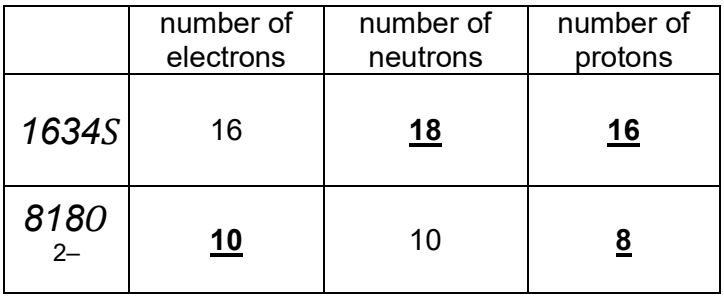
PASIR RIS SECONDARY SCHOOL
2025 Preliminary Examination
SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC
SCIENCE (CHEMISTRY) 5086 / 5088
MARKING SCHEME

MCQ

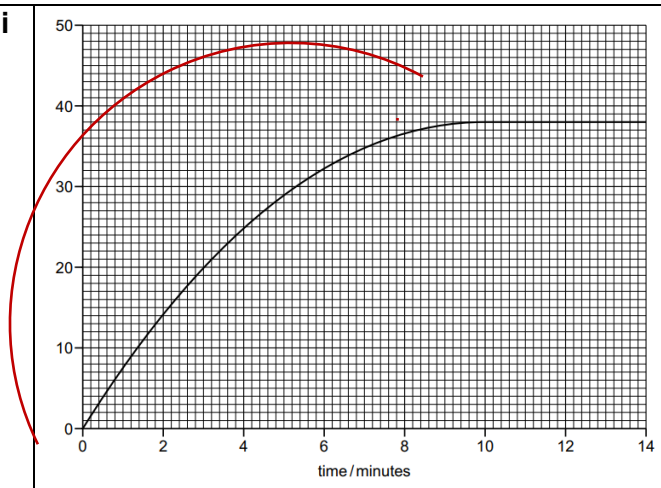
Question	21	22	23	24	25	26	27	28	29	30
Answer	**C**	**D**	**D**	**D**	**C**	**B**	**C**	**A**	**A**	**B**

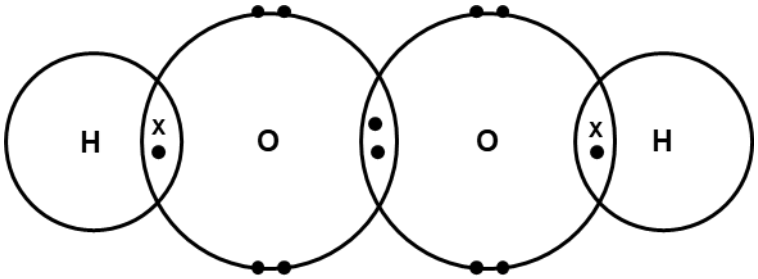
Question	31	32	33	34	35	36	37	38	39	40
Answer	**C**	**C**	**C**	**D**	**D**	**B**	**B**	**A**	**A**	**B**

