Position dependence of channel potential

Find out the position dependence of the channel potential within the square-law model.

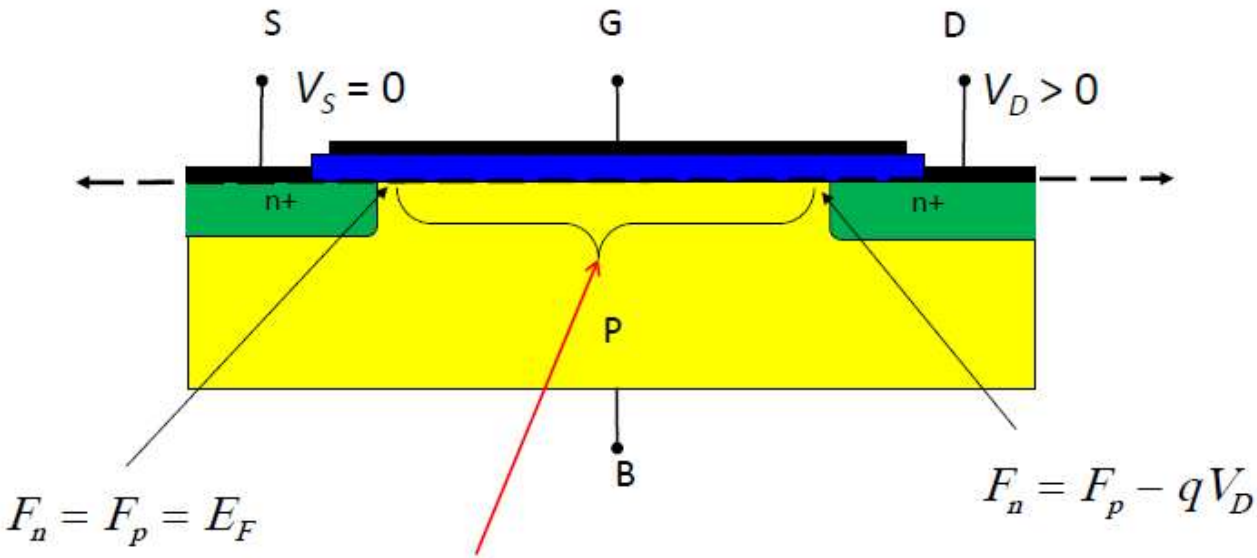
$$Q_i(V) = -C_G(V_G - V_T - V)$$

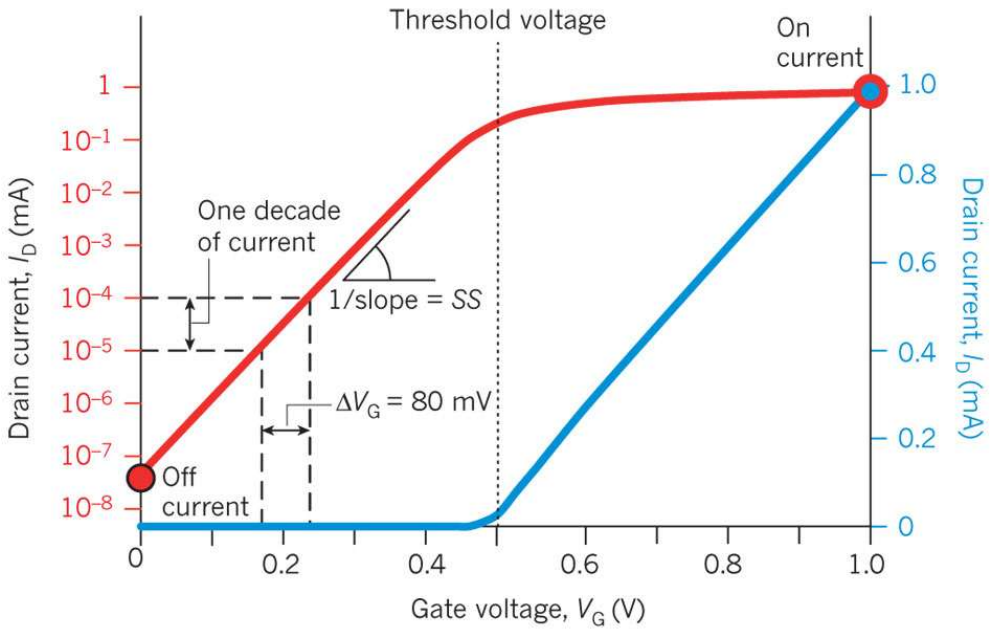
$$J = \mu Q_i(V)\frac{dV}{dy} \Rightarrow \qquad I_D = W\mu C_{ox}(V_G - V_T - V)\frac{dV}{dy}$$

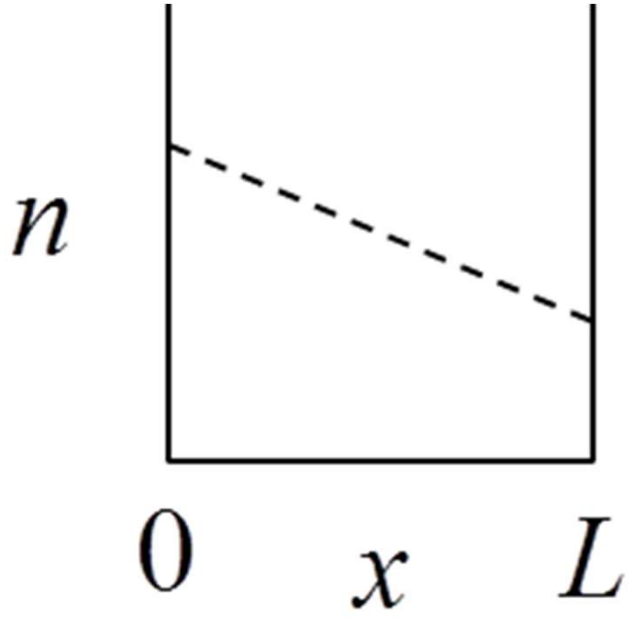
$$\frac{dV}{dy} = \frac{B}{V_0 - V} \Rightarrow V_0 \cdot V - \frac{V^2}{2} = By + C = By$$

V_{DS} dependence of subthreshold current

Find out the V_{DS} dependence of the subthreshold current.







V_{DS} dependence of subthreshold current

$$I_D = qAD_n \frac{dn}{dx} = qAD_n \left[\frac{n(0) - n(L)}{L}\right]$$

$$n(0) = n_0 exp(q\phi_s / k_B T)$$

$$n(L) = n_0 exp((q\phi_s - qV_D)/k_B T)$$

$$I_D \propto D_n \frac{W}{L} \frac{n_i^2}{N_a} e^{q\phi_s/k_B T}\left(1 - e^{-qV_D/k_B T}\right)$$