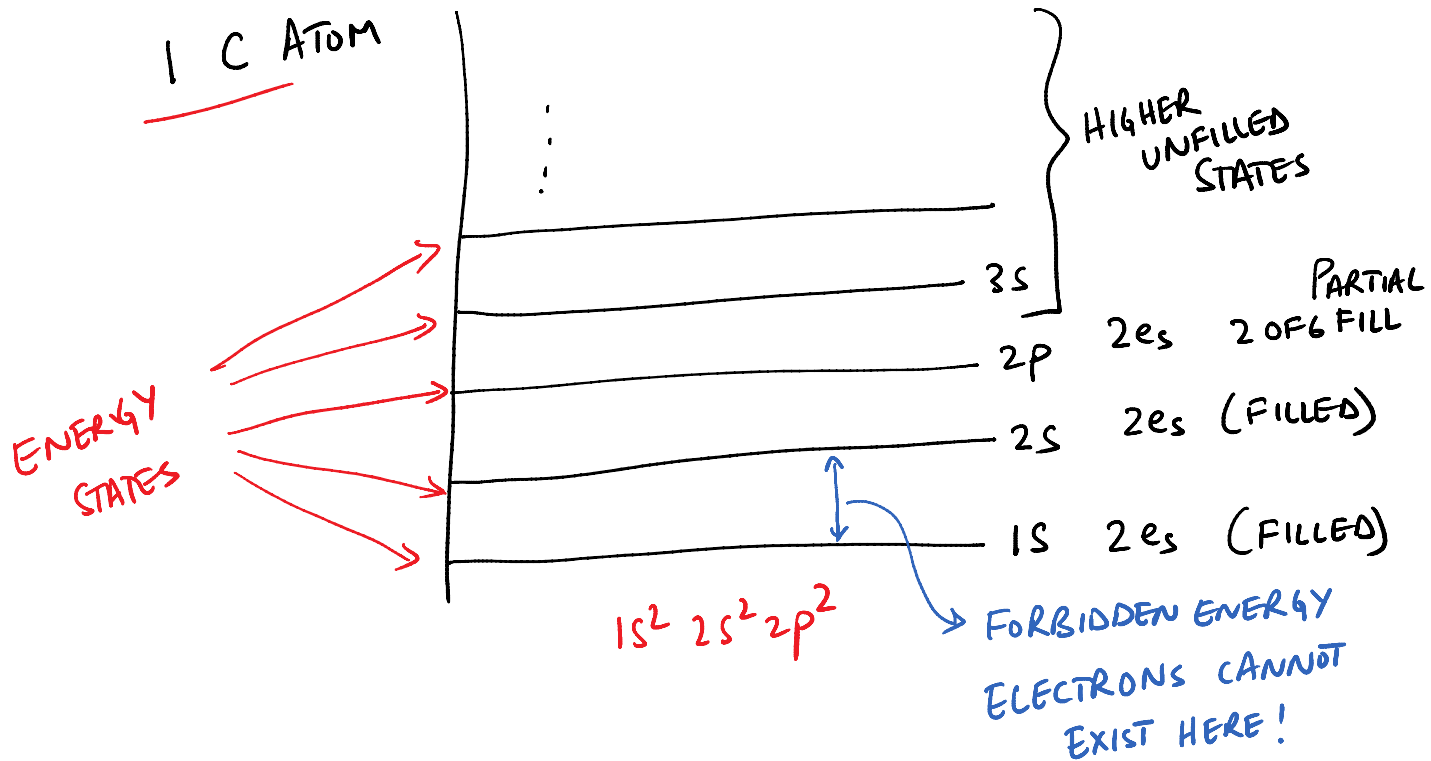
