

<b>Question</b>	<b>Answer</b>	<b>Marks</b>	<b>AO Element</b>	<b>Notes</b>	<b>Guidance</b>
1(a)	<i>any two from:</i> diamond / graphite / graphene	<b>1</b>			
1(b)	carbon monoxide	<b>1</b>			
2(a)	from car engines / lightning / high temperature furnaces	<b>1</b>			
2(b)	irritates eyes / nose / mouth / skin / lungs	<b>1</b>			
2(c)	carbon dioxide / methane	<b>1</b>			
3(a)	chlorine / argon	<b>1</b>			
3(b)	sodium	<b>1</b>			
3(c)	argon	<b>1</b>			
3(d)	sulfur	<b>1</b>			
3(e)	aluminium	<b>1</b>			
3(f)	silicon	<b>1</b>			
3(g)	chlorine	<b>1</b>			

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4(a)	<b>M1</b> oxygen <b>M2</b> water	<b>2</b>			
4(b)	zinc/Zn	<b>1</b>			
5(a)	zinc nitrate + nitrogen dioxide + water (2) If 2 marks <b>not</b> scored: 1 mark for any <b>2</b> correct products in equation	<b>2</b>			
5(b)	nitrogen dioxide/NO <sub>2</sub> (1) lightning/high temperature furnaces (1)	<b>2</b>			
6(a)	oxygen/O <sub>2</sub>	<b>1</b>			
6(b)	carbon + oxygen → carbon dioxide	<b>1</b>			
6(c)	reactants on the left and product on the right (both required)	<b>1</b>			
7	sulfur dioxide/SO <sub>2</sub> is formed SO <sub>2</sub> reacts with (atmospheric) water (vapour)/rain	<b>2</b>			
8	CH <sub>4</sub> / methane	<b>1</b>			

Question	Answer	Marks	AO Element	Notes	Guidance
9	nitrogen and oxygen (from the air) (1)  (react) at high temperatures (in engine) or (electrical) spark (in engine) (1)	2			
10	sulfur dioxide / SO <sub>2</sub>	1			
11	carbon monoxide / CO	1			
12(a)	breathing difficulties / irritates nose / irritates eyes / asthma attacks	1			
12(b)	2 (NO <sub>2</sub> ) (1) 2 (NaOH) (1)	2			
13(a)	nitrogen <b>AND</b> oxygen	1			
13(b)	NO <sub>2</sub>	1			
13(c)	the air / the atmosphere	1			

- Mark Scheme

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Question	Answer	Marks	AO Element	Notes	Guidance
14	<b>B</b> / boiled water <b>AND</b> because no air / no oxygen (1) <b>C</b> / with calcium chloride <b>AND</b> because no water (1)	<b>2</b>			
15	<b>B</b> (1) <b>F</b> (1)	<b>2</b>			<b>allow</b> Ar <b>allow</b> CO <sub>2</sub>
16(a)	1.5 (%)	<b>1</b>			

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Question	Answer	Marks	AO Element	Notes	Guidance
16(b)	<p>any <b>3</b> from:</p> <ul style="list-style-type: none"> <li>• greater percentage of helium (on Neptune) / more helium on Neptune / less helium on Earth</li> <li>• greater percentage of hydrogen (on Neptune) / more hydrogen on Neptune / no hydrogen on Earth / (very) little hydrogen on Earth</li> <li>• no oxygen on Neptune / little oxygen on Neptune (but Earth has 21% oxygen)</li> <li>• greater percentage of methane (on Neptune) / more methane on Neptune / less methane on Earth / more methane on Neptune</li> <li>• more argon on Earth / less argon on Neptune</li> <li>• no nitrogen on Neptune / little nitrogen on Neptune</li> </ul>	<b>3</b>			

Question	Answer	Marks	AO Element	Notes	Guidance
17	any <b>3</b> from: <ul style="list-style-type: none"> <li>• no oxygen on Venus / (very) little oxygen on Venus / Earth has oxygen / Earth has 21% oxygen</li> <li>• greater per cent carbon dioxide on Venus / more carbon dioxide on Venus <b>ORA</b></li> <li>• smaller per cent of nitrogen on Venus / (very) little nitrogen on Venus / less nitrogen on Venus / Earth has 79% nitrogen</li> </ul>	<b>3</b>			
18	carbon monoxide is a gas / carbon monoxide escapes from the mixture	<b>1</b>			
19	<b>D</b>	<b>1</b>			

Question	Answer	Marks	AO Element	Notes	Guidance
20	any <b>3</b> from: <ul style="list-style-type: none"> <li>• greater percentage of helium (on Saturn) / less helium on Earth</li> <li>• greater percentage of hydrogen (on Saturn) / little hydrogen on Earth</li> <li>• no oxygen on Saturn / oxygen on Earth / Earth has 1/5 oxygen</li> <li>• lower percentage of other gases (on Saturn) / more of other gases on Earth</li> <li>• greater percentage of argon on Earth / less argon on Saturn</li> <li>• no <b>OR</b> very little nitrogen on Saturn / Earth has about 80% nitrogen / Earth has a lot of nitrogen</li> </ul>	<b>3</b>			
21	fractional distillation	<b>1</b>			

