Solutions

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

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

2.1

environmental: e.g. water and pesticides used to grow cotton; social: e.g. fair pay and safe conditions for factory workers; economic: e.g. a price people can pay while the firm still makes a profit

2.2

embodied energy: the total energy used to extract, process, make and transport a product before it is used; carbon footprint: the total greenhouse gas emissions caused by the product over its life, in kg CO_2e

2.3

raw materials, manufacture, distribution, use, end of life

2.4

(a) $(90 + 160) \div 330 \times 100 \approx$ **76** %

(b) make the laptop last longer / easier to repair and upgrade, because most of the footprint is made before use, so spreading it over more years cuts it most

2.5

any two, explained: it needs a lot of data, which may not be available, so estimates are used; results depend on assumptions, e.g. how long the product is used or how the electricity is made; the boundaries can be chosen to make a product look better; different impacts, e.g. carbon and water use, are hard to compare

3.1

(a) use; $1300 \div 1750 \times 100 \approx$ **74** %

(b) any two, explained, aimed at use: a more efficient motor and better insulation of the drum, so less electricity per wash; an eco programme / load sensor so water and heat match the load; lower-temperature washing that still cleans, as heating water uses most energy

(c) the outer panels are part of raw materials and manufacture, which are only 400 of 1750 kg; the plastic panels are a small part of that; use is about 74 % of the total, so changes there matter far more

3.2

(a) saving $= (400 - 200) \times 0.5 = 100$ kg CO_2e a year; $350 \div 100 =$ **3.5** years

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(b) award up to [5]: here the new fridge repays its footprint in 3.5 years, so it is better if used for longer than that; but every new product carries a manufacturing footprint and uses raw materials; the old fridge becomes waste unless reused or recycled, and old fridges contain refrigerants that need safe disposal; if the electricity is low-carbon, the saving per year is smaller, so the repayment time is longer; judgement: replace only when the saving repays the footprint well within the new product's life / repair efficient products instead