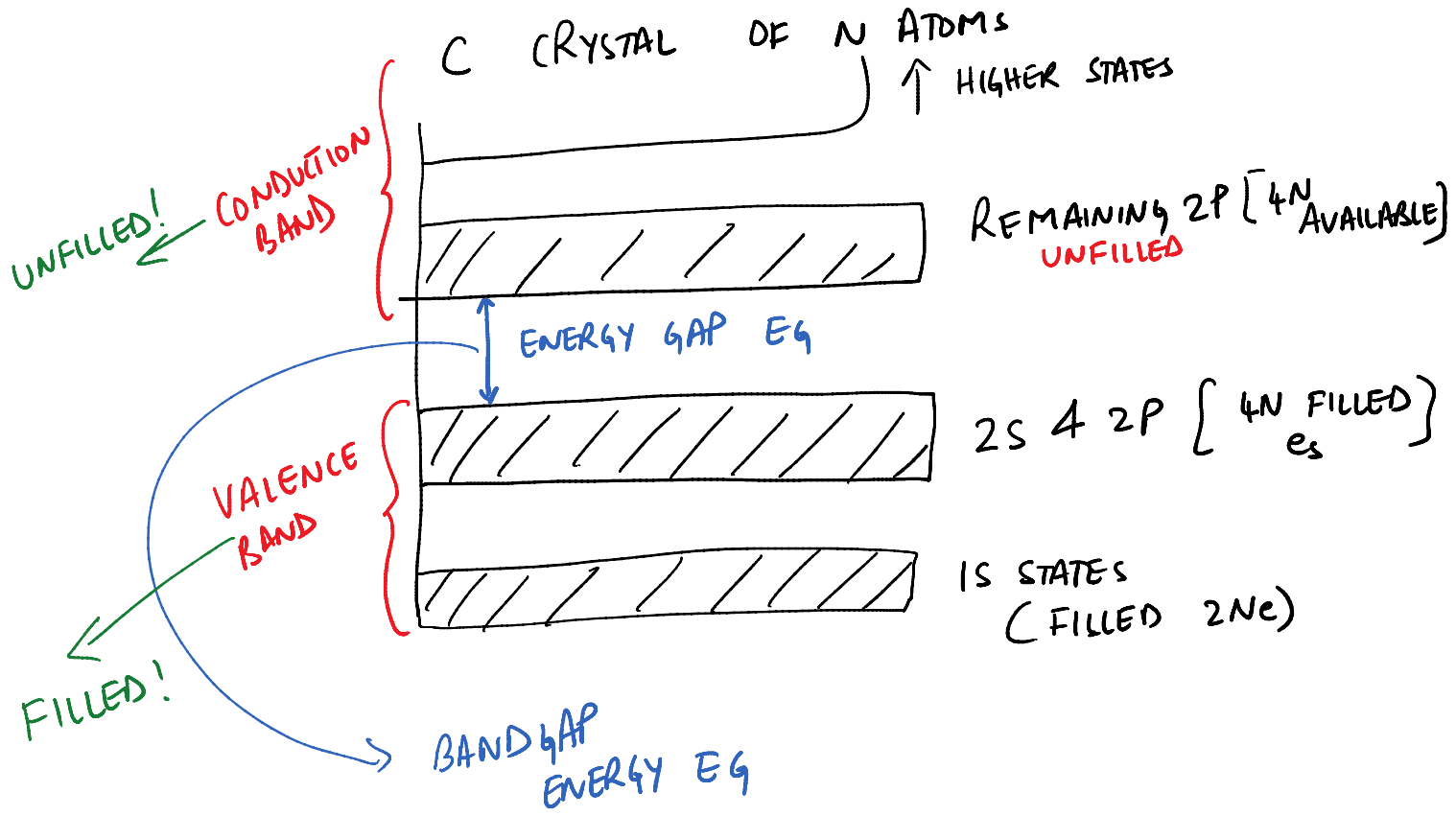


