A student is separating a mixture of three substances, A, B and C.

Look at the table. It gives information about these substances.

Substance	State at room temperature	Melting point (°C)	Boiling point (°C)	Solubility in water
Α	liquid	0	100	soluble
В	liquid	-117	78	soluble
С	solid	1535	2750	insoluble

A and **B** mix together completely.

(a) * Suggest how the student can separate the mixture to get pure samples of substances A, B and C.
Explain in detail how each method works.
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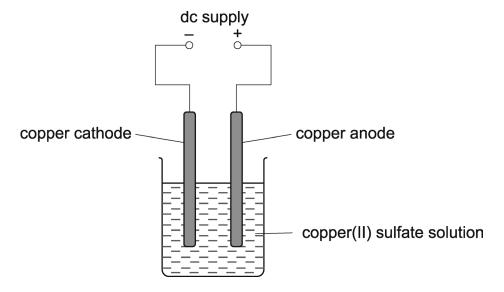
		[2]
	Suggest how the student can check that the sample of substance ${\bf B}$ is pure.	
(b)	The student has separated a pure sample of substance B from the mixture.	

Zind	nitrate can be made by reacting zinc oxide with nitric acid, HNO ₃ .	
(a)	Write a balanced symbol equation for this reaction.	
		[2]
(b)	A student suggests this method for preparing zinc nitrate.	
	 Measure 50 cm³ of dilute nitric acid into abeaker. Add one spatula measure of zinc oxide. Heat the mixture until crystals of zinc nitrate are made. 	
	Her method will not make a pure dry sample of zinc nitrate.	
	What improvements should she make to the method to make sure that:	
	 the reaction is complete the zinc nitrate can be separated from the nitric acid and the zincoxide? 	
	Explain your answer.	
		[4]
(c)	Describe why this reaction is a neutralisation reaction.	
		[2]

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23 A student electrolyses copper sulfate using copper electrodes.

Look at the diagram. It shows the apparatus she uses.



She investigates the change in mass at each electrode before and after the electrolysis.

Look at her method.

- 1. Using a balance, measure the mass of the copper cathode and copper anode.
- 2. Set up the apparatus and run the electrolysis for 30 seconds.
- 3. Remove the copper cathode and the copper anode and immediately place them on the balance and measure their masses again.

a)	What improvements could you make to the student's experiment?
	Explain your answers.

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[4]

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Question	Answer		AO element	Guidance	
20 (a)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Suggestion would enable pure samples of all three components to be obtained in the correct sequence with clear explanations of why the methods work. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. Level 2 (3–4 marks) Suggestion would enable pure samples of two of the components of the mixture to be obtained with an attempt at an explanation. There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence. Level 1 (1–2 marks) Suggestion would enable a pure sample of one of the components to be obtained. There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. O marks No response or no response worthy of credit.	6	2 x 1.2 2 x 2.2 2 x 3.3a	 AO1.2: Knowledge of process of fractional distillation Use fractional distillation to separate substance A from substance B. Substance B will come off first as it has lowest boiling point. Stronger forces between molecules in substance A / ora. AO2.2: Apply knowledge of process of fractional distillation Fractional distillation works as substances A and B have different boiling points. As substance C is insoluble in water. Because there are differing forces of attraction between the molecules. AO3.3a: Analyse information in the table to develop experimental procedure Heat mixture to boil off substances A and B leaving pure C. Filter mixture to remove substance C. Substance C can be washed with water and dried. 	

	Question		Answer	Marks	AO element	Guidance
	Questi	ion	Answer	Marks	AO element	Guidance
	(b)		measure its melting point or boiling point (1) if pure melting point or boiling point will be sharp / if impure melting point is lowered / if impure boiling point is elevated (1)	2	1.2 2.1	
21	(a)		ZnO + 2HNO₃ → Zn(NO₃)₂ + H₂O correct formulae (1) balancing (1)	2	2.2	balancing mark is conditional on correct formulae ALLOW any correct multiple e.g. 2ZnO + 4HNO₃ → 2Zn(NO₃)₂ + 2H₂O (2) ALLOW = or ≒ or ⇒ for arrow DO NOT ALLOW 'and' or & for + ALLOW one mark for correct balanced equation with minor errors in case, subscript and superscript

