Solutions

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

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

2.1

only about 10% of energy passes to the next level; most is lost as heat in respiration, or in waste and parts not eaten; after a few levels too little energy is left to support another population

2.2

(i) $24\,000 - 15\,000 = \mathbf{9000}$ kJ m^{-2} yr^{-1}; (ii) $\dfrac{900}{9000} \times 100 = \mathbf{10}\%$

2.3

GSP $= 100 - 60 = \mathbf{40}$ MJ; NSP $= 40 - 35 = \mathbf{5}$ MJ; grass is hard to digest, and keeping a large warm body moving uses much energy in respiration

3.1

(a) numbers: a narrow bar for the one tree, a wide bar for the caterpillars, a narrow bar for the birds; biomass: widest at the base, getting narrower at each level

(b) a pyramid of numbers ignores size: one tree is very large; biomass takes mass into account, and biomass falls at each level because energy is lost

3.2

(a) $25 \div 0.04 = \mathbf{625}$ times

(b) DDT is persistent and fat-soluble, so it is stored in body fat and not excreted (bioaccumulation); each organism eats many from the level below; so the DDT is passed on and concentrated at each level (biomagnification)

(c) eggshells become thin and break, so fewer chicks hatch and the population falls

3.3

(a) $64 \div 800 \times 100 = \mathbf{8}\%$

(b) it shows energy flow over time; energy is lost at every transfer, so each level must be smaller than the one below

(c) eating plants uses NPP directly: about ten times more energy per area than eating herbivores; so less land is needed per person; but some land (dry grassland, hills) cannot grow crops, and meat provides protein and incomes, so a reduction rather than an end may be best

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