

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	water that is safe to drink		1	AO1 4.10.1.2
01.2	passing water through filter beds – to remove pieces of solid sterilising – to kill microorganisms desalination – to remove dissolved salts	one mark for one or two correct two marks for all three correct	2	AO1 4.10.1.2
01.3	two from: <ul style="list-style-type: none"> • chlorine • ozone • ultraviolet light 	one mark for each correct answer up to a maximum of two marks	2	AO1 4.10.1.2
01.4	advantage – water can be obtained from eawater if supplies of freshwater are limited disadvantage – large amount of energy required		1 1	AO1 4.10.1.2
02.1	crushing and melting the jar to make a bottle		1	AO2 4.10.2.2
02.2	SiO ₂ CaCO ₃ sodium carbonate		1 1 1	AO2 4.1.1.1
02.3	reduced use of raw materials reduced use of energy reduced waste		1 1 1	AO1 4.10.2.2
03.1	use a pipette instead of a measuring cylinder to measure the volume of water more accurately		1 1	AO3 4.10.1.2

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03.2	heat until some of the water has evaporated, then leave in a dry place for the rest of the water to evaporate evaporating basin less likely to break/solution spill out		1 1	AO3 4.10.1.2
03.3	two from: <ul style="list-style-type: none"> • wear eye protection • do not touch hot apparatus • tie long hair back • wear a lab coat 	accept sensible precautions one mark for each correct answer up to two marks	1 1	AO3 4.10.1.2
03.4	A		1	AO3 4.10.1.2
03.5	C greatest mass of dissolved solids		1 1	AO3 4.10.1.2
04.1	Bunsen burner reaches high enough temperature (to make the salty water boil) (water bath does not)		1	AO2 4.10.1.2
04.2	so that there are no gaps between the test tube and cooling system		1	AO3 4.10.1.2
04.3	no bung in top of flask		1	AO3 4.10.1.2
04.4	pure water leaves the seawater as steam so concentration of salt increases		1 1	AO2 4.10.1.2

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05.1	grow plants on the low-grade ore harvest and burn the plants add sulfuric acid to the ash displace copper from the copper sulfate solution by adding scrap iron or use electrolysis		1 1 1 1	AO1 4.10.1.4
05.2	Level 3: The comparisons are detailed and accurate. The writing is clear, coherent and logical and comparisons are clearly made.		5-6	AO1 × 3 AO3 × 3
	Level 2: The comparisons are generally correct, although may lack detail. The writing is mainly clear, although the structure may lack logic and comparisons are not always clear.		3-4	4.10.1.4 4.10.2.2
	Level 1: Some comparisons are correct. The writing lacks clarity, coherence and logic, and the comparisons are not clearly expressed.		1-2	
	No relevant content.		0	

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	<p>Indicative content:</p> <ul style="list-style-type: none"> ● scrap copper advantages <ul style="list-style-type: none"> ○ uses copper waste, preventing its need to be disposed of in other ways ● scrap copper disadvantages <ul style="list-style-type: none"> ○ cannot be obtained from mixtures containing very small amounts of copper ○ copper must be separated from other materials it is mixed with ● bioleaching advantages <ul style="list-style-type: none"> ○ copper can be obtained from lower-grade ores ● bioleaching disadvantages <ul style="list-style-type: none"> ○ slow 			
05.3	$\frac{22.1}{100} \times x = 50 \text{ kg where } x \text{ is the mass of ore mined}$ $x = 226 \text{ kg}$ $\text{waste} = 226 - 50$ $= 176 \text{ kg}$		1 1 1 1	AO2 4.10.1.1
06.1	<p>Level 3: The comparisons are detailed and accurate. The writing is clear, coherent and logical and comparisons are clearly made. A conclusion about which is better is clearly made and justified in detail.</p>		5-6	AO3 4.10.2.1

Question	Answers	Extra information	Mark	AO / Specification reference
	Level 2: The comparisons are generally correct, although may lack detail. The writing is mainly clear, although the structure may lack logic and comparisons are not always clear. A conclusion about which is better is given, but not justified.		3-4	
	Level 1: Some comparisons are correct. The writing lacks clarity, coherence and logic, and the comparisons are not clearly expressed. No conclusion is given about which is better.		1-2	
	No relevant content.		0	

