HW 7 Solutions

1. $W = -\int p \, dV$

$$= -\int_{V_1}^{V_2} \frac{RT}{V-b} - \frac{a}{V^2} \, dV$$

$$= -\left[RT\ln(V-b) + \frac{a}{V} \right|_{V_1}^{V_2}$$

$$\boxed{W = -RT\ln\left(\frac{V_2-b}{V_1-b}\right) - \frac{a}{V_2} + \frac{a}{V_1}}$$

2. (a) $R_H Q = -kT\left([Na^+]^{int} - [Na^+]^{ext} + \frac{X}{V}\right)$

(b) $I_{Na} = g_{Na}\left(V - \frac{kT}{q}\ln\left(\frac{[Na^+]^{ext}}{[Na^+]^{int}}\right)\right) - pq$ ← pumped IN.

(c) $[Na^+]^{int} = \frac{X}{V}$.

(d). (a) gives $0 = [Na^+]^{int} + \frac{X}{V} - [Na^+]^{ext}$

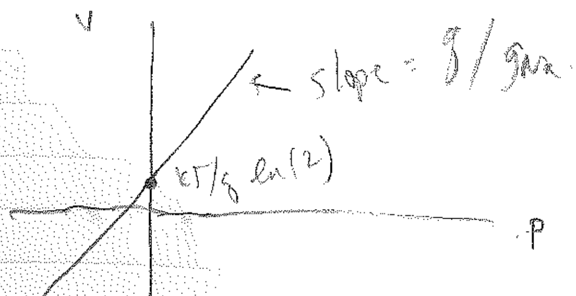
$$= \frac{2X}{V} - [Na^+]^{ext} \longrightarrow \boxed{V = \frac{2X}{[Na^+]^{ext}}}$$

$$\rightarrow [Na^+]^{int} = \frac{X}{V} = \boxed{\frac{[Na^+]^{ext}}{2} = [Na^+]^{int}} = 70 \text{ mEq/L.}$$

$$V = \frac{pq}{g_{Na}} + \frac{kT}{q}\ln\left(\frac{[Na^+]^{ext}}{[Na^+]^{int}}\right)$$

$$\boxed{V = \frac{pq}{g_{Na}} + \frac{kT}{q}\ln(2)}$$

(e)



(f) $V > 0$ when $p = 0$. "Outflow" of charge compensates for would-be input since $[Na^+]^{ext} > [Na]^{int}$

(g) as p increases, more Na comes in. Voltage must be more positive to keep S.S.