LECTURE 4

ENERGY LEVELS IN SEMICONDUCTOR CRYSTALS

* ENERGY STATES ARE DISCRETE IN NATURE!



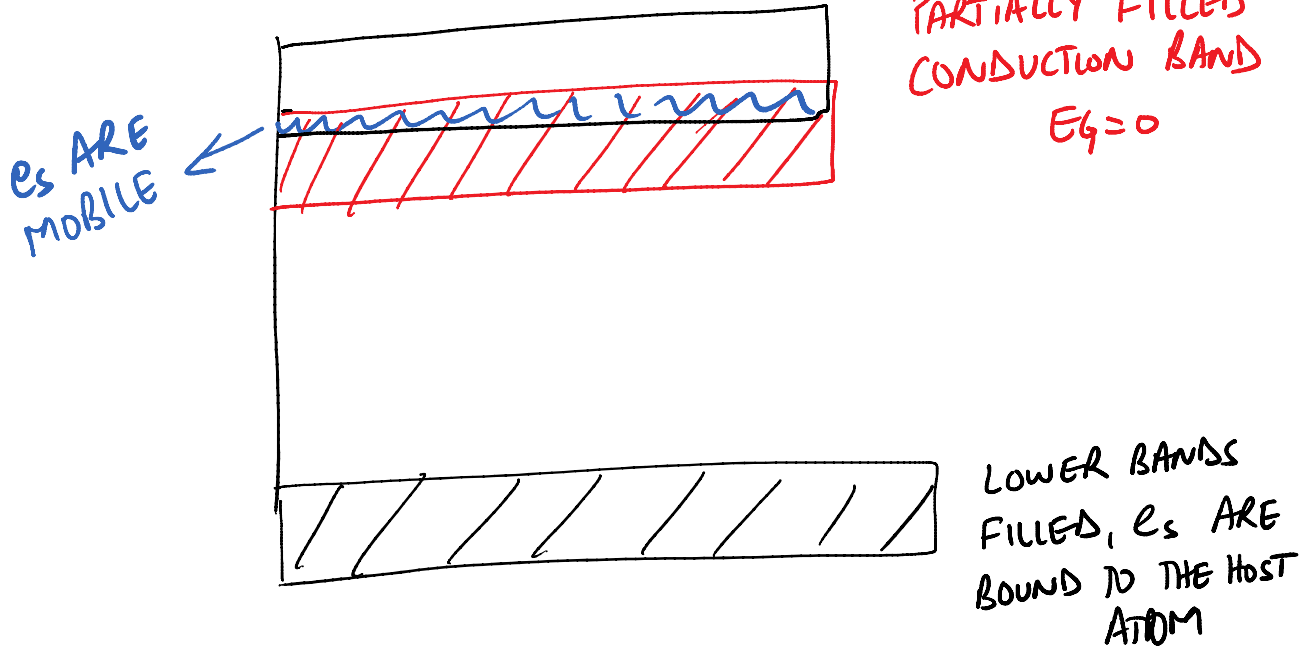


a) METALS → CONDUCTORS

