-style-type: none"> the reading should be taken level with the mark/meniscus (to reduce parallax error) (1) 	<p>Allow</p> <ul style="list-style-type: none"> 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 <p>Allow</p> <ul style="list-style-type: none"> 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 <p>Ignore other errors e.g. “room temperature is not 20 C”</p>	2

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	<p>An answer that makes reference to</p> <ul style="list-style-type: none"> 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) 	<p>Do not award: the concentration of sodium hydroxide would change.</p> <p>M2 depends on M1 or near miss</p> <p>Ignore any reference to accuracy</p> <p>An answer that implies that the pipette should be emptied completely to deliver 25cm³ scores 0.</p> <p>An answer that states the titre will decrease scores 0</p>	2

Question Number	Answer	Additional Guidance	Mark
2 (b)(iv)	<ul style="list-style-type: none"> (from) pink (1) (to) colourless (1) 	<p>Do not award purple or red</p> <p>Award one mark for colours the wrong way around</p>	2

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	<p>An answer that includes the following</p> <ul style="list-style-type: none"> all subtractions correct (1) titres 2 and 3 chosen and correctly averaged (1) 	<p>25.05, 24.6(0), 24.5(0)</p> <p>$\frac{24.60 + 24.50}{2} = 24.55(\text{cm}^3)$</p> <p>TE on incorrect subtraction</p>	2

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	<ul style="list-style-type: none"> calculation of moles ethanedioic acid in titre (1) moles sodium hydroxide in 25 cm³ aliquot (1) calculation of sodium hydroxide concentration (1) 	<p>Example of calculation: $\frac{24.55 \times 0.0900}{1000} = 0.0022095/0.00221/2.2095 \times 10^{-3}(\text{mol})$</p> <p>$0.0022095 \times 2 = 0.004419/0.00442/4.419 \times 10^{-3}(\text{mol})$</p> <p>$\frac{0.004419}{25} \times 1000 = 0.17676/ 0.177/ 0.18 (\text{mol/dm}^3)$</p> <p>TE from (i) TE throughout</p> <p>Ignore SF except 1SF</p>	3

(Total for Question 2 = 15 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	<p>An answer that makes reference to one of the following</p> <ul style="list-style-type: none"> to prevent “suck back” (of the water/liquid) <p>Or</p> <ul style="list-style-type: none"> so that the water/liquid does not move/flow back into the tube 	<p>Allow to stop the test tube breaking/cracking</p> <p>Do not award explosion any references to gases sucking back/ escaping/entering the tube</p>	(1)

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	<ul style="list-style-type: none"> 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) 	<p><u>Example of calculation:</u></p> <p>$95 \div 24000 = 0.0039583 / 3.9583 \times 10^{-3} \text{ moles}$</p> <p>$0.33 - (0.0039583 \times 60) = 0.33 - 0.2375 = 0.0925 \text{ g}$</p> <p>$0.0925 \div 0.0039583 = 23.368$ and magnesium/Mg</p> <p>First Alternative method M2 $M_r(\text{MCO}_3) = 0.33 / 0.0039583 = 83.4$ M3 $M_r(\text{CO}_3^{2-}) = 60$ $83.4 - 60 = 23.4$ and magnesium/Mg</p> <p>Second Alternative method M2 Mass of Group 2 metal oxide $0.33 - (0.0039583 \times 44) = 0.15583 \text{ g}$ M3 $\text{Ar} = (0.15583 \div 0.0039583) - 16$ $= 39.3685 - 16 = 23.368$ and magnesium/Mg</p> <p>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</p>	3

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	<p>An answer that makes reference to</p> <ul style="list-style-type: none"> 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) 	<p>Ignore references to Just “accuracy/precision” explosions changes to rate of reaction CO₂ dissolving in the water incomplete reaction gas leak modifications e.g. larger measuring cylinder/ gas syringe</p> <p>Allow gas would escape</p>	2

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	<ul style="list-style-type: none"> 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) 	<p>Example of calculation: $Q = 60 \times 4.18 \times 6 = 1504.8 = 1505 \text{ (J) or } 1.505 \text{ (kJ)}$</p> <p>$\Delta H_1 = 1.505 \div 0.05 = -30.096 \text{ (kJ mol}^{-1}\text{)}$</p> <p>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</p>	2

Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	ΔH_1 (answer to (i)) – (–150)	<p>Example of calculation: $-30.1 + 150 = (+)119.9/ (+)120 \text{ (kJ mol}^{-1}\text{)}$</p> <p>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)</p>	1

