

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	points plotted correctly line of best fit drawn		1 1	AO2 AO3 4.9.3.1
01.2	average concentration of carbon dioxide in the atmosphere increases with time		1	AO3
01.3	burning more fossil fuels releases more carbon dioxide into the atmosphere/carbon dioxide that was trapped in the fossils deforestation less trees to remove carbon dioxide from the atmosphere	accept other sensible answers that specifically relate to carbon dioxide in the atmosphere	1 1  1 1	AO1 4.9.2.2
02.1	oxides of nitrogen		1	AO1 4.9.3.1
02.2	incomplete combustion	'incomplete' must be present to gain mark	1	4.9.3.1
02.3	$C_4H_{10} + 4\frac{1}{2}O_2 \rightarrow 4CO + 5H_2O$ or $2C_4H_{10} + 9O_2 \rightarrow 8CO + 10H_2O$		1	AO2 4.9.3.1
02.4	oxides of nitrogen – breathing problems carbon monoxide – poisoning of humans particulates – global dimming		1 1 1	AO1 4.9.3.2
02.5	sulfur dioxide		1	AO1 4.9.3.2

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03.1	<p><u>advantages:</u></p> <ul style="list-style-type: none"><li>• reduction in combustion of fossil fuels so less carbon dioxide released</li><li>• provide new jobs</li><li>• alternatives can be sustainable</li></ul> <p><u>disadvantages:</u></p> <ul style="list-style-type: none"><li>• some alternatives to fossil fuels still produce carbon dioxide</li><li>• alternatives to fossil fuels not always as reliable</li><li>• alternatives can be expensive</li><li>• jobs from fossil fuel industry could be lost</li><li>• not all governments may be able to afford to invest in alternatives to fossil fuels</li></ul>	<p>accept other sensible answers</p> <p>one mark per correct answer up to a maximum of four marks</p> <p>to receive full marks, at least one advantage and one disadvantage must be provided</p>	4	AO3
03.2	<p><u>advantages:</u></p> <ul style="list-style-type: none"><li>• reduces deforestation</li><li>• some farming/cattle farming can produce greenhouse gases</li></ul> <p><u>disadvantages:</u></p> <ul style="list-style-type: none"><li>• prevents population from farming/producing enough food/making money</li><li>• unfair to South American countries</li></ul>	<p>accept other sensible answers</p> <p>one mark per correct answer up to a maximum of three marks</p> <p>to receive full marks, at least one advantage and one disadvantage must be provided</p>	3	AO3

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03.3	<p><u>advantages:</u></p> <ul style="list-style-type: none"> <li>reduction in greenhouse gases released</li> <li>reduction in pollutants released</li> </ul> <p><u>disadvantages:</u></p> <ul style="list-style-type: none"> <li>some forms of alternative transports (e.g. trains and buses) still release greenhouse gases</li> <li>relies on good public transport/government investment in transport</li> <li>lots of people rely on cars/not always possible to travel by public transport</li> </ul>	<p>accept other sensible answers</p> <p>one mark per correct answer up to a maximum of four marks</p> <p>to receive full marks, at least one advantage and one disadvantage must be provided</p>	4	AO3
04.1	<b>Level 3:</b> The descriptions of the comparisons are detailed and accurate.		5-6	AO1
	<b>Level 2:</b> The descriptions of the comparisons are correct, although lacks detail.		3-4	AO2
	<b>Level 1:</b> The descriptions of the comparisons lacks clarity and coherence.		1-2	4.9.1.1
	<b>No relevant content.</b>		0	

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	<b>Indicative content</b> <ul style="list-style-type: none"> <li>• Mars' atmosphere is mainly CO<sub>2</sub></li> <li>• but the percentage of CO<sub>2</sub> in Earth's atmosphere is only about 0.04%</li> <li>• both atmospheres include nitrogen and argon</li> <li>• but the percentage of nitrogen in Earth's atmosphere is much greater than that on Mars (around 80% on Earth, about 2% on Mars)</li> <li>• percentage of argon in both atmospheres is similar, at around 1%</li> <li>• both atmospheres include oxygen</li> <li>• but the percentage of oxygen in Earth's atmosphere is much greater than that on Mars (around 20% on Earth, less than 1% on Mars)</li> </ul>			
04.2	$\frac{21}{0.7} = 30$		1	AO2
04.3	cannot observe directly	accept other suitable reasons	1 1	AO3 4.9.1.2
04.4	greenhouse gases (carbon dioxide, methane, and water vapour) present in atmosphere percentage of the atmosphere made of carbon dioxide is greater on Mars than on Earth but Mars' atmosphere is less dense therefore less radiation from the Sun is absorbed by the atmosphere reduced greenhouse effect		1  1  1  1	AO3 4.9.2.1
04.5	sublimation		1	AO1 4.2.2.1

