Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

greenhouse effect: natural; greenhouse gases absorb outgoing heat and keep the Earth about 33 °C warmer than without them; enhanced greenhouse effect: human activity (burning fossil fuels, cutting forests, farming) adds more gases, so more heat is kept and the Earth warms

2.2

$\frac{425 - 317}{317} \times 100 \approx \mathbf{34}$ %; burning coal, oil or gas / cutting down forests / cement making

2.3

any two: changes in the Earth's orbit or tilt (Milankovitch cycles); changes in the Sun's output; large volcanic eruptions that put ash and sulfur gases in the upper air

2.4

warming melts sea ice; the darker ocean reflects less sunlight (a lower albedo) and absorbs more energy; this causes more warming, which melts more ice, so the change gets bigger

2.5

any two, each with data: global temperature about 1.1 °C higher in 2011–2020 than 1850–1900; sea level about 20 cm higher from 1901 to 2018; CO_2 rose from about 280 ppm before industry to about 425 ppm in 2024; shrinking glaciers or Arctic sea ice, with a named example

3.1

(a) $100 - 30 = \mathbf{70}$ %

(b) any two, explained: burning fossil fuels adds CO_2, which absorbs more outgoing heat, so more energy stays in the system; cattle and rice fields add methane, a strong greenhouse gas; cutting forests releases CO_2 and removes a carbon store; air pollution and land-use change alter the albedo, e.g. soot on ice makes it darker

3.2

Mark with the markbands: [9-10] focused on the command term, detailed and accurate knowledge, well-developed explanation, specific named examples (places, dates, numbers), balanced evaluation and a supported conclusion; [7-8] mostly focused, good knowledge and examples, some evaluation; [5-6] relevant knowledge and examples, explanation partly developed, little evaluation; [3-4] general knowledge, few examples, mostly description; [1-2] little that is relevant. Points that may be included: natural causes exist: Milankovitch cycles drove ice ages over tens of thousands of years; the Sun's output varies a little, and large eruptions cool the Earth for a year or two; but orbital changes are far too slow to explain warming over decades; the Sun's output has not risen enough since 1950 to explain the warming; CO_2 rose from about 280 ppm to about 425 ppm, far outside the 180–300 ppm range of the last 800,000 years; the rise follows the burning of fossil fuels since the industrial revolution; warming of about 1.1 °C (2011–2020 compared with 1850–1900) matches the extra greenhouse effect (IPCC); natural feedbacks such as ice–albedo and permafrost make human warming bigger; conclusion: natural causes explain past changes and short ups and downs, but human activity is the main cause of the warming since 1950, so the statement is not supported

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