**Answer on** Question #61087, Physics / Astronomy | Astrophysics

A main sequence star has mass $2\times10^{31}$ kg and radius $3\times10^{9}$ m. Obtain an estimate of the average temperature throughout the star.

**Find:** $T_{star}$ – ?

**Given:**

$m_{star}=2\times10^{31}$ kg

$r_{star}=3\times10^{9}$ m

$m_{sun}=1{,}9891\times10^{30}$ kg

$r_{sun}=6{,}96\times10^{8}$ m

$T_{sun}=5778$ K

**Solution:**

The relationship between luminosity L, temperature T and radius r:

$$L_{star} = L_{sun} \left(\frac{r_{star}}{r_{sun}}\right)^2 \left(\frac{T_{star}}{T_{sun}}\right)^4 \quad (1)$$

$$m = \frac{m_{star}}{m_{sun}} \quad (2)$$

Of (2) $\Rightarrow$ m=10.1

If m=10.1 (2<m<20), then $l = \frac{L_{star}}{L_{sun}} = m^{3.5}$ (3)

(3) in (1): $(10.1)^{3.5} = \left(\frac{3\times10^{9}}{6{,}96\times10^{9}}\right)^2 \left(\frac{T_{star}}{T_{sun}}\right)^4$ (4)

Of (4) $\Rightarrow$ $\left(\frac{T_{star}}{T_{sun}}\right)^4 = 176.23$ (5)

Of (5) $\Rightarrow$ $\frac{T_{star}}{T_{sun}} = 3.64$ (6)

Of (6) $\Rightarrow$ $T_{star}=21032$ K

**Answer:**

21032 K