Answer on Question#61094 – Physics – Astronomy – Astrophysics

A white dwarf star has a mass of 10^{30} kg. Its luminosity is 10^{24} Js−1. Calculate how long it can survive with its present luminosity if its internal temperature is 10^{7} K.

Solution. The amount of energy emitted will be equal to the amount of energy produced by fusion of hydrogen to helium over that lifetime. $E = mc^2$. Here m is the amount of matter that was converted into energy. Hence total energy of the star equal

$E = Mc^2 = 10^{30}kg \cdot \left(3 \cdot 10^8 \frac{m}{s}\right)^2 = 9 \cdot 10^{46}J.$

Using luminosity definition we get lifetime for star $t = \frac{E}{L} = \frac{9 \cdot 10^{46}}{10^{24}} = 9 \cdot 10^{22}s \approx 2.85 \cdot 10^{15}year.$

Answer. $t = 9 \cdot 10^{22}s \approx 2.85 \cdot 10^{15}year.$