A. The diode equations are

$$J_1 = J_{sc,1} - J_{01}\left(e^{V/V_T} - 1\right)$$

parallel:

$$J_{||} = \underbrace{(J_{sc,1} + J_{sc,2})}_{36\ mA/cm} - (J_{01} + J_{02})\left(e^{V/V_T} - 1\right)$$

Use v_{oc} to get $J_{0i} = \dfrac{J_{sc,i}}{e^{V_{oc,i}/V_T} - 1}$

$J_{01} = 5.26 \times 10^{-6}\ mA/cm^2$

$J_{02} = 1.39 \times 10^{-9}\ mA/cm$

$$V_{oc,||} = V_T \ln\left(\frac{36}{J_{01} + J_{02}} + 1\right)$$

$$V_{oc,||} = 0.515\ V$$

In series, at open circuit $V_{oc} = V_{oc1} + V_{oc2}$.
at short circuit $V_1 = -V_2$

$$I_{sc1} - I_{01}\left(e^{-V_2/V_T} - 1\right) =$$

$$I_{sc2} - I_{02}\left(e^{V_2/V_T} - 1\right)$$

Expect cell 1 to be slightly forward biased to match currents, i.e. $V_2 < 0$

$$I_{sc1} - I_{01}\, e^{-V_2/V_T} = I_{sc2} + I_{02}$$

$$-V_2 = V_T \ln \frac{-I_{sc2} + I_{sc1}}{I_{01}}$$

$$V_2 = -0.458$$

$$I_{sc\,II} = I_{sc,2} - I_{02}\left(e^{.458/V_T} - 1\right) = 15.93$$

$$=$$

$I_{sc\,II} = 16\ mA$ as expected (weak link)

B.) With an applied voltage V_a

$$\cancel{\phi_{graphene}} + V_{ox} + \psi_s = V_a + \cancel{\phi_s}$$

$$V_{ox} = \frac{Q_{dupl}}{C_{ox}} = \frac{q N_A W x_o}{K_o \epsilon_o}$$

$$V_a = \psi_s + \frac{q N_A x_o}{K_o \epsilon_o} \left(\frac{2 K_s \epsilon_o}{q N_A} \right)^{1/2} \psi_s^{1/2}$$

$$V_a = 100 = \psi_s + 1.59 \psi^{1/2}$$

$$\psi_s = 100 - 1.59 \psi^{1/2}$$

iterate a few times

$$\psi_s = 85.3 \Rightarrow V_{ox} = 100 - 85.3$$

$$\mathcal{E} = \frac{14.7}{x_o} = 4.90 \times 10^5 \text{ V/cm}$$

In accumulation, $\mathcal{E} = \frac{100}{x_o}$