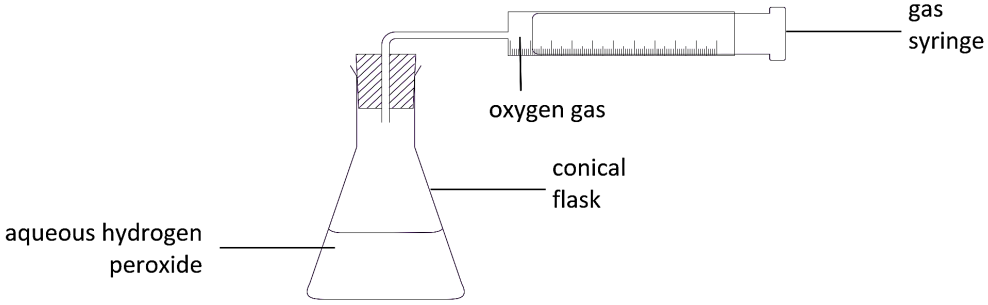
SECTION A			
1	**ai**	**C**	1m
	aii	**B**	1m
	aiii	**E**	1m
	aiv	**A**	1m
	b	 Many students did not manage to get the correct number of electrons for the oxide ion. These students often assume that number of electrons is the same as the number of protons (8) or did a subtraction to end up with 6 instead.	4m
2	**a**	**fractional distillation** Some students gave incomplete answers citing 'distillation' without the word 'fractional' or identified incorrectly the method as 'simple distillation' instead.	1m
	b	**A**: to **measure the temperature of the vapour** Many students wrote "measure the temperature" without specifying what temperature are they measuring. This answer is ambiguous as there are students who gave incorrect ideas such as "measure temperature of solution". **B**: to (cool and) **condense** the vapour into the distillate	1m 1m

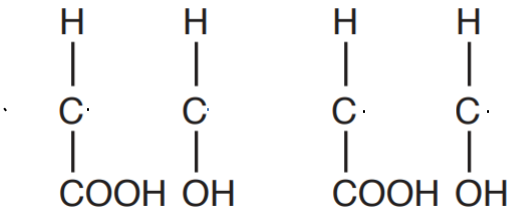
		This part of the question was attempted.	
	c	the **<u>alcohols are flammable</u>** / may catch fire easily This question was poorly attempted. Many students gave incorrect ideas such as electric heater not being able to reach the boiling points of the alcohols, or that heating with the Bunsen burner may break the glass of the round-bottomed flask.	1m
	d	the **<u>boiling point of water is lower</u>** than that of butanol OR the **<u>boiling point of butanol is higher</u>** than that of water OR the water would have boiled off Many students gave vague / incomplete answers e.g. indicating that the boiling points of butanol and pentanol is high but not making reference to the water. The key idea here is that water (in the water bath) would have boiled but the boiling points of butanol and pentanol is still not reached yet, and thus cannot be separated.	1m
3	**ai**	**<u>Neutralisation</u>** Well done	1m
	aii	**$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$** correct chemical formula correct state symbols Poorly attempted	 1m 1m
	bi	**<u>exothermic</u>** **<u>30 cm^3</u>** Generally well done	1m 1m
	bii	**Reaction is already completed / All hydrochloric acid has been reacted** when 30 cm^3 of aqueous NaOH is added. Not enough HCl to react with NaOH suggesting HCl is the LR [1] Limiting reagent is used up - not specific [0.5] Rej: there is excess NaOH unreacted causing the temp to decrease	1m
	ci	no. of moles of hydrochloric acid = 1.5 × $(\frac{25}{1000})$ = **<u>0.0375 mol</u>** Poorly attempted	1m
	cii	no. of moles sodium hydroxide no. of moles of hydrochloric acid = **<u>0.0375 mol</u>** Poorly attempted Allow ecf	1m
	ciii	concentration of sodium hydroxide = 0.0375 / $(\frac{30}{1000})$ = **<u>1.25 mol/dm^3</u>** Allow ecf	1m

		Some students did not use the volume of NaOH from the graph, used 25 cm^3 as the volume	
4	**a**	**i.** **<u>copper / Cu</u>** **ii.** **<u>copper(II) oxide / CuO</u>** **iii.** **<u>hydrogen gas / H_2</u>** **iv.** **<u>copper(II) nitrate / $Cu(NO_3)_2$</u>** Poorly attempted Rej: Copper(II) for i, No roman numeral for compound	1m 1m 1m 1m
	b	**$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$** OR **$CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$** OR **$CuO(s) + 2HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + H_2O(l)$** OR **$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$** correct chemical formula correct coefficients correct state symbols Poorly attempted Allow ecf	 1m 1m 1m
	c	**<u>dark blue</u>** / **<u>deep blue</u>** Only emphasise on colour	1m
5	**ai**	**<u>All the sulfuric acid has been used up / reacted away</u>**, hence no more new gas produced. Rej: Some students did not specify the limiting reactant as sulfuric acid	1m
	aii	**<u>3 minutes</u>** Well done	1m

