a) $0 = v|_V - v|_{V+\Delta V} - v_{leak}$

$0 = v|_z - v|_{z+\Delta z} - v_{leak}$

$\lim_{\Delta z \to 0} \frac{v_{leak}}{\Delta z} = \frac{v|_z - v|_{z+\Delta z}}{\Delta z}$

$\frac{v_{leak}}{\Delta z} = \frac{dv}{dz} = v_0\left(-\frac{1}{2L}\right)$

$\frac{v_{leak}}{\Delta z} = -\frac{v_0}{2L}$

b) $\frac{dN_A}{dt}^{\circ} = F_A|_V - F_A|_{V+\Delta V} - kC_A\Delta V - C_A v_{leak}$

$\frac{dF_A}{dV} = -kC_A - C_A\frac{v_{leak}}{\Delta V}$

$\frac{dF_A}{dV} = -kC_A - \frac{C_A}{A_c}v_0\left(-\frac{1}{2L}\right)$

$\frac{dF_A}{dz} = -kC_A A_c + \frac{C_A v_0}{2L}$

c) $\frac{dF_A}{dz} = -k\frac{F_A}{v_0(-\frac{z}{2L})}A_c + \frac{F_A v_0}{v_0(-\frac{z}{2L})}$

$\frac{dF_A}{dz} = -k\frac{F_A A_c}{v_0(1-\frac{z}{2L})} + \frac{F_A v_0}{v_0(1-\frac{z}{2L})2L}$

$\frac{dF_A}{dz} = -k\frac{F_A A_c}{v_0(1-\frac{z}{2L})} + \frac{F_A}{2L(1-z/2L)}$