

Interpreting and Interacting with Earth Systems

Q1. (2018)

5			D ✓	1	1.1	
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Q2. (2018)

16	(a)		(Electric car) uses Less energy (needed to make it) ✓ Causes less global warming / less greenhouse gases produced ✓ Causes less ozone ✓	3	3 x 3.1b	IGNORE just a restatement of the data; must be a comparison IGNORE references to carbon footprint DO NOT ALLOW eg less greenhouses gases so less acid rain ALLOW less water pollution than (making) a diesel car / produces the second least water pollution IGNORE less (water) pollution
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Q3. (2018) – 16d

	(d)		ANY TWO Advantages of fuel cell: Refuelling time (for a fuel cell) is less / ORA ✓ Fuel cell emits less CO₂ / ORA ✓ Mass (of car) is less (with fuel cell) / ORA ✓ AND Disadvantage of fuel cell: Cost of refuelling is more / ORA ✓	3	3 x 3.1b	Assume unqualified answer refers to fuel cell IGNORE just a restatement of the data; must be a comparison ALLOW fuel cell takes 356 minutes less to refuel / ORA ALLOW fuel cell only takes 4 minutes to refuel ALLOW fuel cell emits 12kg less CO₂ / ORA ALLOW fuel cell only emits 36 kg CO₂ ALLOW mass of car with fuel cell is 350(kg) less than electric car / ORA ALLOW mass of car with fuel cell is only 1200(kg) IGNORE electric car is faster ALLOW cost of refuelling car with fuel cell is £1 more than an electric car / ORA ALLOW cost of refuelling electric car is only £3.20 ALLOW costs more to run
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Q4. (2019)

2			D ✓	1	2.1	
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Q5. (2019)

3			C ✓	1	1.1	
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Q6. (2019)

12			B ✓	1	1.1	
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Q7. (2019)

A)

17	(a)	CO₂ emissions (in the UK) have decreased (from 1993 to 2013 / from 2006) ✓ Global sea levels have risen (from 1993 to 2013) ✓ (Therefore) data suggests that CO₂ emissions are not the (only) cause of rising sea levels / Idea that factors other than CO₂ emissions contribute to rising sea levels / data does not support a link (between human activity and climate change) ✓	3	3.1b	ALLOW idea that there is a negative correlation between CO₂ emissions and global sea levels / CO₂ emissions and global sea levels are inversely proportional for 2 marks ALLOW idea that sea levels were still rising when CO₂ emissions were decreasing for 2 marks ALLOW idea that the data does not completely support a link ALLOW idea that there is a mismatch between the data, ie one is UK but one is global
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B)

	(b)	Any two from: Idea that CO₂ emissions (from burning fossil fuels) are only from the UK and not a global figure ✓ Global CO₂ emissions could be increasing ✓ Idea that CO₂ emissions from other sources (not just burning fossil fuels) should be considered ✓ Idea that there is a lag between CO₂ emissions impacting on global sea levels ✓	2	3.2a	ALLOW idea that different countries produce different CO₂ emissions ALLOW idea that emissions from one country will not have a large impact on global CO₂ levels IGNORE idea that other factors may affect global sea levels IGNORE idea that there are other greenhouse gases
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C)

	(c)	(i)	Any one from: Idea of melting ice caps / melting glaciers / melting sea ice ✓ Altered weather patterns ✓	1	1.1	IGNORE 'melting ice' ALLOW specific examples or effects of altered weather patterns eg drought in some places or flooding in others ALLOW specific effects of rising sea levels eg coastal erosion / flooding of low lying land IGNORE rising temperatures
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D)

		(ii)	Any one from: Reduce consumption of fossil fuels ✓ Use biofuels ✓ Use renewable energy sources ✓ Stop carbon dioxide escaping when fuels are used ✓ Plant more trees / reduce deforestation / AW ✓ Recycle plastics etc (rather than burning) ✓	1	1.1	ALLOW specific examples eg car share / cycle to work / use public transport / use electric cars / don't leave appliances on standby ALLOW specific renewable energy sources eg wind / solar energy / tidal IGNORE use carbon neutral energy sources ALLOW use carbon capture (and storage)
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Q8. (2020) – 16c

A)

	(c)	(i)	Any two from: Aluminium (metal) is sorted from other metals / materials ✓ Idea that aluminium/metal is shredded or crushed into smaller pieces ready for processing ✓ Idea that aluminium/metal is melted (by heating) ✓ Molten aluminium/metal is poured into moulds ✓	2	1.1	DO NOT ALLOW references to electrolysis ALLOW idea of cooling to form a solid (again)
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B)

