

QUIZ 3 Spring 2008 YOUR NAME: _____

Some numbers: $L_{\odot} = 4 \times 10^{33}$ ergs/second

$M_{\odot} = 2 \times 10^{33}$ grams

$c = 3 \times 10^{10}$ cm/second.

$E = mc^2$

Stephan's Law: $F = \text{Luminosity/area} = \sigma T^4$

$\sigma = 6 \times 10^{-5} \text{ erg} \cdot \text{cm}^{-2} \text{s}^{-1} \text{K}^{-4}$

$L = F \cdot (\text{surface area})$

Surface area of a sphere of radius $r = 4 \times \pi \times r^2$

$E = L \cdot \tau$

1. Label each of the following statements about the solar wind true or false.

1. F Hydrostatic equilibrium is the balance between electrical repulsion and gravity.
2. T The Earth's surface is protected from the solar wind by the Earth's magnetic field
3. F The solar wind is made mostly of neutrinos
4. T Most or all stars form in groups or clusters of stars.

2. How long will a $5M_{\odot}$ star with $L = 1000L_{\odot}$ spend on the main-sequence? (Hint, the main-sequence lifetime of the Sun is 10 billion years).

$$\tau \propto \frac{E}{L} \Rightarrow \tau = 10 \text{ bill} \left(\frac{5}{1000} \right) = 1 \times 10^9 \cdot 0.005 = 5 \times 10^7 \text{ yrs}$$

(50 mill yrs)
(0.05 billion yrs)

3. You are given that a star has a (surface) temperature of 5000 K and a radius of 7×10^{10} cm.

(a) What is the surface area of the star?

$$SA = 4\pi (7 \times 10^{10} \text{ cm})^2 = 6.1575 \times 10^{22} \text{ cm}^2$$

(b) Find the ~~energy per area~~ ^{flux} at the surface of the star?

$$F = \sigma T^4 = 6 \times 10^{-5} \text{ erg cm}^{-2} \text{s}^{-1} \text{K}^{-4} \cdot (5000 \text{ K})^4$$

$$= 3.75 \times 10^{10} \text{ erg cm}^{-2} \text{s}^{-1}$$

(c) Find the luminosity of this star using your relation for the ~~energy/area~~ ^{flux} from (b) and the surface area in (a).

$$L = F \cdot SA = (3.75 \times 10^{10} \text{ erg cm}^{-2} \text{s}^{-1}) \cdot (6.1575 \times 10^{22} \text{ cm}^2)$$

$$= 2.3 \times 10^{33} \text{ erg s}^{-1}$$

(1.85 $\times 10^{22}$ if $F = 3 \times 10^{-1}$)

Note: we gave you solar-ish values \Rightarrow get $L \sim L_{\odot}$