

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	pure metal has atoms/ions arranged in layers these layers can slide, thus it is soft alloys have distorted layers these cannot slide, so alloys are hard		1 1 1 1	AO1 4.10.3.2
01.2	copper, tin copper, zinc	accept either order	1 1	AO1 4.10.3.2
01.3	rarer	ignore references to reactivity (in the example given, copper is also not reactive)	1	AO3 4.10.3.2
01.4	$\frac{75}{18} \times 14$ = 58.3%	ignore any recurring sign shown	1 1	AO2 4.10.3.2
01.5	high carbon steel stainless steel low carbon steel		1 1 1	4.10.3.2
02.1	4 H atoms, 2 C atoms and 1 O atom is drawn one C atom is joined to 2 H atoms by – and joined to 1 C atom by = one C atom is joined to 1 O atom and 1 H atom by = and joined to 1 C atom by = one O atom is joined to 1 C atom and 1 H atom by -		1	AO2 4.10.3.3
02.2	addition		1	AO2 4.7.3.1

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02.3	<u>property</u> : more viscous/thicker/solid <u>explanation</u> : borax introduces cross links between polymer chains prevent chains from across each other		1 1 1	4.10.3.3
03.1	$N_2 + 3H_2 \rightarrow 2NH_3$	one mark for formulae one mark for reactants ignore state symbols	2	AO2 4.10.4.1
03.2	fertilisers		1	AO1 4.10.4.1
03.3	air		1	AO1 4.10.4.1
03.4	six from: <ul style="list-style-type: none"> • 450 °C • high temperature increases rate of reaction • forward reaction is exothermic so high temperature shifts equilibrium/decreases yield • 200 atm pressure • high pressure favours the forward reaction/increases yield • can't be too high or it will be dangerous/expensive • iron catalyst • lowers rate of reaction so a lower temperature can be used and still have a reasonable rate 	one mark for each correct point up to a maximum of six marks	6	AO2 4.10.4.1

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04.1	nitrogen, phosphorous and potassium	all three needed for the mark	1	AO1 4.10.4.2
	<u>disadvantages:</u> <ul style="list-style-type: none"> costs money to buy takes time to apply to crops can go into water ways/cause pollution <u>advantages:</u> <ul style="list-style-type: none"> increase yield of crops faster growing crops healthier crops 		2	AO3 4.10.4.2
04.3	$2\text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2 \rightarrow 2\text{NH}_3 + \text{CaCl}_2 + 2\text{H}_2\text{O}$			
04.4	four from: <ul style="list-style-type: none"> in industrial process/Haber process, nitrogen from air and hydrogen from natural gas react together 450 °C, 200 atm, iron catalyst ammonia is cooled, condenses and is tapped off ammonia in laboratory is produced as a gas in industry, process is continuous/in laboratory, it is produced in small batches 	one point for each correct answer up to a maximum of four marks	4	
05.1	The destruction of materials by chemical reactions with substances in the environment.		1	
05.2	hard/shiny		1	AO1 4.10.3.2

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05.3	iron painted/greased/electroplated barrier protection and water accessing iron		1 1	4.10.3.1
05.4	aluminium reacts with oxygen in the air forms an oxide coating that prevents further aluminium reacting with oxygen		1 1 1	4.10.3.1
06.1	$4\text{Fe} + 3\text{O}_2 + 6\text{H}_2\text{O} \rightarrow 4\text{Fe}(\text{OH})_3$	one mark for oxygen one mark for balanced	2	AO1 4.10.3.1
06.2	Level 3: Three valid issues with the method are identified and improvements are clearly made. The writing is clear, coherent and logical.		5-6	AO3 4.10.3.1
	Level 2: Less than three issues/ improvements are made. The writing is mainly clear, although the structure may lack logic and coherence.		3-4	
	Level 1: An issue is identified with an improvement made. The writing lacks clarity, coherence and logic.		1-2	
	No relevant content.		0	

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	<p>Indicative content <u>half fill three with water:</u></p> <ul style="list-style-type: none"> this is not an accurate value of measurement, this is a control variable accurately measure the volume of water <p><u>put lids on A and B:</u></p> <ul style="list-style-type: none"> this does not exclude air add in dehumidifying crystals for and boil for B <p><u>put a spoon full of salt:</u></p> <ul style="list-style-type: none"> this is not an accurate measurement weigh salt before <p><u>add in nails:</u></p> <ul style="list-style-type: none"> this does not specify what type or size of nails should be ungalvanized nails of a set diameter and length 	no marks for any section of the answer using the word 'amount'		
06.3	E water and air both needed for rusting salt dissolved in water will allow electrons to move more freely than pure water		1 1 1	AO2 AO3 4.10.4.1
06.4	zinc is a stronger reducing agent than iron so electrons from zinc are lost/zinc is oxidised in place of iron		1 1	AO1 4.10.3.1
07.1	sand and boron trioxide		1	AO1 4.10.3.3

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07.2	borosilicate glass has higher melting point	accept reverse answer	1	AO1 4.10.3.3
07.3	Na ₂ CO ₃	one mark for correct positive ions one mark for correct negative ions	2	AO2 4.10.3.3
07.4	fibre optic cables: germanium-oxide glass decorative vase: crystal glass windows: aluminosilicate glass		1 1 1	AO3 4.10.3.3
08.1	2 C atoms and 4 H atoms are drawn each C atom is joined to 1 C atom and 2 H atom by - all atoms are inside square brackets with – extending beyond brackets subscript n to the right of the brackets	one mark for inside brackets one mark for brackets, line outside the brackets and n	2	AO1 4.7.3.1
08.2	2 C atoms and 2 H atoms are drawn each carbon atom is joined to 2 H atoms by – and joined to 1 C atom by =		1	AO1 4.7.3.1
08.3	<u>LD poly(ethene):</u> <ul style="list-style-type: none"> polymer chains are branched spaces between polymers <u>HD poly(ethene):</u> <ul style="list-style-type: none"> fewer branches on polymer chains chains sit closely together 		1 1 1 1	AO1 4.10.3.3