Question	Answers	Extra information	Mark	AO / Specification reference
05.1	2 O atoms with 1 ring each one O atom has 6 crosses, the other 6 dots O atoms share 1 pair of crosses and 1 pair of dots		1	AO1 4.2.2.1
05.2	little oxygen in atmosphere algae and plants evolved carried out photosynthesis $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ as algae and plants increased, so did the percentage of oxygen in the atmosphere	levelled response	1 1 1 2 1	AO1 4.9.1.3
05.3	trees carry out photosynthesis carbon dioxide converted to other products therefore, reduce volume of greenhouse gases in atmosphere		1 1 1	AO1 4.9.1.4
05.4	acid rain damages plant life/trees therefore, less plants carrying out photosynthesis and removing carbon dioxide from the atmosphere		1 1	AO3 4.9.2.2
06.1	greenhouse gases in the atmosphere maintain temperatures in Earth high enough to support life/absorb and re-emit infrared radiation		1	AO1 4.9.2.1
06.2	methane/water vapour		1	AO1 4.9.2.2
06.3	burning fossil fuels deforestation	accept other correct answers	1 1	AO1 4.9.2.2
06.4	rising sea levels more extreme weather events species extinctions	accept any three correct effects	1 1 1	AO1 4.9.2.3

Question	Answers	Extra information	Mark	AO / Specification reference
07.1	120 × 100 = 12 000 g 12 000 g = 12 kg		1 1	AO2 4.9.2.4
07.2	$\frac{12}{2} = 6$ kg		1	AO1 4.9.2.4
07.3	mass of carbon dioxide = 1050 × 120 = 126 000 g <b>or</b> 126 kg $\frac{126}{6} = 21$ people for the same mass of CO <sub>2</sub> per person 22 people for a smaller mass of CO <sub>2</sub> per person		1  1  1	AO2 4.9.2.4
07.4	cars are more convenient	accept any sensible answer	1	AO3 4.9.2.4
08.1	0.68 °C		1	AO2
08.2	2015, 2016, 2017, 2018	all four required for the mark	1	AO2
08.3	2001		1	AO2
08.4	global annual mean surface temperature increases with time		1	AO3
08.5	increase in greenhouse gases in the atmosphere due to: <ul style="list-style-type: none"> <li>• burning fossil fuels leading to the release in carbon dioxide</li> <li>• cattle farming releases methane</li> <li>• deforestation so less carbon dioxide removed from the atmosphere</li> <li>• decomposition of landfill releases methane</li> </ul>	one mark for each correct answer, up to a maximum of two marks	2	AO1 4.9.2.2

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08.6	student is correct for the years 2016 to 2018 but since 2000, the overall trend is up the time period from 2016 to 2018 is not long enough to draw a firm conclusion		1 1 1	AO3 4.9.2.2
09.1	to allow people to reduce their carbon footprints	accept other suitable answers	1	AO3 4.9.2.4
09.2	<ul style="list-style-type: none"> <li>most vegetarian foods produce less carbon dioxide emissions than meat</li> <li>so vegetarian diet likely to have lower carbon dioxide emissions</li> <li>however, if a person swapped chicken for cheese, they could increase carbon dioxide emissions</li> </ul>		1  1  1	AO3 4.9.2.4
09.3	8 kg for beef + 3 kg for cheese = 11 kg		1 1	AO2 4.9.2.4
09.4	cattle farming produces methane		1	AO3 4.9.2.4
10.1	no direct observations (because so long ago)		1	AO1 4.9.1.2
10.2	<b>Level 3:</b> The descriptions of the explanations are detailed and accurate. The reasons given are clear and coherent.		5-6	AO1 4.9.1.2 4.9.1.3 4.9.1.4
	<b>Level 2:</b> The descriptions of the explanations are correct, although lacks detail. Reasons are given for some, although these may not be clearly explained.		3-4	
	<b>Level 1:</b> The descriptions of the explanations and reasons lacks clarity and coherence.		1-2	

