Q- The sun radiates electromagnetic energy at a constant rate of $3.92*10^{26}$ W.

(a) What is the change in the sun's mass during each second due to radiating energy?

(b) The mass of the sum is $1.99*10^{30}$ kg. What fraction of the sun's mass is lost during a human lifetime of 75 years?

a) As W (watt) is SI unit of power, which is J/s, the energy radiated by the sun per second is given by

$$\frac{dE}{dt} = 3.92*10^{26} \text{ J}$$

Now according to mass energy relation of Einstein $E = mc^2$. Thus loss in mass per second is equal to the loss is energy per second and given by

$$\frac{dm}{dt} = \frac{1}{c^2}\frac{dE}{dt} = \frac{3.92*10^{26}}{(3.0*10^8)^2} = 4.356 * 10^9\ kg/s$$

Thus the mass converting per sec in energy i.e. decrease in mass of the sun per second is $4.356*10^9$ kg/s

b) The mass of the sun converting as energy in 75 years is given by

mass = rate of decrease*time

or $$m = \frac{dm}{dt} * \Delta t = 4.356 * 10^9 * (75 * 365 * 86400) = 1.030 * 10^{19}\ kg$$

And thus the fraction is given by

$$f = \frac{m}{M_s} = \frac{1.030*10^{19}}{1.99*10^{30}} = 5.177 * 10^{-12}$$