Question	Answers	Extra information	Mark	AO / Specification reference
	<p>Indicative content:</p> <ul style="list-style-type: none"> • PLA advantages <ul style="list-style-type: none"> ○ lower energy requirements ○ smaller amounts of greenhouse gases produced ○ biodegradable • PLA disadvantages <ul style="list-style-type: none"> ○ requires more land ○ pollutes soil more ○ not recyclable • PET advantages <ul style="list-style-type: none"> ○ requires less land ○ pollutes soil less ○ recyclable • PET disadvantages <ul style="list-style-type: none"> ○ higher energy requirements ○ greater amounts of greenhouse gases produced ○ not biodegradable 			
06.2	$\frac{0.0565}{12} = 0.0047083$ $= 4.71 \times 10^{-3} \text{ m}^2$		1 1	AO2

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06.3	energy required lower for recycled PET one from: <ul style="list-style-type: none"> raw materials/oil does not need to be sources reshaping PET required less energy than making PET from raw materials shorter process less transportation costs as recycling can be carried out locally/raw materials don't have to be transported 	accept any sensible answer	1 1	AO3 4.10.2.1
07.1	2,3,4	all three required for the mark	1	AO3 4.10.2.1
07.2	extracting and processing raw materials: 1 manufacturing and packaging: 2/3/4 use and operation during the end of its lifetime: 6 disposal at the end of its life: 7		1 1 1 1	AO1 AO3 4.10.2.1
07.3	energy to heat water used for washing		1	AO3 4.10.2.1
07.4	recycle/give to someone else/use for rags		1	AO3 4.10.2.2
08.1	organic matter harmful microbes		1 1	AO1 4.10.1.3

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08.2	screening and grit removal sedimentation to make sewage sludge and effluent anaerobic digestion of sludge aerobic biological treatment of effluent		1 1 1 1	AO1 4.10.1.3
08.3	groundwater has smaller amounts of impurities in it/groundwater contains less organic matter and harmful microbes		1	AO1 4.10.1.3
09.1	760	allow any answer between 755 and 765	1	AO2 4.10.1.1
09.2	$\frac{45}{760} \times 100$ = 6 %		1 1	AO2 4.10.1.1
09.3	mass of Ta ₂ O ₅ = $\frac{72}{100} \times 80 = 57.6$ kg mass of Ta in this mass of Ta ₂ O ₅ = $\frac{(2 \times 181)}{(2 \times 181) + (5 \times 16)} \times 57.6 = 47$ kg		1 1+1	AO2 4.10.1.1
09.4	$\frac{1.5 \times 10^5}{760}$ = 197 (accept 200)		1 1	AO2 4.10.1.1

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09.5	two from: <ul style="list-style-type: none"> more tantalum ore might have been found less tantalum might have been extracted each year new technology might enable tantalum to be extracted from ores from which it was not previous economic to extract the metal demand for tantalum may decrease/increase in the rate of rather than may be able to recycle it 	one for each correct answer up to a maximum of two marks	2	AO3 4.10.1.1
10.1	development that meets the need of current generations without compromising the ability of future generations to meet their own needs		1	AO1 4.10.1.1
10.2	wood is renewable wood is biodegradable		1 1	AO3 4.10.1.1
10.3	less land is required for plastic production/plastic chairs may last longer		1	AO3 4.10.1.1
11.1	alkanes		1	AO1 4.7.1.1
11.2	C_9H_{20}		1	AO2 4.7.1.1
11.3	butane		1	AO1 4.7.1.1
11.4	no change/remain orange		1	AO2 4.7.1.3

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11.5	$C_4H_{10}(g) + 6.5O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$		3	AO2 4.7.1.3
11.6	temperature of 550 °C catalyst		1 1	AO1
11.7	1 C atom and 4 H atoms are drawn with 1 shell each C atom has 4 dots and 4 crosses, each H atom has 1 dot and 1 cross which it shares with C		2	AO1 4.1.2.4
11.8	shorter-wave radiation from the Sun penetrates the atmosphere the Earth's surface emits longer-wavelength radiation greenhouse gases absorb some of the longer-wavelength radiation so trapping some of the radiation within the atmosphere		1 1 1 1	AO1 4.9.2.1