	aiii	 steeper gradient than original graph plateau earlier at same volume (38 cm^3) Some students missed this qn but generally well done	1m 1m
	b	Zinc carbonate powder is smaller in size than the small pieces of zinc carbonate. There is **larger (total) surface area (to volume ratio) of contact between reactant particles / more surface area exposed for reactant particles to collide** in zinc carbonate powder. The particles in zinc carbonate powder will collide more frequently and **increases the frequency of effective collisions**. Hence, the **rate of reaction increases**. Phrasing of answers missing key terms e.g. frequency of effective collisions and the use of comparative terms e.g. more/larger SA Missing rate of reaction increases -0.5	1m 1m
	ci	**H^+** Not very well done. Students end up giving hydroxide instead of hydrogen ion	1m
	cii	**colourless to red** Poorly attempted. Students did not realise that the colour change should be in the solution not the Universal indicator.	1m
6	**ai**	**ZnO is reduced** as the oxidation state of zinc **decreased from +2 in ZnO to 0 in Zn**. **CO is oxidised** as the oxidation state of carbon **increased +2 in CO to +4 in CO_2**. Since oxidation and reduction occurred at the same time, the reaction is redox. Some students have difficulty explaining in terms of oxidation states	1m 1m
	aii	Zinc oxide has a **giant ionic structure^** while carbon monoxide has a **simple covalent structure^**. A **large amount of energy# is needed to overcome the strong electrostatic forces of attraction between oppositely charged ions***, while **only a small amount of energy# is needed to overcome the weak intermolecular forces of attraction between carbon monoxide molecules***.	

		Hence, the melting point of zinc oxide is very high and it exists as a solid while the boiling point of carbon monoxide is very low and it exists as a gas at room temperature and pressure. Compare type of structures^ Compare amount of energy# Compare bonds/forces* 0.5m per point Rej: ionic bonding vs covalent bonding only. Some students have misconceptions eg. ionic bonding as weak intermolecular forces / weak covalent bonds / electromagnetic forces / strong electrostatic forces of attraction between molecules etc	1m 1m 1m 1m
	bi	**<u>cobalt, zinc, magnesium, barium</u>** Moderately well done Some students gave the opposite sequence	1m
	bii	Zinc has a **<u>higher melting point / is denser / harder</u>** compared to lithium. Some students gave chemical property instead. Can cut easily does not answer to the qn of physical property Not very well done	1m
7	**a**	 <u>legend</u> ● : electron of oxygen x : electron of hydrogen correct number of bonded electrons correct number of all other valence electrons Some students are able to do this while others attempted with the dot and cross diagram of water instead.	1m 1m
	b	Particles in a liquid are **<u>close together in a disorderly manner</u>** while particles in a gas are **<u>spread far apart randomly</u>**. Particles in a liquid **<u>slide over each other</u>** throughout the liquid volume while particles in a gas **<u>move at high speeds</u>**, occupying every available space. OR Particles in a gas are **<u>moving faster</u>** than particles in a liquid. Particles in a gas are **<u>further apart</u>** than those in a liquid. 0.5m per point	1m 1m

