Solutions

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

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

2.1

- nitrate: to make amino acids and proteins
- magnesium: to make chlorophyll

2.2

- vitamin C: scurvy
- iron: anaemia

2.3

- boil the leaf in water, then in ethanol to remove the chlorophyll; rinse in water
- add iodine solution: the starch areas turn blue-black

2.4

- it neutralises stomach acid, giving the alkaline pH that intestine enzymes need
- it emulsifies fats into small droplets, giving a larger surface area for lipase

3.1

- many villi (and microvilli) give a large surface area
- the wall is only one cell thick, so the diffusion distance is short
- a good blood supply (capillaries) keeps the concentration gradient steep; a lacteal absorbs fatty acids and glycerol

3.2

- broad and thin: a large surface area to absorb light and a short distance for gases
- palisade cells packed with chloroplasts near the upper surface, to absorb most light
- stomata and air spaces let carbon dioxide diffuse to the cells

3.3

(a) $(38 + 41 + 41) \div 3 = \mathbf{40}$; to spot anomalies, or to make the mean more reliable

(b) as the distance increases, the number of bubbles falls; the light intensity falls further from the lamp; light is the limiting factor; so less light energy for photosynthesis and less oxygen is made

(c) to absorb heat from the lamp, so the temperature stays the same; any two (1 mark each): carbon dioxide concentration (sodium hydrogencarbonate), the same piece of pondweed, the temperature of the water, the time allowed at each distance

(d) points to include:

- bubbles may be different sizes, so the number does not show the volume of oxygen (K)
- small bubbles may be missed, or bubbles counted when the student loses count (K)
- the gas may not be pure oxygen; some oxygen dissolves in the water (An)
- improvement: collect the gas in an inverted measuring cylinder or a gas syringe (photosynthometer) (App)
- measure the volume collected in a fixed time, e.g. 5 minutes (App)
- let the plant adjust for a few minutes at each new distance before measuring (App)

Levels: **5–6** a full, logical answer with correct biology and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.