

Solutions

2.1

- $61.5 \log_{10}(15/140) = 61.5 \times (-0.970) = -59.7 \text{ mV}$.

2.2

- Facilitated diffusion via the GLUT carrier: glucose is hydrophilic, so the bilayer alone is impassable; movement is downhill, no ATP.

2.3

- $E_K \propto \log_{10}([out]/[in])$; doubling [out] adds $\log_{10} 2$ inside the log: $+18.5 \text{ mV}$.

3.1

- Shift $61.5 \log_{10} 2 = +18.5 \text{ mV}$; new $E_K = -89.0 + 18.5 = -70.5 \text{ mV} \checkmark$.
- V_m tracks E_K (P_K dominates), so depolarisation.
- Cardiac: depolarised myocytes sit closer to threshold – arrhythmia risk.
- Pump: 3 Na^+ out, 2 K^+ in, 1 ATP – it maintains the gradients but cannot by itself fix an extracellular load.

3.2

- Door: a Cl^- channel (facilitated diffusion class).
- Misfolded $\rightarrow$ retained in the ER $\rightarrow$ never reaches the membrane $\rightarrow \text{Cl}^-$ cannot leave.
- Cl^- trapped $\rightarrow$ salt accumulates luminal-side $\rightarrow$ water follows osmotically (290 mOsm gradients equalise) $\rightarrow$ surface liquid dehydrates $\rightarrow$ mucus cannot clear.
- Therapy: folding correctors hold the channel open through processing, restoring some Cl^- flow.