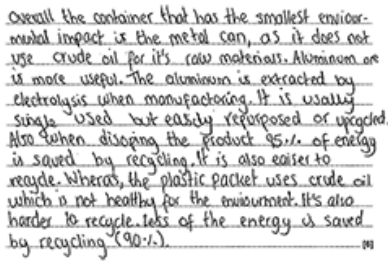
Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1	a		**Any two from:** Idea that tube 1 contains water / there was no water in test tube 2 / water is needed for rusting ✓ Idea that tube 1 contains air / there was no air in test tube 3 / air is needed for rusting ✓	2 (2 x AO 3.2b)	**Examiner's Comments** Almost all candidates linked the change to the presence of air or oxygen, with a considerable number also mentioning water, even if they showed some difficulty in tying that knowledge to the question.
	b		The nail does not rust ✓ (Idea that paint acts as a) barrier to air and/or water ✓	2 (AO 3.2b) (AO 2.2)	'attack / reaction / oxidation' = rustingb **ALLOW** 'painting prevents rusting' for the no rusting mark **IGNORE** paint is a barrier / protects nail. We need what it's being protected from **ALLOW** correct detail but calling it galvanising **Examiner's Comments** The barrier to water or oxygen aspect was well understood, though some candidates missed the significance of 'unchanged mass' and so didn't tie it in to rusting. It was not uncommon to see some confusion with galvanising and sacrificial anodes as some candidates tried to remember partially understood concepts.
	c	i	**Material** - Metal ✓ **Explanation** (Metal) has **the highest** thermal conductivity ✓ Idea that metal has a **suitable / high** melting point ✓	3 (3 x AO 3.2a)	**IGNORE** 'it conducts heat' / it conducts heat well' **ALLOW** it conducts most heat **DO NOT ALLOW** it has the highest mpt **IGNORE** arguments about strength / bpt of pan material **Examiner's Comments** Most candidates correctly chose metal. Here the question very deliberately gave candidates two

					types of information. While the melting point of the metal is by no means the highest, it is certainly adequate for the temperatures involved in cooking, whereas the relative thermal conductivity is the highest of the three. High scoring candidates made this distinction clearly and so gained full marks. Under the pressure of the exam conditions some candidates referred to boiling point when they clearly meant melting point. A significant minority of candidates chose ceramic as the best material for the pan base.
		ii	(2000 ÷ 200 =) 10 ✓ Stationary phase ✓	1 (AO 3.1a)	**IGNORE** 10.8, 11 **Examiner's Comments** Many candidates read the question carefully, did the rounding to one significant figure as the first stage and so got the correct answer. However, there seemed to be examples of candidates, even those who were otherwise very successful, double thinking on this question, so performed some very complex calculation or worked out the boiling point ratio for ceramic to metal. In some cases candidates had problems with 'how many times higher' and subtracted one number from the other.
	d		Recycling aluminium saves the **most** CO2 per year ✓ Idea that recycling aluminium saves a reasonable amount of energy ✓	2 (2 x AO 3.1b)	**IGNORE** 'saves 294kg CO_2 a year' / most beneficial to environment **ALLOW** releases least CO_2 into the environment **ALLOW** saves 4 hours energy without comparator **IGNORE** Al powers TVs **Examiner's Comments** This question used the same approach to tabular information as Question 17 (c) (i) and was well answered with many candidates even calculating a rough ratio of the CO_2 saving for aluminium compared to plastic. Many candidates gained the 'highest CO_2' mark here, even though

					they missed the 'highest thermal conductivity' mark earlier. Some candidates misunderstood the table and assumed it showed the amount of CO_2 produced rather than saved, but still managed to claim that the larger amount was a good thing.
			Total	**10**	
2			C ✓	1 (AO 2.1)	**Examiner's Comments** Almost all candidates answered this question correctly.
			Total	**1**	
3			**Level 3 (5–6 marks)** Analyses the information to give a clear and detailed discussion of the environmental impacts of each container over its lifetime. **AND** Clear evaluation, that supports information from the table, of which container has the smallest environmental impact. *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)** Analyses the information to discuss the possible environmental impacts of each container, but there is limited detail. **AND** Clear evaluation of which container has the smallest environmental impact. *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)** Analyses the information to give a basic discussion of some of the environmental impacts of each container.	6 (6 × AO 3.2a)	**AO3.1b Analyse ideas and information to evaluate** **Raw Materials & Manufacture** • the raw materials used to make plastic packets come from crude oil, which is a non-renewable resource • obtaining crude oil from the ground, fractional distillation, cracking and polymerisation requires a lot of energy • mining of aluminium uses up limited resources and damages the environment • extraction of aluminium by electrolysis uses a lot of energy • the energy in both manufacturing processes often comes from burning fossil fuels so causes the release of greenhouse gases **Use & disposal of the product** • both are usually single use which could increase the amount of waste sent to landfill however metal cans are easier to repurpose/upcycle • plastic packets are non-biodegradable so will stay in the environment for a long time if sent to landfill • plastic packets can be recycled, though it is harder to

			There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 mark** *No response or no response worthy of credit.*		do so, and recycling uses only 10% of the energy needed to make the plastic from crude oil • metal cans are non-biodegradable so will stay in the environment for a long time if sent to landfill • metal cans can be more easily recycled, and recycling uses only 5% of the energy needed to extract aluminium from aluminium ore • recycling reduces the use of valuable raw materials **<u>Examiner's Comments</u>** Candidates responded well to this question and often summarised the table quite articulately. Those who added their own scientific knowledge to their arguments often went on to score Level 3. While the vast majority argued that the aluminium cans would be more environmentally friendly, a few candidates made a very clear case for the plastic packaging option. Often this was because they discussed the environmental impact of mining. Such candidates received full credit. Exemplar 3  Overall the container that has the smallest environmental impact is the metal can, as it does not use crude oil for it's raw materials. Aluminium ore is more useful. The aluminium is extracted by electrolysis when manufactoring. It is usually single used but easily repurposed or upcycled. Also when disposing the product 95% of energy is saved by recycling. It is also easier to recycle. Whereas, the plastic packet uses crude oil which is not healthy for the environment. It's also harder to recycle. Lots of the energy is saved by recycling (90%). [4] This candidate has discussed most of the major sections of the table and given an excellent response. At present it is a very good Level 2, gaining 4 marks. Had the candidate added some of their own knowledge

					that is not in the table, it would have been a strong Level 3.
			Total	**6**	
4			(By reacting with) carbon✓ (Because carbon) is more reactive that iron / by displacement / **ORA** ✓	2 (AO 2.1) (AO 1.1)	**ALLOW** only elements from the list **Examiner's Comments** Candidates very sensibly took their cue from the question and discussed reactivity, but the actual use of carbon was not widely known. A sizeable minority of candidates discussed electrolysis.
			Total	**2**	
5			**A**	1 (AO 1.1)	**Examiner's Comments** Galvanising was recognised by most candidates. A good two-thirds of candidates successfully answered this question.
			Total	**1**	
6			**D**	1 (AO 1.1)	**Examiner's Comments** Almost all candidates knew that both air and water are necessary.
			Total	**1**	
7			**C**	1 '(AO 1.1)	**Examiner's Comments** A and B were the most popular choices, in roughly equal numbers.
			Total	**1**	