		(ii)	Any three from: Idea that recycling aluminium saves energy (compared to extracting aluminium from bauxite) / ORA ✓ Idea that recycling makes more aluminium (than extraction from bauxite) ✓ Aluminium isn't wasted ✓ Use of data to back up either idea ✓ Idea of finite resource ✓ Idea of aluminium not being biodegradable, so recycling reduces landfill ✓ Idea that recycling aluminium produces less waste material (than extraction from bauxite) / ORA ✓ Idea that recycling aluminium produces less greenhouse gas emissions (than extraction from bauxite) / ORA ✓	3	3.2b	IGNORE just quoting numbers; answer must be comparative IGNORE references to cost ALLOW idea that recycling aluminium uses less raw materials
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Q9. (2020)

A)

23	(a)		Idea that both carbon dioxide levels and variation in air temperature shows an increasing trend ✓ (Therefore) data suggests that carbon dioxide emissions are linked to global warming ✓ OR Idea that carbon dioxide levels have increased steadily but variation in air temperature has fluctuated ✓ (Therefore) data does not support a link between carbon dioxide emissions and global warming ✓	2	2 x 3.1b	Evidence and conclusion must be linked ALLOW there is a positive correlation (between carbon dioxide levels and variation in air temperature)
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B)

	(b)		Any three from: Idea that energy transferred by radiation from the Sun warms up the Earth's surface ✓ Idea that infrared radiation is emitted by the Earth's surface ✓ Idea that some infrared radiation goes directly into space ✓ Idea that greenhouse gases absorb (some) infrared radiation (radiated by the Earth's surface) ✓ Idea that greenhouse gas molecules emit infrared radiation (in all directions), warming the Earth's surface / atmosphere ✓	3	1.1	DO NOT ALLOW references to the ozone layer ALLOW energy instead of infrared radiation throughout IGNORE idea of trapping infrared radiation ALLOW named greenhouse gases eg carbon dioxide / methane
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C)

	(c)	(i)	Any one from: Burning fossil fuels ✓ Deforestation ✓ Intensive use of fertilisers (by farmers) ✓ Cement manufacture ✓	1	1.1	ALLOW example of burning fossil fuels
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D)

		(ii)	Any two from: Global warming / increased temperature of Earth's atmosphere ✓ Melting ice caps ✓ Rising sea levels ✓ Altered weather patterns / extreme weather events ✓ Flooding ✓ Increasing ocean acidity ✓	2	1.1	ALLOW climate change
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Q10. (2021)

3			D ✓	1	1.1	
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Q11. (2021) – 16c (ii)

	(c)	(i)	$\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ Formulae ✓ Balancing ✓	2	1.1 2.1	ALLOW any correct multiple, including fractions DO NOT ALLOW and / & instead of '+' balancing mark is dependent on the correct formulae but ALLOW 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. $\text{C}_2\text{H}_5\text{Oh} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
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Q12. (2021)

A)

17	(a)	(i)	Idea of looking at each stage of the life of a product to work out the potential environmental impact at each stage ✓	1	1.1	
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B)

		(ii)	Any two from: Raw materials needed ✓ Energy used in processing or manufacturing ✓ Water used in processing or manufacturing ✓ Energy needed to <u>use</u> the product ✓ Energy needed to <u>maintain</u> the product ✓ Water or other substances needed to maintain the product ✓ Energy needed to <u>dispose</u> of the product ✓ Space needed to dispose of the product ✓	2	1.1	ALLOW sustainability ALLOW idea of environmental impact of transporting raw materials ALLOW do the materials used decompose or break down ALLOW can the product be recycled IGNORE references to cost IGNORE references to waste products or pollution (stem of question)
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C)

	(b)	(i)	Vehicle operation ✓	1	3.1a	
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D)

		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 9.5 (tonnes) award 4 marks Mass of CO ₂ produced by petrol car = 80% of 29.8 tonnes = 23.84 (tonnes) ✓ Mass of CO ₂ produced by diesel car = 70% of 20.5 tonnes = 14.35 (tonnes) ✓ Difference = 23.84 – 14.35 = 9.49 (tonnes) ✓ To 2 sig figs = 9.5 (tonnes) ✓	4	3.2b	ALLOW ECF ALLOW ECF ALLOW 1 mark for correct identification of percentages of CO ₂ from vehicle operation for each car (petrol – 80%, diesel – 70%), if no other mark awarded ALLOW answers given to 2 sig figs throughout the question, i.e. Mass of CO ₂ produced by petrol car = 24 (tonnes) Mass of CO ₂ produced by diesel car = 14 (tonnes) Difference = 10 (tonnes)
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Q13. (2022)

6			D ✓	1	1.1	
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Q14. (2022)

8			B ✓	1	1.1	
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Q15. (2022) – 18e, 18f

A)

	(e)		Finite (resource) ✓	1	1.1	NOT non-renewable
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B)