Question	Answer	Marks	AO Element	Notes	Guidance
22	<p><b>any two sources:</b></p> <ul style="list-style-type: none"> <li>• sulfur dioxide: from volcanoes / burning fossil fuels</li> <li>• oxides of nitrogen: from car exhausts / high temperature furnaces / lightning</li> </ul> <p><b>any three effects:</b></p> <ul style="list-style-type: none"> <li>• sulfur dioxide: acid rain / named effects of acid rain</li> <li>• sulfur dioxide: irritates eyes or skin</li> <li>• oxides of nitrogen: acid rain / named effect of acid rain</li> <li>• oxides of nitrogen: breathing difficulties / breathing problems / irritates eyes / skin / photochemical smog</li> </ul>	5			
23	C - carbon monoxide	1			
24	B - Carbon monoxide is produced by the complete combustion of petrol.	1			
25(a)	nitrogen 78%, oxygen 21%, noble gases 1%	1			



Question	Answer	Marks	AO Element	Notes	Guidance
25(b)	argon is unreactive / inert	1			
	air (or oxygen) may oxidise metals / air (or oxygen) may react with the (hot) metals / to prevent the air (or oxygen) reacting with the metals	1			
26(a)	<u>mixture</u> of metals / <u>mixture</u> of metal(s) + non-metals	1		<b>do not allow:</b> compound	
26(b)	covers surface / idea of protective layer	1			
	prevents contact with air / prevents contact with water / so air (or water) does not react with steel	1		<b>do not allow:</b> reference to tin being more reactive / sacrificial protection (for second marking point)	

Question	Answer	Marks	AO Element	Notes	Guidance
27	Any <b>three</b> from: sulfur dioxide reacts with water in air / reacts with water on surface of building / forms acid rain limestone is a carbonate idea of reaction of acid with limestone / carbonate carbon dioxide (+ salt + water) formed	<b>3</b>		<b>allow:</b> sulfur dioxide is acidic / it is acidic	
28(a)	3 (H <sub>2</sub> )	<b>1</b>			
28(b)	(hydrogen is) flammable / explosive	<b>1</b>		<b>allow:</b> fire hazard	
	(CO is) poisonous / toxic	<b>1</b>		<b>ignore:</b> CO harmful	
29	water absorbed	<b>1</b>			
30	air/oxygen and water (need both)	<b>1</b>			
31	aluminium oxide layer is impervious <b>or</b> non-porous <b>or</b> passive <b>or</b> unreactive <b>or</b> will not allow water/air to pass through it (rust allows passage of water <b>or</b> air <b>or</b> it flakes off)	<b>1</b>			

Question	Answer	Marks	AO Element	Notes	Guidance
32(a)	copper + nitric acid → copper nitrate + nitrogen dioxide + water	2			1 mark if one / two errors
32(b)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• blue (solution) / blue (precipitate) ;</li> <li>• precipitate / ppt ;</li> <li>• in excess the precipitate redissolves ;</li> <li>• dark blue solution (above precipitate) ;</li> </ul>	3			
32(c)	car engines / car exhausts / lightning / high temperature furnaces ;	1			
33	they are gases / vapours ;	1			
34(a)	points all correctly plotted ; 1 mark for 6 points correctly plotted	2			
	best curve (through the points) ;	1			

<b>Question</b>	<b>Answer</b>	<b>Marks</b>	<b>AO Element</b>	<b>Notes</b>	<b>Guidance</b>
34(b)	value from candidate's graph at 25°C to within $\pm 0.1 \text{ mg / dm}^3$ ;	<b>1</b>			
34(c)	21% / 20% ;	<b>1</b>			
35	they are gases / vapours ;	<b>1</b>			
36	in tube A the calcium chloride absorbs the water vapour;	<b>1</b>			
	in tube B there is both water and air / there is water (vapour) in the air;	<b>1</b>			

Question	Answer	Marks	AO Element	Notes	Guidance
37	<p>burn fossil fuels / burn fuels containing sulfur / burn compounds containing sulfur / burn ores containing sulfur / roast metal sulfides / burn metal sulfides (1)</p> <p>sulfur dioxide / SO<sub>2</sub> (formed) (1)</p> <p>(form) sulfuric / H<sub>2</sub>SO<sub>4</sub> / sulfurous acid / H<sub>2</sub>SO<sub>3</sub> (1)</p> <p><b>OR</b></p> <p>nitrogen and oxygen (in air) react at high temperatures / in jet engines / car engines / lightning. (1)</p> <p>(form) oxides of nitrogen (1)</p> <p>(form) nitric acid / HNO<sub>3</sub> / nitrous acid / HNO<sub>2</sub> (1)</p>	3			
38	<p>any <b>two</b> from:</p> <p>limited or finite resource / non-renewable / will run out / depleted</p> <p>greenhouse effect / gas(es) / climate change / (cause) global warming</p> <p>acid rain</p> <p>production of <u>poisonous</u> / <u>toxic</u> gases</p>	2			

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39(a)	78 (%)	1			
39(b)	fractional (1) distillation (1)	2			
39(c)	acid rain	1			
39(d)	nitrogen and oxygen (from the air) react (in the engine) (1) (due to) high temperatures (1)	2			
39(e)	nitrogen (1) carbon dioxide (1) platinum (1)	3			
39(f)	$\text{CH}_4 + 1\frac{1}{2}\text{O}_2 \rightarrow \text{CO} + 2\text{H}_2\text{O}$ CO and H <sub>2</sub> O as products and methane as reactant (1) rest of the equation (1)	2			
40	H <sub>2</sub> O and CO or C formed (1) $2\text{C}_4\text{H}_{10} + 9\text{O}_2 \rightarrow 8\text{CO} + 10\text{H}_2\text{O}$ (1)	2			<b>allow</b> correctly balanced alternatives with CO and/or C formed

[Total: 107]