Julia Nelson Homework 3 "I pledge my honor that I have abided by the Stevens Honor System."

Problem 1

a) $T = 9940K$ Wein's law $\binom{5.2}{\text{Textbook}} \Rightarrow \lambda_{max} = \frac{3\times10^6}{T}$

more accurate # $\Rightarrow$ $\lambda_{max} = \frac{2.898 * 10^6}{T}$

$\lambda_{max} = \frac{2.898\times10^6}{9940K}$

$= \boxed{291.55 \text{ nm} \rightarrow \text{part of Ultraviolet part of Spectrum}}$

b) Sirius $T = 9940K$ Sun $T = 5777K$

Sirius $R = 1.71 * R_{sun}$ Sun $R = ?$

Luminosity Ratio $\Rightarrow$ $\frac{L_{sirius}}{L_{sun}} = \frac{R_{sirius} * T_{sirius}^4}{R_{sun} * T_{sun}^4} = \frac{(1.71)R_{sun} * (9940^4)}{R_{sun} * (5777^4)}$

$= \frac{(1.71)(9940^4)}{(5777^4)} = \frac{14.9876}{1} = \frac{L_{sirius}}{L_{sun}}$

$\approx \boxed{15:1 \text{ ratio } L_{sirius}:L_{sun}}$

Problem 2

a) Distance (Parsecs) = $\frac{1}{\text{paralex angle (arcseconds)}}$

$D = 1/0.13$ arcseconds $= \boxed{7.69 \text{ parcseconds}}$

Distance in Light Years $= (7.69 \text{ pc}) * (3.26) = \boxed{25.077 \text{ light Years}}$

b) Distance to Arcturus = 36.7 light years

$D = 1/\text{paralex angle}$

$36.7ly / 3.26 = 11.2577$ parcsecs

11.2577 pc $= 1/x$ arcseconds

paralex angle $= \boxed{0.08883 \text{ arcseconds}}$

"Pledge"

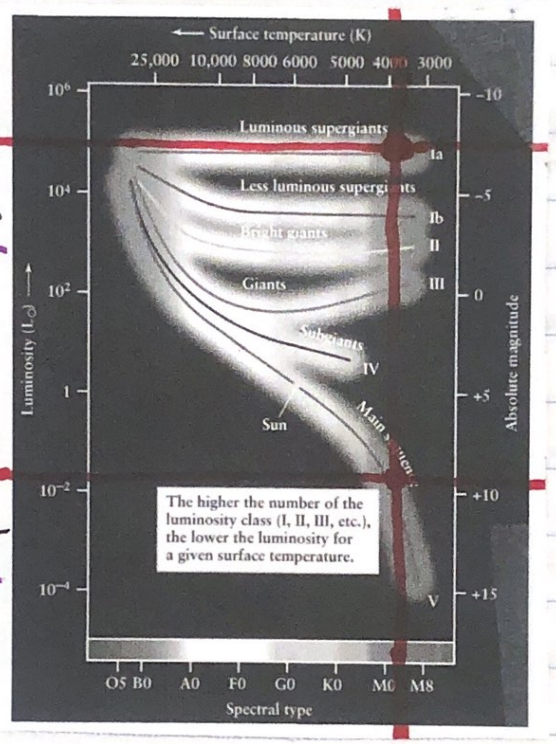
Problem 3

	Gliese	+ Betelgeuse
Spectral Type:	M1	M1
surface Temp:	~3700K	~3700K
luminosity class:	V (main seq.)	Ia (luminous supergiant)

a)

Betelquese — roughly less $\approx 10^5$ — L $\approx 95{,}000$

Gliese — roughly less $\approx 10^{-2}$ — L ≈ 0.015



b) $R_{Gli} / R_{Bet} = ?$

$$\frac{L_{Gli}}{L_{Bet}} = \frac{4\pi R_{Gli}^2 \sigma T_{Gli}^4}{4\pi R_{Bet}^2 \sigma T_{Bet}^4} = \frac{R_{Gli}^2}{R_{Bet}^2} = \frac{0.015}{95{,}000} \Rightarrow \frac{\sqrt{0.015}}{\sqrt{95000}}$$

$$= 0.00039735375$$

$$\boxed{= 0.000397}$$

"Pledge"

Problem 4

before collapse core mass = 2 solar masses
radius = 105 km
rotating period = 120 days

Neutron Star radius = 10 km
mass conserved
what is the rotating period?

M_1 = 2 solar masses
R_1 = 105 km
T_1 = 120 days

M_2 = 2 solar masses
R_2 = 10 km
T_2 = ?

$L = I\omega$ — L = angular momentum, I = inertia, ω = angular speed

$\omega = 2\pi / T$ — T = rotating period

$I = (2/5) MR^2$ — I = inertia, M = mass, R = radius

$L_1 = L_2$ ~~___~~ conserved momentum

$(I\omega)_1 = (I\omega)_2$

initial angular speed → $\omega_1 = 2\pi / 120 \text{ days} = 0.0523599$

$$I_1\omega_1 = I_2\omega_2$$

$$\cancel{\left(\tfrac{2}{5}\right)}\cancel{M_1}(R_1^2)\left(\frac{\cancel{2\pi}}{120\text{days}}\right) = \cancel{\left(\tfrac{2}{5}\right)}\cancel{M_2}(R_2^2)\left(\frac{\cancel{2\pi}}{T_2}\right)$$

$$\frac{(R_1)^2}{120\text{days}} = \frac{(R_2^2)}{T_2}$$

$$T_2 = \frac{(R_2)^2(120 \text{ days})}{(R_1)^2}$$

$$T_2 = \left(\frac{10 \text{ km}}{105 \text{ km}}\right)^2 * 120 \text{ days} = 1.0884353736 \text{ days}$$

$$\Rightarrow 1.088 * (24*60*60) = \boxed{94040.82 \text{ seconds}}$$

"Pledge"

Problem 5

a) Blackhole mass = 20 solar mass

$20 * 1,988 * 10^{30} \Rightarrow 39.78 * 10^{30}$ kg

$$R_s = \frac{2GM}{c^2}$$

$$R_s = \frac{2(6.67 * 10^{-11})(3.978 * 10^{31})}{(2.99 * 10^8)^2}$$

$$R_s = \frac{5.306652 * 10^{21}}{8.9401 * 10^{16}} = 59357.8595 \text{ m}$$

$$\boxed{R_s = 59.358 \text{ km}}$$

b) mass = 50 kg

$$R_s = \frac{2(6.67 * 10^{-11}) * (50)}{(2.99 * 10^8)^2} = \frac{6.67 * 10^{-9}}{8.9401 * 10^{16}}$$

$$\boxed{R_s = 7.4608 * 10^{-26} \text{ meters}} =$$

The radius of a hydrogen atom is roughly $5.2917 * 10^{-11}$ m. The 50 kg Sphere's radius is significantly smaller than that of a hydrogen atom