Solutions

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

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

2.1

O_2: simple diffusion

glucose by GLUT1: facilitated diffusion

Na^+ by the pump: primary active transport

2.2

$61.5 \log_{10}(5/150)$

$\approx$ **−90.8** mV

2.3

$z = 2$, so the factor is $61.5/2 = 30.75$

ratio $1.2 \times 10^{-3}/10^{-7} = 1.2 \times 10^4$

$30.75 \times 4.08 \approx$ **+125** mV

2.4

each cycle moves one more positive charge out than in

so it makes a small current and the inside becomes more negative

3.1

(a) 5 mM: $61.5 \log_{10}(5/140) =$ **−89.0** mV; 8 mM: $61.5 \log_{10}(8/140) =$ **−76.4** mV

(b) the resting potential mostly follows E_K, so it becomes less negative: the cells are depolarised

(c) heart cells sit closer to threshold and their Na^+ channels become inactivated, so conduction slows and dangerous rhythms can start

3.2

(a) halved: $\times\frac{1}{2}$

(b) $\frac{1}{2} \times \frac{1}{2} =$ **$\frac{1}{4}$**

(c) O_2: it diffuses much less easily, so it is limited first, while CO_2 still has a large margin

3.3

(a) SGLT1 carries Na^+ and glucose in together, using the Na^+ gradient; this carrier still works in cholera; the absorbed solutes pull water in by osmosis

(b) $75 + 65 + 20 + 10 + 75 =$ **245** mmol/L: a little below blood, so water moves from gut to blood

(c) the extra sugar is not absorbed and draws water into the gut by osmosis

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(d) give ORS by mouth in small frequent sips, matching the losses; use a drip for patients too weak or too dehydrated to drink