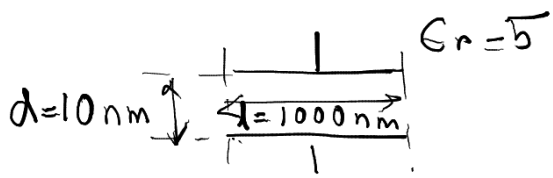
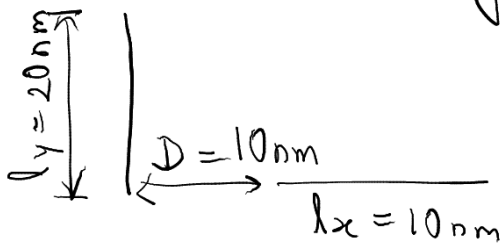
1. Find out the capacitance between two parallel plates by numerically solving 2D Poisson's equation. The capacitance dimension is as below:



Validate that the capacitance per unit width; $C = \frac{l \epsilon_0 \epsilon_r}{d}$.

2. Vary l from 1000 nm to 10 nm in steps of 50 nm and plot C(y) versus (l). Also plot parasitic capacitance $C_p = \left[C(y) - \frac{l \epsilon_0 \epsilon_r}{d}\right]$ and qualitively explain the nature of the plot.

3. Find out the capacitance of a perpendicular plate capacitor with the following dimension:



(a) Plot the 2D electric field profile in x and y directions
(b) Plot the 2D potential and equipotential lines.
(c) Find out the position where magnitude of electric field is maximum. Find out its direction.

Hints & assumption:

(1) Assume all the capacitors are enclosed in big box potential box with boundaries maintained at V = 0.
(2) Assume the thickness of the metal plates = 1 nm.
(3) The entire dielectric region is charge free.
(4) $V(x,y) = \frac{V(x+h,y) + V(x-h,y) + V(x,y+h) + V(x,y-h)}{4}$ in charge free region.