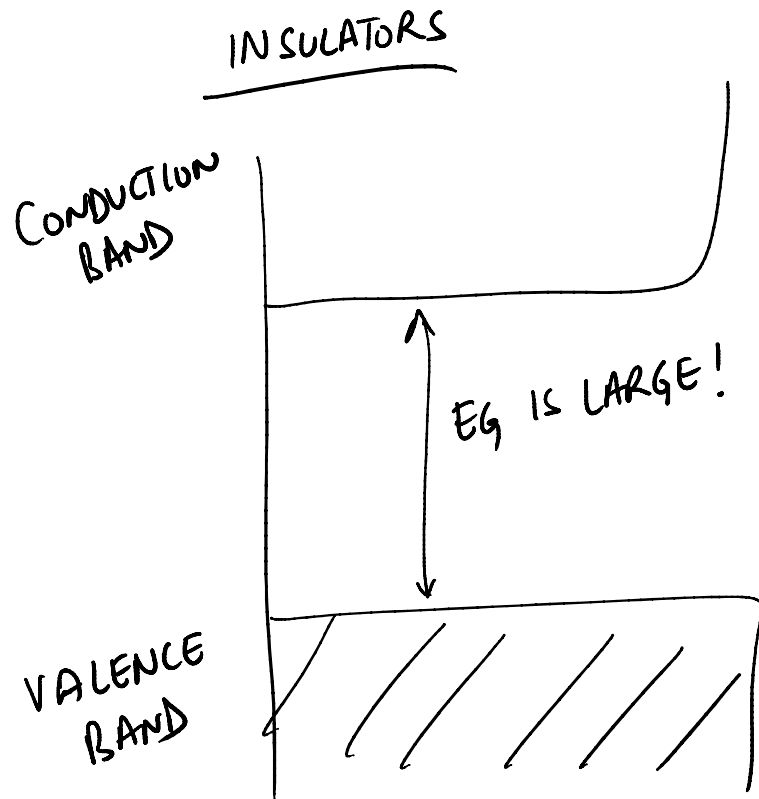
c) SEMICONDUCTORS

b) INSULATORS →

METALS → GOOD CONDUCTORS

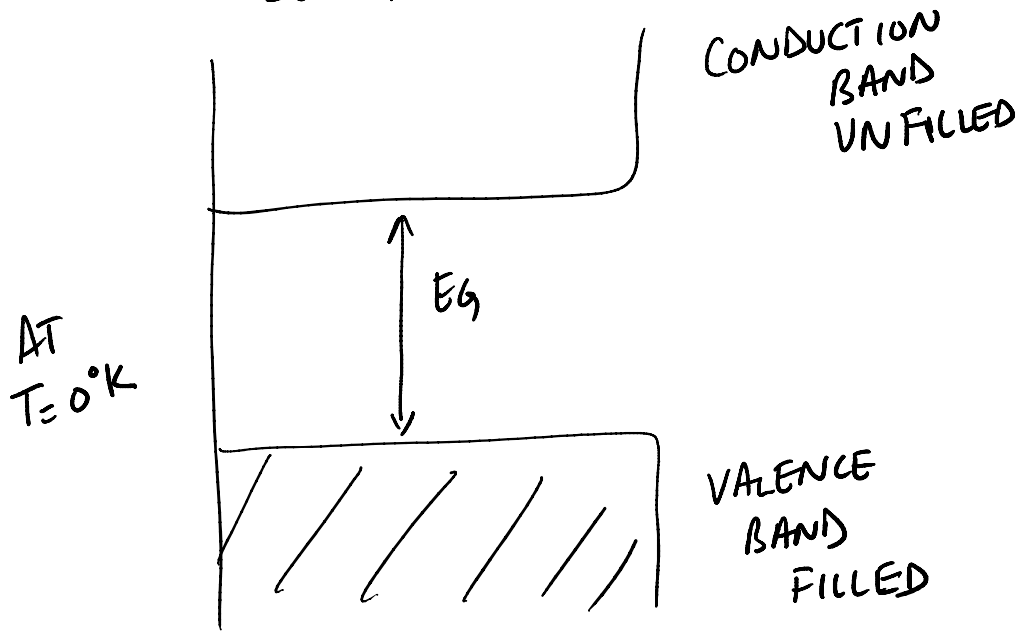
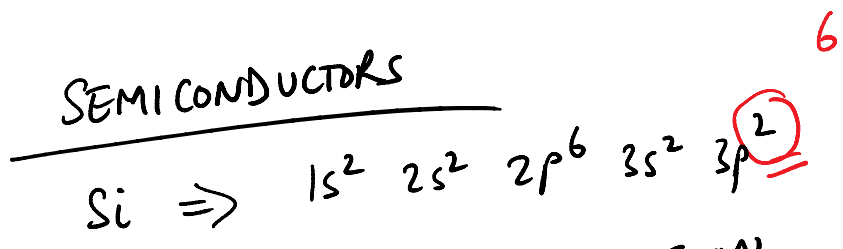


