Q- The radius of the Sun is 6.96 x 10^8 m and the total power output from its surface is 2.51 x 10^{26} W.
(a) Assuming that the Sun acts like a black body, calculate its surface temperature.
(b) What is the maximum wavelength of radiation from the Sun?

(a) The heat radiated by a black body is given by Stefan-Boltzmann law according to which the heat radiated per unit area per second by a black body is directly proportional of the fourth power of its absolute temperature T.

$$\frac{dQ}{Adt} \propto T^4$$

Or $$\frac{dQ}{Adt} = \sigma T^4$$

Here A is the area radiating heat and σ is the constant of proportionality called Stefan-Boltzmann constant and its value is $5.67*10^{-8}$ W/ ($m^2.K^4$)

Hence the radiant power is given by

$$\frac{dQ}{dt} = \sigma A T^4$$

Gives $$T = \left(\frac{1}{\sigma A}\frac{dQ}{dt}\right)^{\frac{1}{4}}$$

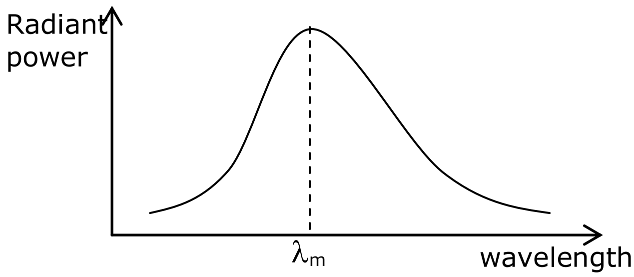
Now the surface area of the sun is A = $4\pi R^2 = 4*3.14*(6.96*10^8)^2 = 6.08*10^{18}$ m^2.

Substituting the values we get

$$T = \left(\frac{2.51*10^{26}}{5.67*10^{-8}*6.08*10^{18}}\right)^{\frac{1}{4}} = 5194.54\text{ K}$$

Hence the temperature of the outer surface of the sun is 5194.54 K or 4921.54°C.

(b)



The sun as well as every black body radiates energy with all possible wavelengths and hence the maximum wave length radiated by it will be infinite.

But I think the question is about the wavelength for which the radiant power is maximum.

The relation between the absolute temperature of a black body and the wave corresponding to the maximum radiation is given by Wien's law which is given as

$$\lambda_m = \frac{b}{T} = \frac{2.892*10^{-3}}{5194.54} = 5.57*10^{-7} m = 0.557\ \mu\text{m}.$$

The constant b is Wien's constant.