Week 12 Quiz 2: MOS Electrostatics II
ECE 606: Solid State Devices
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Answer the four multiple choice questions below by choosing the one, best answer.

1) The quantity, $\phi_F$, is a critical parameter in MOS theory. What happens when the surface potential equals $2\phi_F$?
   a) the majority carrier concentration at the surface equals the majority carrier concentration in the bulk.
   b) the majority carrier concentration at the surface equals the intrinsic carrier concentration, $n_i$.
   c) the minority carrier concentration at the surface equals the majority carrier concentration in the bulk.
   d) the minority carrier concentration at the surface equals the intrinsic carrier concentration, $n_i$.
   e) the minority carrier concentration at the surface equals the minority carrier concentration in the bulk.

2) The minority carrier charge (in C/cm$^2$) is an important quantity for an MOS capacitor. How does it vary with surface potential and with gate voltage above threshold.
   a) linearly with surface potential and linearly with gate voltage
   b) linearly with surface potential and exponentially with gate voltage
   c) exponentially with surface potential and linearly with gate voltage
   d) exponentially with surface potential and exponentially with gate voltage
   e) exponentially with surface potential and quadratically with gate voltage

3) Why is it hard to bend the bands in an MOS capacitor by more than about $2\phi_F$?
   a) Because of the role Fermi-Dirac statistics when the Fermi level approaches the band edge.
   b) Because the electric field in the oxide is so high that it breaks down.
   c) Because the electric field in the semiconductor is so high that it breaks down.
   d) Because SRH generation places an upper limit on the number of minority carriers.
   e) Because the increase in gate voltage needed to increase $\phi_s$ is mostly accommodated by an increased voltage drop in the oxide, not in the semiconductor.

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4) The “exact” solution for the MOS capacitor discussed in class is not really exact. Why not?

a) It assumes Maxwell-Boltzmann (non-degenerate) carrier statistics.
b) It assumes classical particles and does not treat quantum mechanical confinement.
c) Complete ionization of dopants is assumed.
d) All of the above.
e) None of the above.

Turn in to Ms. Wanda Dallinger, EE-326 by Friday, April 8.