Solutions

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

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

2.1

ribosome: makes proteins; nucleus: stores DNA

rough ER: makes proteins for export; Golgi: sorts and labels them

lysosome: breaks material down; mitochondrion: makes ATP

2.2

$r = 2.5$ µm: $3/2.5 = \mathbf{1.2}$ µm^{-1}

4 times the 20 µm cell's 0.3

2.3

$6.4 \times 10^{9} \times 0.34 \times 10^{-9}$ m

$\approx \mathbf{2.2}$ m

$2.2/(6 \times 10^{-6}) \approx \mathbf{3.6 \times 10^{5}}$ times

2.4

ribosomes on the rough ER → inside the ER → Golgi

→ secretory vesicle → fuses with the membrane: exocytosis

3.1

(a) area ×4; volume ×8

(b) demand grows with volume but supply grows with area, so each unit of volume gets half the membrane: the cell would be short of supply

(c) about **20** times

(d) the inner mitochondrial membrane (cristae), which carries the electron transport chain that makes ATP

3.2

(a) the enzyme's substrate is not broken down; it builds up in the lysosomes, which swell; the cell cannot recycle its parts and its function fails

(b) a leaked enzyme meets pH 7.2 in the cytosol, where it is almost inactive, so it does not digest the cell

3.3

(a) X: a secreting cell, e.g. a plasma cell, because of the large rough ER; Y: a high-energy cell, e.g. heart muscle, because of the many mitochondria; Z: a red blood cell, with no nucleus and no mitochondria

(b) $0.30 \times 5000 = \mathbf{1500}$ µm^3

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(c) by glycolysis only, in the cytosol; with no nucleus and no ribosomes it cannot make new proteins

(d) cell Y: it depends most on mitochondrial ATP, while Z does not use mitochondria at all