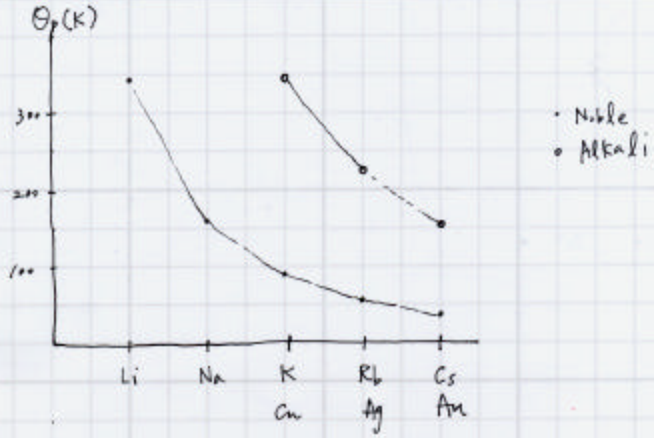
Phy 240 B | HW 4 solutions.

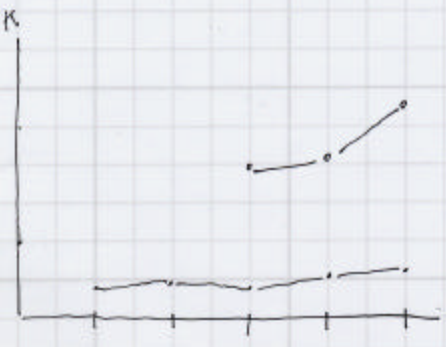
1. (i) In general, the Debye temperature decreases as you go down a periodic column; this is expected since a larger mass should have a lower frequency. The lower values of Fe, Co, & Ni are a result of magnetic ordering. The decrease in Θ_D near the end of 4d & 5d series * comes from the decrease in ion density. The Θ_D of Cr is unusually high. The sharp increase in Θ_D from Nb to Mo & Ta to W † correlates with the sharp increase in their bulk modulus.

(ii) K increases as we go from 3d to 5d. Again, this is what we expect as mass increases. We expect linear, slowly increasing trends (like that of the 3d graph); perhaps graphing $\sqrt{M}\,\Theta_D$ might look better.

* The d-states are filling up near the end of the series
† Sharp increase is related to the decrease in DOS at the Fermi level & filling of the binding states in Mo & W.

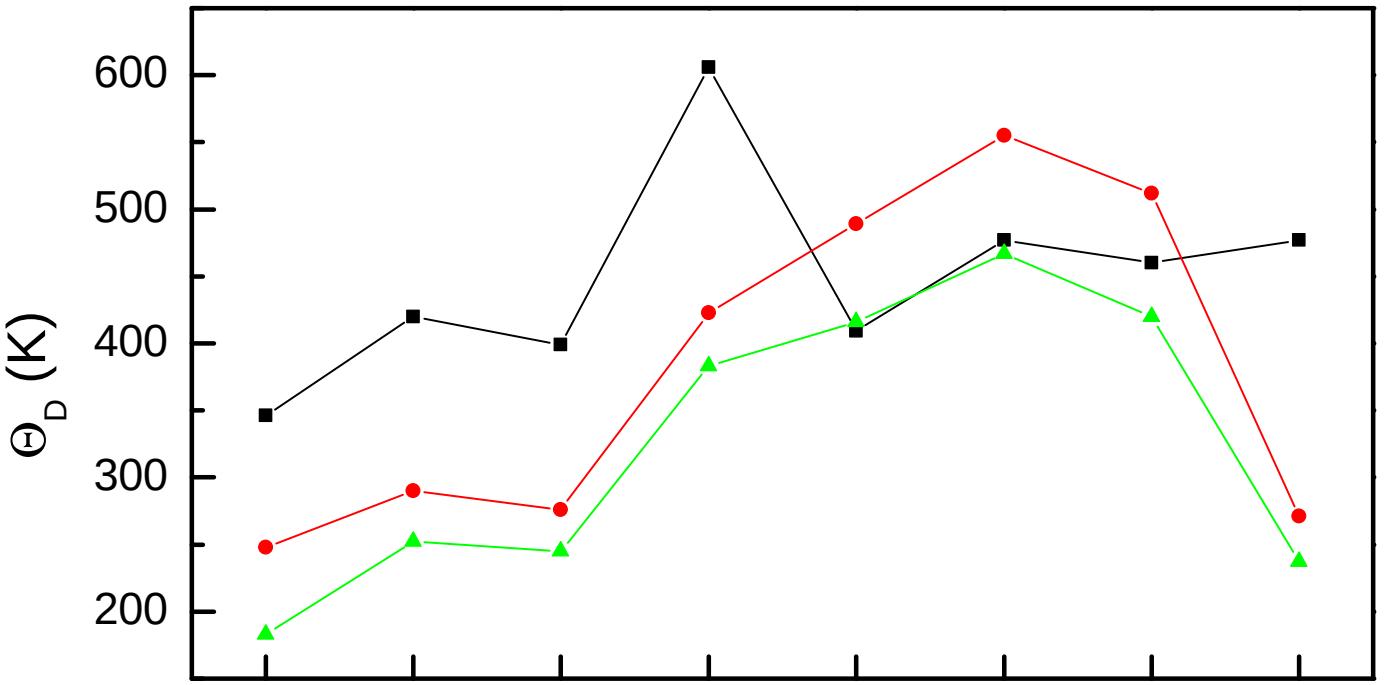
2. (i) 

The Θ_D values go like 1/(atomic number) for each group, which is expected.

(ii) 

As in 1(ii), we expect flat lines.

Prob 4.1(i)--Debye Temperature



Prob 4.1(ii)--Lattice stiffness