

Long theoretical questions

4. At the beginning of 2011, the discovery of several bodies of masses between 10 and 20 times the mass of Jupiter and temperatures similar to Earth was announced. These were classified as brown dwarfs.

Assume for simplicity that the temperature changes identically throughout the whole volume of the body, that the mass of the body is equal to 10 Jupiter masses, the density is 1000 kg/m^3 and that it is composed of molecular hydrogen (i.e. that its specific heat capacity is that of an ideal gas of mass 2 g/mol).

Estimate the rate of cooling. In particular, find how many years it will take for the temperature to fall by 1 K .

Note: The ideal gas constant is the product of the Avogadro constant and the Boltzmann constant.