

Physics 223A  
Fall 2009  
Assignment 6  
Due 5 pm **WEDNESDAY, DEC. 2**

1. Fill in the steps Solyom skipped to derive formulas 16.3.17, 16.3.24, and 16.3.27.
2. A dimensionless figure of merit  $ZT$  for thermoelectric materials is given by

$$ZT = \frac{\sigma S^2}{\lambda} T$$

where  $\sigma$  is the electrical conductivity,  $S$  is the Seebeck coefficient,  $\lambda$  is the thermal conductivity, and  $T$  is the average temperature between the hot and cold sides of a thermoelectric cooler or power generator. Values of  $ZT=1$  are considered good, but  $ZT$  in the 3-4 range are considered essential for thermoelectrics to compete with mechanical power generation and refrigeration in efficiency.

Derive an expression for  $ZT$  from the Sommerfeld model of free electrons in metals (see Solyom, sections 16.3.3 and 16.3.4, which contains expressions for each of the coefficients).

According to your result, at 400K, what is  $ZT$  for Gold? Copper?