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	<b>No relevant content.</b>		0	
	<b>Indicative content</b> <u>carbon dioxide:</u> <ul style="list-style-type: none"> <li>percentage of carbon dioxide has decreased</li> <li>water vapour from volcanoes condensed to form oceans</li> <li>carbon dioxide dissolved in the oceans</li> <li>removed during formation of fossil fuels</li> <li>removed during formation of sedimentary rocks</li> <li>removed during photosynthesis</li> </ul> <u>oxygen:</u> <ul style="list-style-type: none"> <li>percentage of oxygen increased</li> <li>algae and plants first produced oxygen by photosynthesis</li> <li>about 2.7 million years ago</li> <li>as more algae and plants grew, the percentage of oxygen in the atmosphere increased</li> </ul>			
10.3	methane carbon dioxide	accept other correct answers	1 1	AO1 4.9.2.2
10.4	global climate change	accept an effect of global climate change (e.g., rising sea levels, more extreme weather, changes in rainfall, changes to ecosystems, polar ice caps melting)	1	AO1 4.9.2.2



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11.1	shorter wave radiation emitted from the Sun passes through the atmosphere emitted by the Earth as longer wave radiation greenhouse gases in the atmosphere trap some of the longer wave radiation trapping the energy and warming the Earth		1 1 1 1	AO1 4.9.2.1
11.2	produces sulfur dioxides that cause acid rain acid rain damages plants plants carry out photosynthesis, which removes carbon dioxide from the atmosphere		1 1 1	AO2 4.9.3.1
11.3	human activity leads to increase in carbon dioxide and methane in the atmosphere as greenhouse gases, they increase the average temperature of the Earth therefore, this will in turn cause more water vapour to be held by the atmosphere as water vapour is also a greenhouse gas, this will further enhance the greenhouse effect leading to a further increase in the average temperature of the Earth/global climate change		1 1 1 1 1	AO2 4.9.2.2
12.1	dissolve a sample of each compound in water mix with sodium hydroxide solution aluminium and calcium compounds will form white precipitate. add more sodium hydroxide and aluminium precipitate will dissolve iron(II) compound will form green precipitate		1 1 1 1 1	AO1 4.8.3.2

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12.2	dissolve sample of iron compound in water add barium chloride and dilute hydrochloric acid sulfates will form white precipitate/barium sulfate		1 1 1	AO1 4.8.3.5
12.3	$\text{FeSO}_4 + 2\text{NaOH} \rightarrow \text{Fe}(\text{OH})_2 + \text{Na}_2\text{SO}_4$		2	AO2 4.8.3.2
12.4	A: calcium iodide C: aluminium chloride		1 1	AO2 4.8.3.4
13.1	energy/enthalpy	ignore units	1	AO1 4.6.1.4
13.2	A		1	AO2 4.5.1.2
13.3	endothermic because energy of products greater/higher than energy of reactants		1 1	AO2 4.5.1.2
13.4	thermal decomposition/citric acid and sodium hydrogencarbonate/photosynthesis		1	AO1 4.5.1.2
14.1	2 C atoms are drawn with 2 shells, first shell has 2 dots 2 shell has 6 dots and 2 crosses 4 H atoms are drawn with 1 shell which has 1 dot and 1 cross each H atom shares 1 dot and 1 cross with a C atom, with each C atom sharing with 2 H atoms C atoms share 4 dots		3	AO2 4.2.1.4 4.7.2.1
14.2	two pairs of electrons are shared in a C=C bond compared to one pair of shared electrons in C-C		1	AO2 4.7.2.1

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14.3	in reactions with ethene, the C=C double bond becomes a C-C single bond C=C double bond is weaker/requires less energy to break than C-C single bond (642 - 348 = 294)		1 1	AO3 4.7.2.2