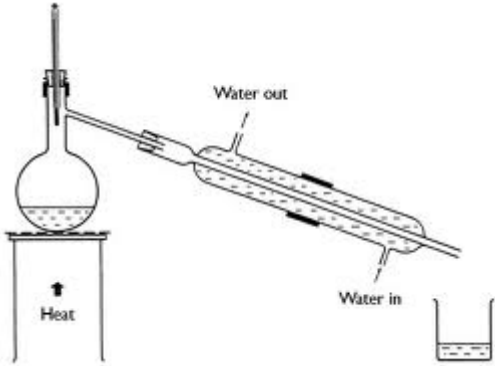
(Total for Question 3 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	<p>An answer that makes reference to the following points</p> <ul style="list-style-type: none"> (use) gloves (1) (use a) fume cupboard (1) 	<p>Allow ensure that the laboratory is well-ventilated</p>	2

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	<p>An answer that makes reference to the following points</p> <ul style="list-style-type: none"> 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) 	<p>Allow for London forces: dispersion forces / temporary dipole-induced dipole forces van der Waals (forces)</p> <p>Any mention of the product being non-polar loses M1</p> <p>Ignore just “the product cannot form H bonds”</p> <p>Allow just water forms hydrogen bonds / H bonds it/ product cannot form H bonds with water</p> <p>Ignore product is insoluble/miscible different densities hydration energy cannot balance the existing forces</p>	2

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	An answer that makes reference to the following point <ul style="list-style-type: none"> pressure / gas / CO₂ must be released 	<p>Allow so that the pressure does not build up</p> <p>Ignore references to explosions just to balance pressure</p> <p>Do not award: “to release air/water vapour”</p>	1

Question Number	Answer	Additional Guidance	Mark
4(a)(iv)	An answer that makes reference to the following point <ul style="list-style-type: none"> to remove water / to dry (the product) / as a drying/desiccating agent 	<p>Do not award: dehydrating agent, to dry the solution</p>	1

Question Number	Answer	Additional Guidance	Mark
4(a)(v)	<p>Distillation apparatus that includes</p> <ul style="list-style-type: none"> • 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) 	<p>Do not award an obviously conical flask</p> <p>The water in/out can be on the same or opposite sides of the condenser <u>Example of diagram</u></p>  <p>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.</p>	4

Question Number	Answer	Additional Guidance	Mark
4(b)	<ul style="list-style-type: none"> calculation of moles of alcohol (1) calculation of mass of halogenoalkane (1) calculation of percentage yield (1) <p>First Alternative method</p> <ul style="list-style-type: none"> calculation of mole ratio (1) calculation of expected yield (1) calculation of actual yield (1) <p>Second Alternative method</p> <ul style="list-style-type: none"> calculation of moles of alcohol (1) calculation of moles of halogenoalkane (1) calculation of percentage yield (1) 	<p><u>Example of calculation</u></p> <p>moles of alcohol = $8 \div 74 = 0.10811$</p> <p>mass of halogenoalkane = $0.10811 \times 92.5 = 10$</p> <p>percentage yield = $100 \times 2.62 \div 10 = 26.2 (\%)$</p> <p>92.5: 74 = 1.25</p> <p>$8.00 \times 1.25 = 10.0\text{g}$</p> <p>$(2.62 \div 10.0) \times 100 = 26.2 (\%)$</p> <p>moles of alcohol = $8 \div 74 = 0.10811$</p> <p>moles of halogenoalkane = $2.62 \div 92.5 = 0.028324$</p> <p>percentage yield = $100 \times \frac{0.028324}{0.10811} = 26.2 (\%)$</p> <p>Allow TE throughout</p> <p>If final answer >100% no TE for M3</p> <p>Correct answer with no working scores 3</p> <p>Ignore SF except 1 SF</p> <p>Note use of 0.108 → 26.226% yield, so we should accept 26.226 and 26.23 (%)</p>	3

Question Number	Answer	Additional Guidance	Mark
4(c)	<p>An answer that makes reference to the following</p> <ul style="list-style-type: none"> 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) 	<p>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</p> <p>Do not award if they only refer to the times taken for the different halogenoalkanes.</p> <p>Allow tertiary (2-chloro-2 methylpropane) is faster/ takes less time (than the primary 1-chloro-2 methylpropane) or reverse argument</p> <p>Ignore reference to carbocations</p> <p>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.</p>	3

(Total for question 4 = 16 marks)

Total for paper = 50 marks