Mark scheme – Purity and Separating Mixtures (H)

Question			Answer/Indicative content	Marks	Guidance
1			D ✓	1 (AO1.1)	
			Total	**1**	
2			C ✓	1 (AO 2.2)	
			Total	**1**	
3			B ✓	1 (AO2.2)	
			Total	**1**	
4			B ✓	1(AO2.2)	
			Total	**1**	
5			C ✓	1(AO1.2)	
			Total	**1**	
6			B ✓	1(AO1.1)	
			Total	**1**	
7		i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 120 (tonnes) award 3 marks** M_r of NH_3 = 17 **AND** M_r of NH_4NO_3 = 80 ✓ Mass of ammonium nitrate = $\frac{80}{17}$ × 25.5 / 1.5 × 80 ✓ = 120 (tonnes) ✓	3 (AO2.1)	**ALLOW** ECF from incorrect RMMs
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 10(g) award 2 marks** Actual mass $= \frac{80 \times 12.5}{100}$ ✓ = 10 (g) ✓	2 (AO1.2) (AO2.2)	**ALLOW** % yield = (am ÷ pm) × 100 **OR** 80 = (am ÷ 12.5) × 100 for 1 mark if no other mark awarded
			Total	**5**	
8			**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 373 (tonnes) award 4 marks**	4	

			M_r $CaCO_3$ = 100.1 **and** M_r CaO = 56.1 ✓ 209 g of calcium oxide = $\frac{100.1}{56.1} \times 209$ = 372.9215686 (g) ✓ = 373 (g) (**3 significant figures**) ✓	(AO3 × 2.2) (AO1.2)	Need both relative formula masses for 1 mark **DO NOT ALLOW** 100 or 56 **ALLOW** ECF from incorrect RFMs **ALLOW** ECF **ALLOW** ECF for sig fig mark
			Total	**4**	
9	a	i	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 0.62 award 3 marks** R_f = distance travelled by substance / distance travelled by solvent = 37/60 ✓ = 0.61666…. ✓ = 0.62 (**2 significant figures**) ✓	3 (AO1.1) (AO2.2) (AO1.2)	**ALLOW** ECF for use of correct calculation from incorrect measurements **ALLOW** 0.59 – 0.67 **ALLOW** ECF for sig fig mark
		ii	A **and** B	1 (AO3.2a)	Both needed for the mark
		iii	Idea that D forms weak(er) bonds with the mobile phase than C / Idea that D forms strong(er) bonds with stationary phase than C / D is less polar than C / ORA ✓	1 (AO2.1)	**ALLOW** C is more soluble (in the solvent) than D / ORA
	b	i	Similarity: Both have stationary and mobile phases / both use silica in the stationary phase ✓ Difference: Thin-layer uses liquid for mobile phase / gas chromatography use gas for mobile phase ✓	2 (AO2 × 1.1)	**ALLOW** the mobile phases are different states
		ii	Thin-layer chromatography is used to separate solids / gas chromatography is used to separate gases (in a gas mixture) ✓	1 (AO2.1)	**ALLOW** idea that the tomato sauce is a liquid or not a gas
			Total	**8**	
10		i	Methanol ✓ (because it has the) lowest boiling point ✓	2(AO3.2b)	**IGNORE** (because it has the) lowest melting point **Examiner's Comments**

					Most candidates correctly identified that methanol will be distilled first as it has the lowest boiling point.
		ii	Particles (are close together in a liquid and) move further apart in a gas ✓	1(AO1.1)	**Answer must be comparative** **ALLOW** idea that arrangement of particles becomes less regular or more random **IGNORE** the idea that movement increases **Examiner's Comments** Many candidates described the arrangement of the particles in the gaseous state without any comparison with the liquid state, which was required to gain the mark.
		iii	Particles move more quickly (in all directions) in a gas ✓	1(AO1.1)	**Answer must be comparative** **IGNORE** particles have more (kinetic) energy **IGNORE** the idea that movement increases **Examiner's Comments** As in (ii), many candidates described the movement of the particles in the gaseous state without any comparison with the liquid state.
		iv	Fractionating column ✓ Large surface area ✓	2(AO3.3b) (AO1.2)	**ALLOW** fractional (distillation) column **IGNORE** distillation / fractional distiller **Examiner's Comments** This question required candidates to identify the use of a fractionating column and then explain that this would provide a large surface area. Candidates who stated the name of the process (fractional distillation), rather than the piece of equipment as required by the question, did not gain credit. Only the most able candidates were able to explain why a fractionating column is used.
			Total	**6**	
11	a		Low density **and** idea that aircraft is lightweight / isn't too heavy to fly / less weight to carry / AW ✓ High strength **and** idea that aircraft is less likely to be damaged ✓	2(AO3.2b)	**DO NOT ALLOW** light / lighter for low density but **ALLOW** so aircraft is light or lighter **Answers must give property and explanation for marks** **BUT ALLOW** 1 mark for low density and high strength / strongest if no or only one explanation given **Examiner's Comments**

					This question required candidates to identify **and explain** the properties that make alloy **C** the best choice for making an aircraft. Lower ability candidates often simply stated the properties (low density and high strength) without explaining why these properties were important. When reasons were stated they were often trivial e.g. 'low density because it would be good for the aircraft'. A common misconception was that high melting point was a key property.
	b	i	(Percentage of lithium =) (2 ÷ 10) x 100 = 20(%) ✓	1(AO3.1a)	**Examiner's Comments** Most candidates correctly calculated the percentage of lithium atoms at 20%.
		ii	Idea that alloy B is only 2.2% lithium / Idea that alloy B is 2.2% lithium but the diagram has 20% lithium / Idea that the % of lithium in the alloy is much smaller than in the diagram / there should be 100 aluminium atoms (and 2 lithium atoms) ✓	1(AO3.2a)	**ALLOW** ECF from incorrect percentage in (c)(i) **ALLOW** should be more Al atoms / 17.8% too large **IGNORE** references to the relative sizes of the atoms **Examiner's Comments** Good responses to this question identified that the percentage of lithium in the alloy is much smaller than in the diagram.
			Total	**4**	
12			B	1	
			Total	**1**	
13	a		**Please refer to point 10 of the marking instructions 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.**	6	**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.

			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.** *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*		• 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.
	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	
			Total	**8**	
14			A	1	
			Total	**1**	
15			C	1	
			Total	**1**	