Tuesday, January 08, 2013
12:41 PM



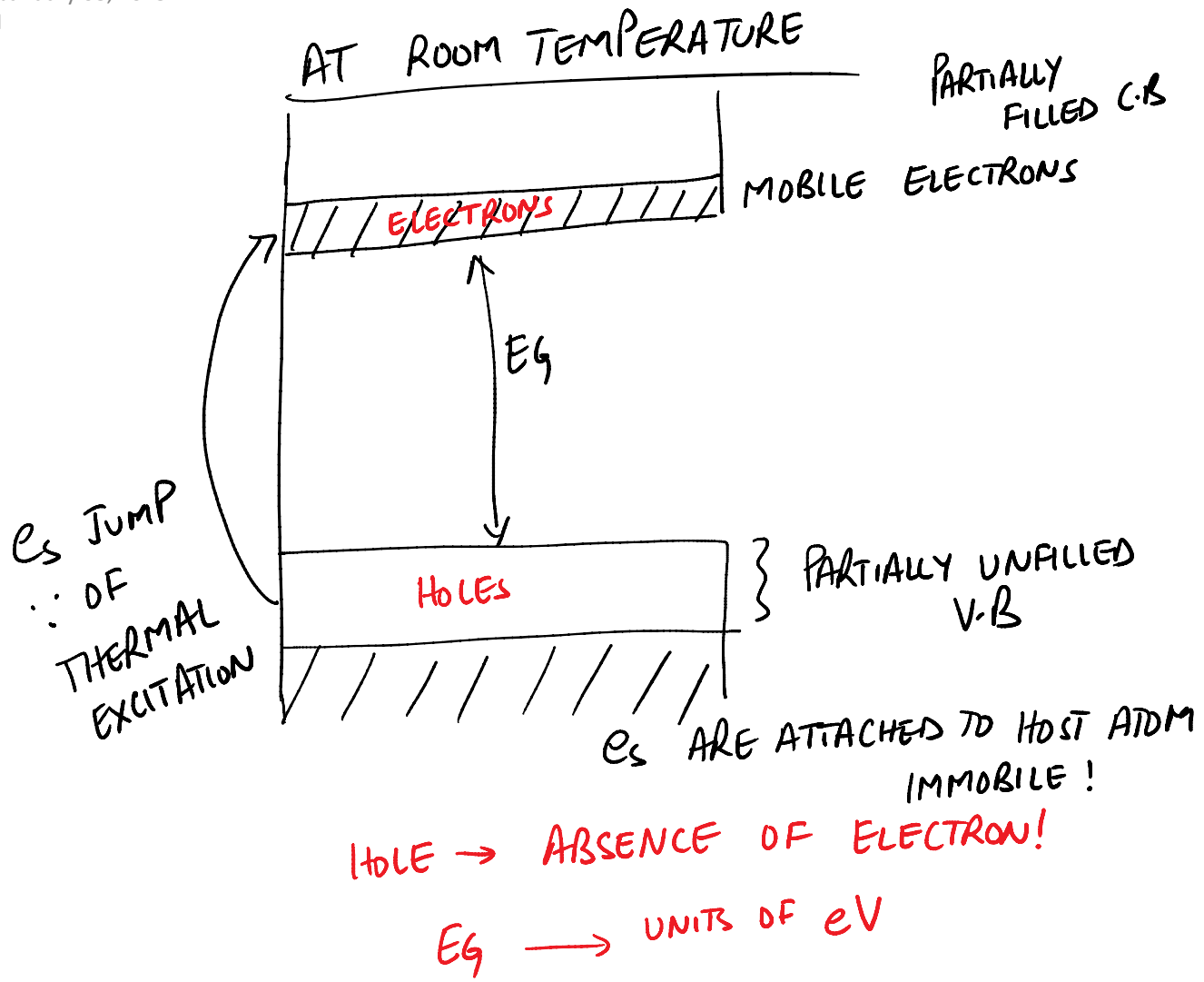
POOR CONDUCTORS
HIGHER EMPTY
BAND

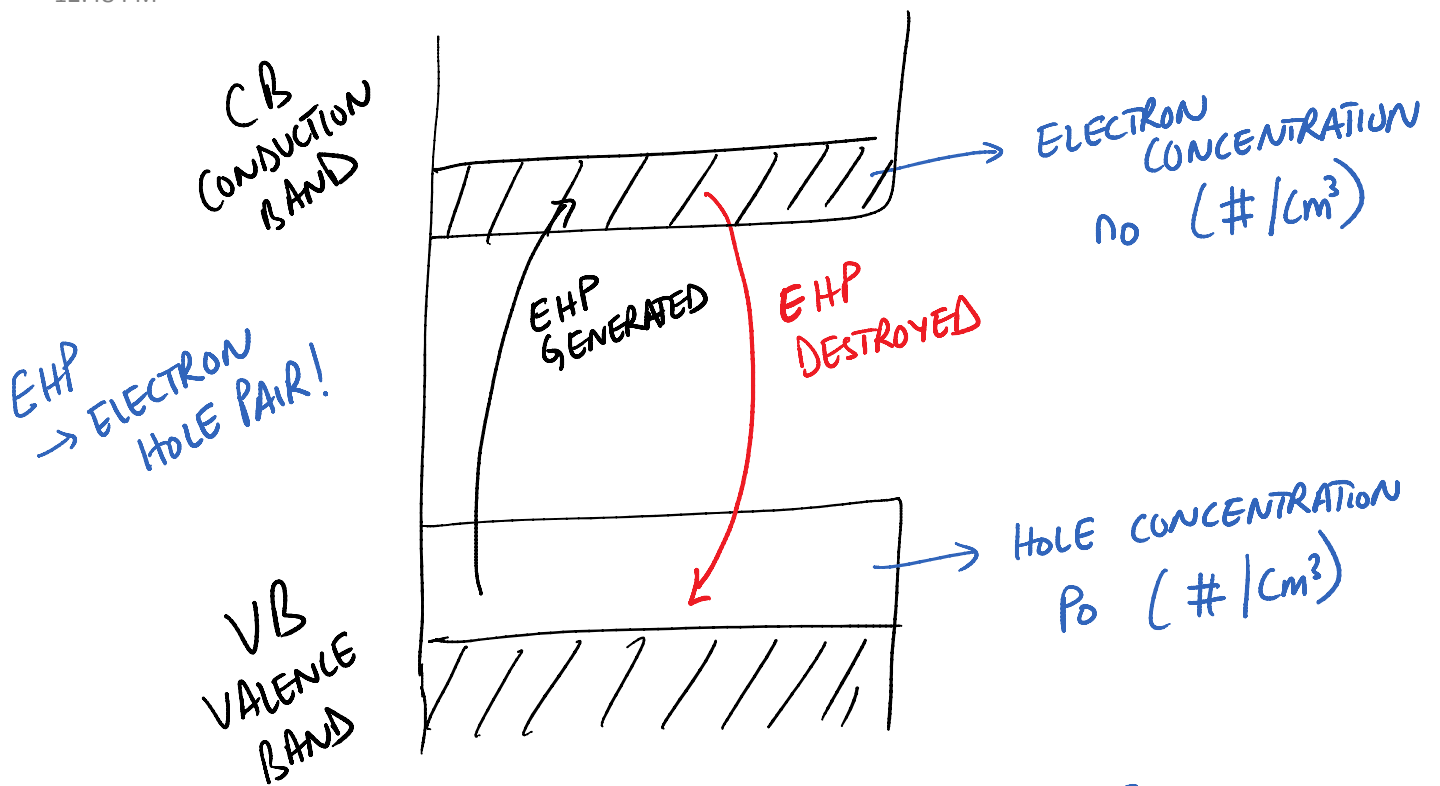
FILLED e⁻ ARE
BOUND TO HOST
ATOM



* AT $0^{\circ}K \rightarrow$ VERY LOW TEMPERATURE SEMICONDUCTORS IS AN INSULATOR

$$E_{g, METAL} < E_{g, SEMICONDUCTOR} < E_{g, INSULATOR}$$





CB → ELECTRONS ARE MOBILE
NEGATIVELY CHARGED PARTICLES WITH
AN EFFECTIVE MASS m_n^*

VB → HOLES → POSITIVELY CHARGED
PARTICLES WITH AN EFFECTIVE MASS
 m_p^*

GENERAL CONDITIONS

CARRIER CONCENTRATIONS

$n \rightarrow$ ELECTRONS $\# / \text{cm}^3, \text{cm}^{-3}$

$p \rightarrow$ HOLES $\# / \text{cm}^3, \text{cm}^{-3}$

STEADY STATE CONDITION

CARRIER CONCENTRATION DOES NOT CHANGE BUT SOME E-FIELD MAY BE PRESENT

n
 p

EQUILIBRIUM CONDITIONS

ONLY $\#$ DUE TO TEMPERATURE AND IMPURITIES

n_0
 p_0