Problem 1: Neutrino mass
Ryden, Problem 2.4.

Problem 2: Planck’s Law
Treat the Sun as a blackbody of absolute temperature 5800 K. Use Stefan’s law to show that the total radiant energy emitted by the Sun per second is $3.95 \times 10^{26} \text{ J s}^{-1}$. Find the rate at which energy is reaching the top of the Earth’s atmosphere. Your answer should have units of flux – J s$^{-1}$ m$^{-2}$.
Hints: Stefan-Boltzmann constant $\sigma = 5.67 \times 10^{-8} \text{ J s}^{-1} \text{ m}^{-2} \text{ K}^{-4}$. The radius of the Sun is $7.0 \times 10^8 \text{ m}$, and the Sun – Earth distance is $1.5 \times 10^{11} \text{ m}$.

Problem 3: Tired light Universe
Ryden, Problem 2.5.

Problem 4: When was He formed?
Assuming that the size of a He nucleus is 2 Fermi ($10^{-15} \text{ m}$), estimate the epoch of He formation in a Big Bang cosmology, expressed in redshift and temperature. Hint: order of magnitude estimate is sufficient.

Problem 5: Hot Dark Matter
Assuming dark matter is in the form of massive neutrinos (of approximately equal mass), that the total mass density of the universe is 1 in critical units, and there is no dark energy, compute the required neutrino masses in eV.