Solutions

Problem 1:
(B) The theorem of equipartition of energy states that molecules in thermal equilibrium have the same average energy associated with each independent degree of freedom of their motion. If we use Boltzman statistics, then for solids the total (vibrational) energy per atom is 3kT the energy per mole is $3kTN_A$. The specific heat at constant volume should be $c_V = \partial/\partial T(3kTN_A)$

Einstein recognized that for quantum oscillators Bose-Einstein statistics must be used. For a collection of 3D oscillators we have

$$E_{oscillators} = \frac{3h\upsilon N_A}{e^{h\upsilon/kT} - 1} \quad mole^{-1},$$

$$C_V = \frac{\partial E}{\partial T} = \frac{3N_A k\left(\frac{h\upsilon}{kT}\right)^2 e^{h\upsilon/kT}}{\left(e^{h\upsilon/kT} - 1\right)^2} \quad mole^{-1}$$

Debye's realized that there exist a maximum number of modes of vibration in a solid. He pictured the vibrations as standing wave modes in the crystal. We call these modes phonons. There exists a maximum allowed phonon frequency now called the Debye frequency.
http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/dulong.html#c3

Problem 2:
(D) Reflection invariance (parity) is violated.
https://en.wikipedia.org/wiki/Parity_(physics)

Problem 3:
(C) A heavy nucleus contains ~200 nucleons, and the energy released per nucleon is ~ 1MeV.

Problem 4:
(E) density = number/volume, volume = d^3, d = average distance between particles,

Problem 3:
(A) Fission