

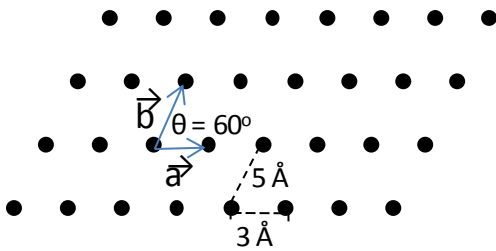
MS Exam Fall 2014 ECE230A/B

230A

1. We have the following 2D crystal.

(a) Find the reciprocal lattice vectors a^* and b^* . Draw the reciprocal lattice and specify a^* and b^* in your drawing. (Note: you need to specify the “length” of the a^* and b^* in your drawing).

(b) Draw the 1st Brillouin zone on your diagram.



230B

1. Design a 0.1 μm channel length nMOSFET with $V_{\text{dd}}=1.5\text{ V}$ and $V_{\text{t}}=0.3\text{ V}$. The inverse slope of the subthreshold current (log scale) should be about 80 mV/decade.

- What gate work function should be used?
- How thick should the gate oxide be?
- What should the maximum gate depletion width be?
- What kind of doping profile (uniform, high-low, or low-high) should be used? Work out the doping level and depth.
- What is the body effect, $dV_{\text{t}}/dV_{\text{bs}}$, where V_{bs} is the substrate-to-source bias?

2. Consider the following chain of identical inverters with a capacitive load C_L at the output of each stage. The propagation delay is 250 ps/stage for $C_L = 100\text{ fF}$. If C_L is increased to 200 fF, the delay becomes 400 ps/stage. Now if the widths of both the nMOSFET and the pMOSFET of the inverters are doubled with respect to their original values, what becomes the delay per stage when C_L is 100 fF?