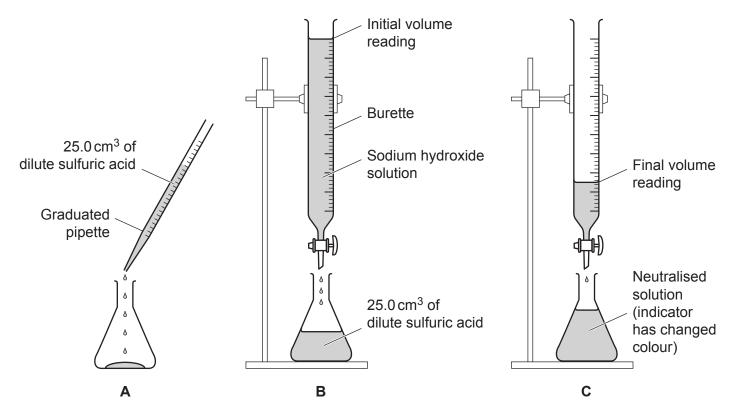
Quest	tion	Answer		AO element	Guidance
					e.g. $ZnO + 2HNO^3 \rightarrow Zn(No_3)_2 + H_2$
(b)		Any four from: idea that an excess of zinc oxide must be added (1) so reaction is complete / all nitric acid is reacted (1) filter off excess zinc oxide (1) evaporate off some of the water (1) allow to crystallise (1)	4	3.3b	
(c)		reaction between nitric acid (HNO ₃), an acid and zinc oxide (ZnO), a base (1) to make zinc nitrate (Zn(NO ₃) ₂ , a salt and water (only) (1)	2	1.1	Only award marks if reactions and products are named in the answer ALLOW the use of just chemical formulae

C	Question	Answer	Marks	AO element	Guidance		
22	(a)	The oxidising agent is oxygen and the reducing agent is magnesium (1)	1	1.2			
	(b)	24.3 / 6.022 x 10 ²³ (1) 4.04 x 10 ⁻²³ (1)	2	2.1	1 mark for 4.03520425 x 10 ⁻²³ or correctly rounded up but not to 3 sig. fig.		
23	(a)	electrolysis needs to run for longer than 30 seconds (1) otherwise insufficient change at electrodes (1) after electrolysis anode and cathode need to be washed (1) and then dried (1) before measuring the mass	4	2 x 3.2a 2 x 3.3b			

20 Student A does a titration with an acid and an alkali.

He uses dilute sulfuric acid, sodium hydroxide solution and an indicator solution.

The diagram shows the apparatus he uses.



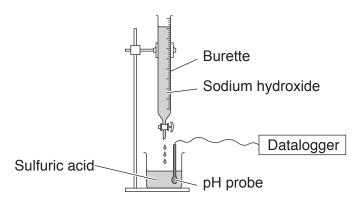
The student adds sodium hydroxide solution from the burette to the sulfuric acid until the indicator changes colour.

He then adds a few more drops of sodium hydroxide to be certain the sulfuric acid is neutralised.

He takes the final volume reading on the burette to find out how much acid reacts with 25.0 cm³ of sodium hydroxide solution.

(a)	Describe and explain how the student could improve his experiment to get a more accurate value.
	[4]

(b) Student B does a titration.



Sodium hydroxide solution is slowly added to the beaker of dilute sulfuric acid.

The pH probe is connected to a datalogger.

			[41
Suggest how student E	s memod is better	man student A s.	

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Q	uestion	Answer	Marks	AO element	Guidance
20	(a)	ANY FOUR FROM: Do not add more sodium hydroxide after the indicator changes colour ✓ As indicator changes colour at endpoint / idea that addition of more sodium hydroxide will make the solution alkaline ✓	4	4 x 3.3b	All marking points are independent IGNORE repeat the titration IGNORE idea of using a pH probe or meter
		Add the sodium hydroxide dropwise or slowly (towards the endpoint) ✓ As indicator should change colour on addition of one drop (of alkali) ✓			ALLOW idea of obtaining an exact endpoint
		Idea of using a single indicator rather than a mixed indicator (such as universal indicator) ✓ As single indicator will give a sharp endpoint ✓			ALLOW named single indicator eg methyl orange
		Idea of swirling the conical flask during the addition of sodium hydroxide ✓ To ensure mixing of acid and alkali / AW ✓			
		Idea of washing down the side of the conical flask with distilled water close to the endpoint ✓ Idea of ensuring all the alkali enters the reaction mixture ✓			
		Use a white tile under the conical flask ✓ Idea of seeing the endpoint more clearly ✓			ALLOW idea that method is incorrect, and they read the burette to find out how much alkali reacts with 25.0 cm ³ of sulfuric acid
	(b)	Idea that endpoint can be determined more accurately using a pH probe / datalogger ✓	1	3.3b	ALLOW idea that a pH probe or datalogger doesn't rely on human judgement ALLOW idea that pH probe or datalogger gives a numerical value / specific pH IGNORE pH probe / datalogger is more reliable