Homework 1

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ECE 542: Semiconductor Development Fundamentals

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# A semiconductor has a bandgap of 0.5 eV. What is the bandgap in Joules?

0.5 Ev = 8.0109e-20 J

# A semiconductor has a bandgap of 2 × 10^−19 J. What is the bandgap in eV?

2e−19 J = 1.2484 eV

# Find the cost per transistor for:

## A single transistor

FQP13N10

$0.98

### Source: Mouser

### Part Number:

#### Mouser #: 512-FQP13N10

#### Manufacturer #: FQP13N10

## A representative IC

AMD Ryzen™ 9 3900X

$0.0499e-8

### Source: AMD

### Part Number: 100-000000023

# Using a computer and your favorite math program, plot the Fermi-Dirac distribution function as a function of energy. On the same plot, show the Maxwell-Boltzmann distribution function. The y-axis should range from 0 to 2. The x-axis should range from Ef – 1 eV to Ef + 1 eV. Do this at a temperature of 300 K.

## A screenshot of a cell phone Description automatically generated

Note: The y-axis range is 0-200 because the entire y-axis is multiplied by 100 to ensure it represents a probability value.

## Over what range does the Maxwell-Boltzmann distribution function approximate the Fermi-Dirac distribution function?

Assuming 0.1% error is a sufficient approximation, the energy range if E-Ef where the Maxwell-Boltzmann distribution function sufficiently approximates the Fermi-Dirac distribution function is 0.17871787178717868 or greater.

# Appendix

## CALCULATIONS.PY



