Solutions

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

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

2.1

the area of productive land and sea needed to supply the resources a person (or population) uses and to absorb their waste, measured in global hectares

2.2

$2.6 \div 1.6 \approx$ **1.6** Earths; humanity uses resources faster than nature renews them, by using up stocks (e.g. fish, forests) and letting waste such as CO_2 build up

2.3

renewable: can be used again if used no faster than it renews, e.g. forests, fish, wind; non-renewable: exists in a fixed amount and is used up, e.g. coal, oil, metals

2.4

more people join the middle class as incomes rise, especially in Asia; each person then uses more: more meat, cars, electronics and energy; so consumption per person rises as well as the number of people

2.5

Malthus: population grows faster than food supply, so famine, disease and war will stop growth; Boserup: population growth pushes people to invent new ways to grow more food, so food supply can keep up with population

3.1

(a) Country X; $5.0 - 1.0 =$ **4.0** gha per person

(b) any two, explained: Country W is richer, so people eat more meat and buy more goods; more energy use from cars, heating and air conditioning, often from fossil fuels; more waste and more imports of goods made elsewhere; Country Z is poorer and more rural, with lower energy use per person

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: Boserup: the Green Revolution (new seeds, fertilizer, irrigation) raised world grain output faster than population; world population passed 8 billion in 2022 without a world famine; new technology keeps raising supply: drip irrigation, new varieties, solar and wind energy; Malthus: famines still happen, though usually because people cannot afford food, not because there is none (Sen); humanity uses about 1.6 Earths, so stocks such as fish and forests are being used up; the Green Revolution needed a lot of water and fertilizer, causing falling water tables

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and polluted rivers; climate change could cut yields in hot regions, a limit Malthus did not foresee; scale: at the global scale Boserup fits better; at a local scale, overuse of land and water fits Malthus; conclusion: Boserup has been more accurate so far, but a Malthusian limit may come from the environment instead of from food