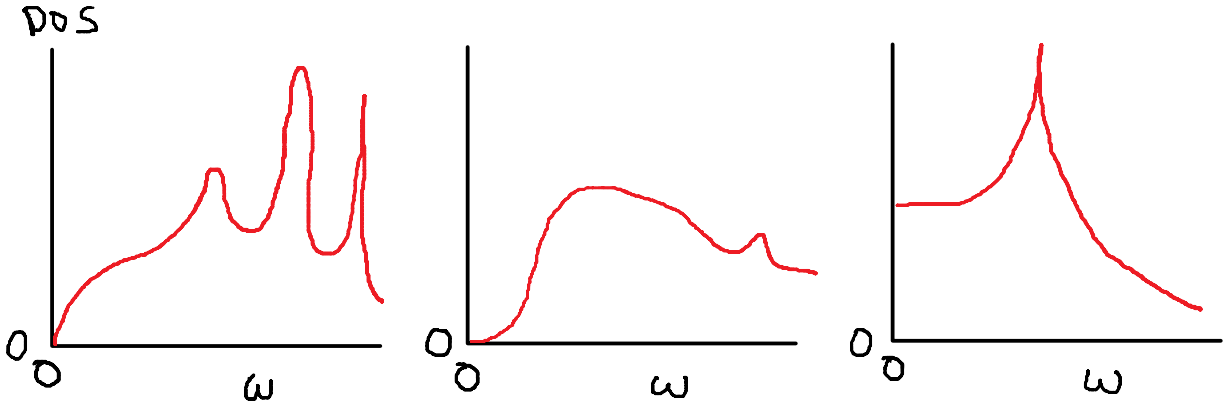
Phonon DOS

Tuesday, February 01, 2011

Suppose the following are the density of phonons for phonons, and that they represent phonons for a crystal 1 dimension, 2 dimensions, and 3 dimensions. Figure out which corresponds to which spatial dimension.



Ans. 2 3 1

Why? From the Debye model,

$D(\omega) \propto \omega^{D-1}$ where D = dimension.

at low energy. ← Universal for any crystals!

Why? $dN_m \propto k^{D-1}\,dk \propto \omega^{D-1}\,d\omega$ ($\omega = vk$, Debye model)

$\propto$ "volume" of a "spherical" shell in D dimensions