PREPARATION WORKSHEET

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TA: _____ Section: _____

Answer the following questions using information obtained from lecture, the textbook, or lab manual. The responses will be collected at the ***beginning of recitation*** *and checked at the start of your lab section for credit.*

1. Define **p-type semiconductor** and **n-type semiconductor.**

P-type: a semiconductor doped with an elenent like Boron, Aluminim, etc. to create an electron vaccume, raisgs valence band

n-type: like p-type but doped with an elenent like Nitrogen phosphorus, etc. instead to create excess electrons. lowers conduction band

2. Explain how doping silicon with either phosphorous or gallium increases the electrical conductivity over that of pure silicon.

phosphorous lwers the conduction band, shrinking the band gap

gallium raises the valence band, shrinking the band gap

3. The Group 3A/Group 5A semiconductors are composed of equal amounts of atoms from Group 3A and Group 5A—for example, InP and GaAs. These types of semiconductors are used in light-emitting diodes and solid-state lasers. What would you add to make a p-type semiconductor from pure GaAs? How would you dope pure GaAs to make an n-type semiconductor?

p-type: add In

n-type: dope with phosphorus

4. The band gap in aluminum phosphide (AlP) is 2.5 electronvolts. What wavelength of light is emitted by an AlP diode? Show work.

$E_{ph} = \frac{hc}{\lambda}$ $\quad 1ev = 1.602 \cdot 10^{-19}\ J$

$\lambda = \frac{hc}{E_{ph}}$

$\frac{2.5\ ev \mid 1.602 \cdot 10^{-19}\ J}{1ev} = 4.005\ E^{-19}\ J$

$\lambda = \frac{6.626 \cdot 10^{-34} \cdot 3.0 \cdot 10^{8}}{4.005 \cdot 10^{-19}} = 4.963\ E^{-7}\ m$

$= 496\ nm$

5. An aluminum antimonide solid-state laser emits light with a wavelength of 730 nm. Calculate the band gap in joules. Show work.

$E_{ph} = \frac{6.626 \cdot 10^{-34} \cdot 3.0 \cdot 10^{8}}{(730/1.10^{9})} = 2.72 \cdot 10^{-19}\ J$

6. Explain the difference between the ***intrinsic band gap*** and the ***active*** or ***optical band gap.***

intrinsic: ~~band gap of~~ undoped band gap (not changed by any doping)

active: bandgap that leads to visible photon emissions (band gap after doping)