HW 3	**Inorganic Materials Chemistry**	Name:	
Points:	C7780	**Date:**	
Max. 100 points	**Fall 2013**	**A**	

1. (25 pts) Consider the solid state synthesis of Sr_2CrTaO_6:
Select the most suitable starting materials and describe in detail all steps you take during this preparation. Prepare 5.04 g of this compound.

Possible starting reagents
- Sr Metal – Hard to handle, prone to oxidation
- SrO - Picks up CO_2 & water, mp = 2430 °C
- $Sr(NO_3)_2$ – mp = 570 °C, may pick up some water
- $SrCO_3$ – decomposes to SrO at 1370 °C
- Ta Metal – mp = 2996 °C
- Ta_2O_5 – mp = 1800 °C
- Cr Metal – Hard to handle, prone to oxidation
- Cr_2O_3 – mp = 2435 °C
- $Cr(NO_3)_3 \cdot nH_2O$ – mp = 60 °C, composition inexact

2. (25 pts) Green light-emitting diodes can be made from solid solution of GaP and AlP. These two compounds have band gaps of 2.26 and 2.43 eV, respectively. What composition would be needed to prepare $Ga_{1-x}Al_xP$ with emitted light wavelength of 520 nm? Band gap varies linearly with composition. Name the law governing this case.
1 eV = $1.602 \cdot 10^{-19}$ J. Show your calculation.

3. (25 pts) Alkaline precipitation method for the preparation of mixed ferrites $(Mn_xZn_{1-x})Fe_2O_4$ presents difficulties due to the varying solubilities of the metal hydroxides. $Fe(OH)_3$ starts to precipitate early at pH 2.6, while $Mn(OH)_2$ precipitates at a much higher pH of 9.4. The Zn^{2+} cations precipitate at pH 7.6, but begin to redissolve at pH 9.
a) Write chemical equations for the precipitation and dissolution of Zn^{2+} cations.
b) What pH should be used to obtain homogeneous precipitate of mixed hydroxides?

4. (25 pts) What is the relation between the diameter of a spherical nanocrystal (D_c, large spheres) and the size of tetrahedral pores (D_p, small sphere). Nanocrystals touch each other, they are close packed. Show your calculation.

Tetrahedral hole