Homework problems #2

1. Determine the density of states of free relativistic particle with mass m in 3D.

2. For a system of N quantum harmonic oscillators (each of them has energy levels $E_n = (n + \frac{1}{2})\hbar\omega,\, n \in N$) determine heat capacity at constant volume and prove that $\lim\limits_{T \to 0^+} C_V = 0$.

3. *Computer problem*: Plot the internal partition function corresponding of excitation of Si IV ion for temperatures $T \in [10^3,\, 10^8]\,\mathrm{K}$ (use logaritmic scaling for temperature axis). Explain behaviour of a function. Take into account first 15 levels of the ion according to data from NIST
`https://www.nist.gov/pml/atomic-spectra-database`:

Configuration	Term	J	g	Energy [eV]
2p6.3s	2S	1/2	2	0.000000
2p6.3p	2P	1/2	2	8.838528
		3/2	4	8.895698
2p6.3d	2D	5/2	6	19.883893
		3/2	4	19.884040
2p6.4s	2S	1/2	2	24.050317
2p6.4p	2P	1/2	2	27.061641
		3/2	4	27.081703
2p6.4d	2D	5/2	6	30.997044
		3/2	4	30.997059
2p6.4f	2F	5/2	6	31.507742
		7/2	8	31.507984
2p6.5s	2S	1/2	2	32.907632
2p6.5p	2P	1/2	2	34.282086
		3/2	4	34.291429

The solution should be submitted not later than on April 16th.