		Some students missed either description of arrangement or motion/ used foreign terms / wrong terms.	
	c	(Colour change of $KMnO_4$ shows) it is a **<u>reducing agent</u>** as it **<u>can be oxidised</u>** / **<u>$KMnO_4$ is reduced</u>**. (Colour change of KI shows) it is an **<u>oxidising agent</u>** as it **<u>can be reduced</u>** / **<u>KI is oxidised</u>**. Some students mistaken RA as OA vice versa. Need to show observations.	1m 1m
	di	 Diagram with suitable apparatus Labelled apparatus and chemicals Many students either gave incomplete diagrams or did not label A: gas collection using inverted measuring cylinder R: gas syringe / gas jar with no interval markings No penalty for not including oxygen gas labelling in the diagram	 1m 1m
	dii	no. of moles of oxygen gas produced = 48 ÷ 24000 = **<u>0.00200 mol</u>** Many students forgot to convert the volume	 1m
	diii	mass of oxygen = 0.00200 × 32 = **<u>0.0640 g</u>** Many students forgot to x2 to the Mr of oxygen	1m
Section B			
8	**ai**	Alcohols This question was well-attempted. But some students incorrectly wrote the name of the functional group (i.e. hydroxyl group) instead.	1m
	aii	**<u>purple</u>** KMnO4 turns **<u>colourless</u>**. It **<u>oxidises</u>** the **<u>hydroxyl</u>** group in malic acid to **<u>-COOH</u>** Most students could describe the colour changes correctly. But many students either did not explain the observation, or did not specify the changes to the functional groups via oxidation.	1m 1m

	b	**<u>Reddish-brown aqueous bromine remains unchanged</u>** when added to malic acid. [1] But **<u>reddish-brown aqueous bromine</u>** is **<u>decolourised</u>** when added to fumaric acid. [1] A: use acidified aqueous potassium manganate(VII) purple solution decolourise malic acid purple solution remains fumaric acid Some students gave incomplete answers i.e. did not include the observation if there were no colour changes.	2m
	ci	**C=C bond breaks** and **<u>many small units joined together</u>** to form a polymer. Most students correctly identified the carbon-carbon double bond, but were unable to articulate the joining of the small units / monomers.	1m 1m
	cii	High temperature and pressure, presence of catalyst Most students could only give partial answers e.g. missing mention of pressure or catalyst. Some students confused the conditions for addition polymerisation with other reactions such as hydrogenation or substitution reaction.	1m
	ciii	 1m – C-C bond between units 1m – correct repeat unit Penalise if n is placed at the end of the structural formula Most students could show that the carbon-carbon double bond breaks to form carbon-carbon single bonds. However, many students did not show clearly that the bond to the carboxyl and hydroxyl groups should be pointed to the carbon and oxygen respectively. Instead, the bond was shown to point towards the middle of the functional groups which is incorrect if the full structural formula is shown.	2m
9	**ai**	Sulfur dioxide Health effect: **<u>breathing difficulties</u>**	1m 1m

		Question was very poorly attempted. Many students cited carbon monoxide as the air pollutant produced during volcanic eruptions.	
	aii	Damage to vegetation: **sulfur dioxide dissolves in rain water to produce acid rain**, which kills vegetation. Question was very poorly attempted. Many students thought that carbon monoxide is acidic (note: it is a neutral oxide). Some students were vague in their answers and did not describe the dissolving of acidic oxide in rainwater to form acid rain.	1m
	bi	**Crude oil is heated until it boils**. The **vapour enters the fractionating column**. Fractionating column is hottest at the bottom and gets cooler towards the top. **Fractions with higher boiling points condense at the lower levels and the fractions with lower boiling points condense at higher levels**. Question was poorly attempted. Most students could not describe the conversion of liquid crude oil / petroleum into a gas and transferring the vapour into the fractionating column. While most students knew the idea of lighter fractions are collected at the top of the column, many did not describe the idea of the vapour condensing before they can be collected.	1m 1m 1m
	bii	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ 1m – correct formula 1m – balanced equation Question was poorly attempted. Most students could not give the correct chemical formula of propane.	2m
	biii	When **biofuels are burnt**, **carbon dioxide is produced**. However, when **plants** (raw material to produce biofuels) grow, they **take in carbon dioxide** during photosynthesis. This offsets the carbon dioxide produced when the biofuel is burnt. Question was very poorly attempted. Many students failed to realise that this question required them to compare the formation (burning of fossil fuels) and removal of carbon dioxide gas (plants grow via photosynthesis).	1m 1m