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08.4	polymer chains are not linked together by crosslinks/strong covalent bonds so chains are relatively easy to separate		1 1	AO2 4.10.3.3
09.1	calcium nitrate		1	AO1 4.10.4.1 4.10.4.2
09.2	$\text{Ca}_3(\text{PO}_4)_2$		1	AO2 4.10.4.1 4.10.4.2
09.3	sulfuric acid		1	AO2 4.10.4.1 4.10.4.2
09.4	ammonia produced in Haber process nitrogen from air and hydrogen from natural gas react together iron catalyst, 450 °C and 200 atm pressure ammonia then reacted with nitric acid to form ammonium nitrate		1 1 1 1	AO1 4.10.4.1 4.10.4.2
10.1	$(31 \times 3) + [(16 \times 4) \times 3] + 35.5 = 320.5$ $\frac{520.5 - 320.5}{5} = 40$ Ca		1 1 1	AO2

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10.2	+2		1 1 1	AO1
10.3	calcium nitrate		1	AO1 4.10.4.2
10.4	$(\text{NH}_4)_3\text{PO}_4$		1	AO2 4.10.4.2
11.1	$\text{N}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$	one mark for reactants one mark for products one mark for state symbols	3	AO2 4.10.4.1
11.2	data line at 450 °C roughly halfway between 400 and 500		1	AO2 4.10.4.1
11.3	45%	accept between 45 and 55% allow error carried forward from 12.2, as long as data point comes from 200atm	1	AO3 4.10.4.1
14.4	Level 3: All three conditions discussed and why it is a compromise is explained fully. The writing is clear, coherent and logical.		5-6	AO2 4.10.4.1
	Level 2: Two conditions discussed fully. An attempt is made to explain why it is a compromise. The writing is mainly clear, although the structure may lack logic.		3-4	
	Level 1: One condition discussed fully or description of conditions, but no attempt made at explaining why it is a compromise. The writing lacks clarity, coherence and logic.		1-2	

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	No relevant content.		0	
	Indicative content <ul style="list-style-type: none"> • high pressure gives higher yield of ammonia favours the forward reaction • as fewer molecules on the product side of reaction • however, too high a pressure is expensive/dangerous • increase in pressure from 200 to 400 (at 450 °C) does not produce significant/large increase in yield • lower temperature gives higher yield of ammonia • because reverse reaction is endothermic • however low temperature would have too slow a rate of reaction • as increasing the temperature increases the rate of reaction • iron catalyst • increases the rate of reaction so lower temperatures can be used 			
11.5	ammonia is used in the production of fertilisers fertilisers are used to improve agricultural productivity/ increase production of food/biofuels		1 1	
12.1	high-yield ores are gone/used up/hard to find growing need in modern society for metals traditional mining techniques will not ore on low-yield ores		1 1 1	AO1 4.10.1.4

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12.2	Level 3: Advantages and disadvantages are described. A judgement of the use of phytomining is given with a detailed justification made. The writing is clear, coherent and logical.		5-6	AO1 AO3 4.10.1.4
	Level 2: An advantage and a disadvantage are described. A judgement of the use of phytomining is given with some justification made. The writing is mainly clear, although the structure may lack logic.		3-4	
	Level 1: An advantage or disadvantage is phytomining is described. The writing lacks clarity, coherence and logic.		1-2	
	No relevant content.		0	
	<u>advantages:</u> <ul style="list-style-type: none"> recovers valuable ore from land energy from burning plants can be used plants remove carbon dioxide from atmosphere can use low grade ores <u>disadvantages:</u> <ul style="list-style-type: none"> burning crop release carbon dioxide into the atmosphere high energy use in electrolysis/smelting plant could be used as food land could be used for growing food/housing fertilisation of soil may lead to environmental issues (eutrophication) 	answer must have an opinion and a justification		

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12.3	C even though it has the lowest mass of copper preferred climate matches the UK, so will grow quickly		1 1 1	AO3 4.10.1.4
12.4	$5000 \times 14.5 = 72\,500 \text{ mg}$ $\frac{72500}{100000}$ $= 0.0725 \text{ kg}$		1 1 1	AO2 4.10.1.4
13.1	pen ink would separate in chromatography experiment/results would not be visible/clear		1	AO1 4.8.1.3
13.2	so the sample doesn't dissolve in the solvent without moving through the paper		1	AO1 4.8.1.3
13.3	to stop evaporation of the solvent or to stop contaminant falling in		1	AO1 4.8.1.3
13.4	<chromatogram>	one mark for each correct substance	3	AO3 4.8.1.3
13.6	methyl red		1	AO3 4.8.1.3
14.1	D		1	AO1 4.7.2.1
14.2	B		1	AO1 4.7.2.1

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14.3	C and D		1	AO1 4.7.3.2
14.4	B poly(ethene)		1 1	AO1 4.7.3.1
14.5	$\text{-(CH}_2\text{-OOC-CH}_2\text{-COO-)}_n\text{-}$	one mark for correct use of brackets and one mark for correct inside of brackets	2	AO2 4.7.3.2