Solutions

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

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

2.1

after lunch: insulin; glycogen made

overnight: glucagon; glycogen broken down, gluconeogenesis starting

day 3: glucagon; gluconeogenesis and ketone production

2.2

glucose attaches to haemoglobin slowly and stays for the cell's life

red cells live about 120 days, so the share reflects the average over that time, weighted to the last 2–3 months

2.3

120/3 = **40** g a day

less glucose must be made from amino acids, so less muscle protein is lost

2.4

insulin falls after the meal (hours 0–4)

liver glycogen runs low (about a day); gluconeogenesis rises (12–24 h)

ketones give a third of brain energy (day 3)

3.1

(a) fasting glucose 8.1 is above 7.0; HbA1c 7.2% is above 6.5%: diabetes

(b) type 2: the patient is older and overweight, and there are no ketones, so some insulin is still made

(c) insulin resistance means the liver does not respond to insulin, so it keeps making glucose overnight as if fasting

(d) it treats the main source of the high fasting glucose, without causing low sugar on its own

3.2

(a) insulin drives glucose into muscle and fat and stops the liver releasing it; with no food arriving, blood glucose falls

(b) shaking and sweating come from adrenaline released as a warning; confusion comes from the brain running short of glucose

(c) give fast sugar, such as a sugary drink or glucose tablets, then a snack, and call for help if there is no improvement

3.3

(a) $500 \times 4 =$ **2000** kcal; shortfall **600** kcal

(b) fat is broken down and oxidised more slowly than glycogen, and gives less ATP per O_2, so the pace that fat alone can support is much lower

(c) $60 \times 3.5 = 210$ g; $\times 4 =$ **840** kcal, more than the shortfall

(d) eat plenty of carbohydrate in the 1–2 days before, to fill glycogen stores; take carbohydrate drinks or gels regularly from early in the race, and practise this in training

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