	(f)		NO Causes acid rain ✓ CO poisonous / toxic ✓	2	2 x 1.1	ALLOW an effect of acid rain, eg erosion of stonework / corrosion of metals / kills trees or kills living things in rivers or lakes ALLOW causes breathing difficulties (asthma) IGNORE references to pollution ALLOW an effect of CO, eg can cause difficulty breathing or suffocation / attaches to the haemoglobin (protein) in red blood cells / reduces the amount of oxygen that the blood can carry / can cause drowsiness / can cause death ✓ IGNORE harmful / dangerous IGNORE contributes to global warming / greenhouse effect
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Q16. (2022)

A)

23	(a)		Idea of working out the potential environmental impact at each stage of the life of the car ✓	1	1.1	IGNORE just the impact of manufacturing a car on the environment
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B)

	(b)	(i)	% = $\frac{0.7}{4.9} \times 100 = 14.3 / 14\%$ ✓	1	3.1a	ALLOW answer in range 12 to 15%
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C)

		(ii)	Coal is a hydrocarbon ✓ When hydrocarbons burn, they produce carbon dioxide ✓	2	2 x 3.2b	ALLOW coal is a fossil fuel ALLOW renewable energy emits less CO ₂ ALLOW burning coal or fossil fuels produces CO ₂ IGNORE just fossil fuel increase CO ₂ emissions, without reference to burning
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D)

		(c)	Petrol has weaker intermolecular forces (than diesel) / ORA ✓	1	1.1	Assume unqualified answer refers to petrol ALLOW petrol has less or smaller intermolecular forces (than diesel) / ORA ALLOW less <u>energy</u> is required to break the intermolecular forces in petrol / ORA IGNORE references to breaking bonds
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Q17. (2023)

1	A	1	1.1	
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Q18. (2023)

4	B	1	1.1	
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Q19. (2023)

6	B	1	1.1	
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Q20. (2023)

11	C	1	1.1	
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Q21. (2023)

19*			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Analyses the information to give a clear and detailed comparison of the environmental impacts of each car over its lifetime. AND Applies knowledge and understanding of scientific ideas to give a detailed evaluation of the difference in emissions with an explanation of why a steel car has the smallest environmental impact. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Analyses the information to give a clear comparison of some of the environmental impacts of each car over its lifetime and suggests which car has the smallest environmental impact with some reasoning. OR Applies knowledge and understanding of scientific ideas to give a clear evaluation of the difference in emissions with an explanation of which car has the smallest environmental impact. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i>	6	2 x 2.1 4 x 3.2a	AO3.2a Analyse ideas and information to make judgements and AO2.1 Apply knowledge and understanding of scientific ideas Production - extraction of aluminium from aluminium ore uses electrolysis which uses lots of energy - due to energy required for electrolysis production of aluminium, it produces the most CO₂ emissions - iron (for steel) is extracted by heating iron ore with carbon - this requires less energy (than electrolysis) so produces less CO₂ emissions Driving - aluminium has a lower density (than iron) so has better fuel economy and reduces CO₂ emissions End of life - aluminium's higher CO₂ emissions when producing the metal mean that there is a greater saving (than with iron) on CO₂ emissions by recycling the metal Overall - lifetime CO₂ emission for aluminium is 42 408kg, compared to 41 952kg for steel/iron - steel/iron therefore has the least environmental impact
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		Level 1 (1–2 marks) Analyses the information to compare an environmental impact of each car. OR Applies some knowledge and understanding of scientific ideas to attempt an explanation of the difference in emissions in one of the three life-cycle stages. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.			
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Q22. (2024)

3	D ✓	1	1.1	
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Q23. (2024)

A)

20	(a)	The Earth cooled, and water vapour condensed / the Earth cooled, and water vapour turned to water ✓ (Water vapour condensed) to form oceans ✓ Plants or algae evolved <u>and</u> used <u>photosynthesis</u> to take in carbon dioxide and make oxygen ✓	3	3 x 1.1	ALLOW MAX 2 marks if processes not in the correct order
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B)

	(b)	(i)	As the percentage of carbon dioxide decreases, the percentage of nitrogen increases / ORA ✓	1	3.1a	IGNORE references to proportionality
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C)

		(ii)	Answer in range 1700 – 1600 (millions of years) ✓	1	3.1a	
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D)

	(c)	(i)	Idea that as the amount of sulfur dioxide increases, the pH (of the rainwater) decreases / ORA ✓ (the lower the pH) the more acidic the water / ORA ✓ (so) the higher the hydrogen ion / H⁺ concentration / ORA ✓	3	3 x 3.1a	ALLOW higher amount of hydrogen / H⁺ ions ALLOW just the idea that as the amount of sulfur dioxide increases the higher the hydrogen ion / H⁺ concentration for 1 mark, if no other mark awarded
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E)

		(ii)	Idea of less acid rain because of less use of fossil fuels / more use of renewable energy OR of using cars less / using mass transportation e.g., trains or buses OR of reducing energy consumption in homes ✓	1	3.1a	ALLOW a named form of renewable energy e.g., solar panels, wind turbines, tidal turbines ALLOW idea that the amount of sulfur dioxide (in the atmosphere) has decreased
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