Electrical potential V(x) in the rectifying diode...

Physical constants

k_B	T	q
$(J \cdot K^{-1})$	(K)	(C)
$1.380 \cdot 10^{-23}$	300	$1.602 \cdot 10^{-19}$

Basic parameters

N_V	E_b	σ	ε	V_d	d
(cm^{-3})	(J)	(J)	$(F \cdot m^{-1})$	(V)	(m)
$1 \cdot 10^{21}$	$0.3 \cdot 1.602 \cdot 10^{-19}$	$0.05 \cdot 1.602 \cdot 10^{-19}$	$4 \cdot 8.854 \cdot 10^{-12}$	0.6	$200 \cdot 10^{-9}$

Constants of the ODE

$$A := -2 \frac{k_B \cdot T}{\varepsilon} N_V \cdot \exp\left(-\frac{1}{k_B \cdot T}\left(E_b - \frac{\sigma^2}{2 \cdot k_B \cdot T}\right)\right) = -1.38071 \cdot 10^{13} \frac{V^2}{m^2}$$

$$B := \frac{-q}{k_B \cdot T} = -38.69565 \frac{1}{V}$$

Given

The ODE to be solved

$$V'(x) = \sqrt[2]{A \cdot (exp(B \cdot V(x)) - 1) + C^2}$$

Boundary conditions

$$V(0\ m) = 0\ V$$

Solution of the ODE

$$V(C) := \text{odesolve}(V(x), d)$$

$$Vd(C) := \left\| \begin{array}{l} f \leftarrow V(C) \\ \text{return } f(d) \end{array} \right.$$

Given

$$C := 10^{-10} \frac{V}{m}$$

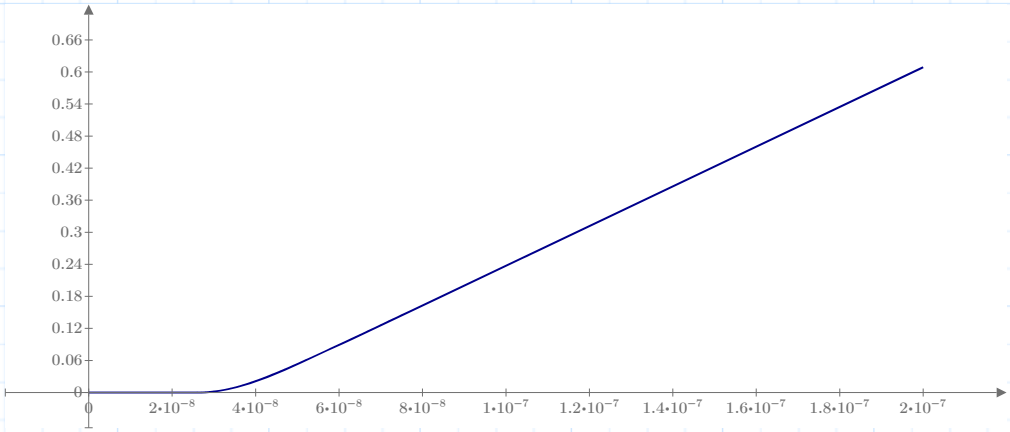
$$Vd(C) = -V_d$$

$$C_{opt} := \text{minerr}(C)$$

$C_{opt} = (1 \cdot 10^{-10}) \frac{V}{m}$ $V_{opt} := V(C_{opt})$ $V_{opt}(d) = 0.60881\ V$ thats NOT $-V_d$

Domain (Distance from cathode)

$x := 0\ m, 1 \cdot 10^{-9}\ m .. d$



$V_{opt}(x)\ \ (V)$

$x\ \ (m)$

$Vd\left(10^{-13}\ \frac{V}{m}\right) = \left(2 \cdot 10^{-20}\right)\ V$

$Vd\left(10^{-12}\ \frac{V}{m}\right) = \left(2 \cdot 10^{-19}\right)\ V$

$Vd\left(5 \cdot 10^{-12}\ \frac{V}{m}\right) = \left(1 \cdot 10^{-18}\right)\ V$

$Vd\left(10^{-11}\ \frac{V}{m}\right) = ?$???

$Vd\left(5 \cdot 10^{-11}\ \frac{V}{m}\right) = 0.53449\ V$

$Vd\left(6 \cdot 10^{-11}\ \frac{V}{m}\right) = 0.60881\ V$

$Vd\left(5.37 \cdot 10^{-11}\ \frac{V}{m}\right) = 0.53449\ V$

$Vd\left(5.38 \cdot 10^{-11}\ \frac{V}{m}\right) = 0.60881\ V$

$Vd\left(10^{2}\ \frac{V}{m}\right) = 0.70719\ V$

$Vd\left(10^{8}\ \frac{V}{m}\right) = 20.01378\ V$

Changing the ODE to $V'(x) = -\sqrt[2]{A \cdot \left(exp\left(B \cdot V(x)\right) - 1\right) + C^2}$ makes the solve block fail !