1. Look up the parallax of the star Betelgeuse on SIMBAD (an online astronomical database providing basic data, cross-identifications, bibliography and measurements for astronomical objects outside the solar system). Use this parallax to calculate the distance to Betelgeuse, in parsecs.   **2 points**

2. The *New Horizons* spacecraft, which zoomed by Pluto in July 2015, was launched with a speed of $36\,000\,\mathrm{km\,h^{-1}}$. Traveling this fast, how long would it take for the spacecraft to reach Gliese 832, a nearby ($d = 16.16\,\mathrm{pc}$) star that is orbited by a planet in the star's habitable zone?   **2 points**

3. Prove that $1\,\mathrm{pc} \approx 206\,265\,\mathrm{au}$. *Hint:* starting from Fig. 1.1 of *Handout 1*, apply the small-angle formula

$$\tan(p/\mathrm{rad}) \approx (p/\mathrm{rad})$$

   where p is the parallax angle and rad indicates radians.   **3 points**

4. A star has an apparent magnitude $m = 6.4$ and an absolute magnitude $M = 2.5$. How far away is the star, in parsecs?   **2 points**

5. Assuming the human body emits radiation like a black body with temperature $37.5\,°\mathrm{C}$, at what wavelength is it brightest? Where in the electromagnetic spectrum is this wavelength situated? Estimate the body's total luminosity, assuming a surface area $1.8\,\mathrm{m^2}$.   **3 points**

6. Derive the Stefan-Boltzmann law [2.3] of *Handout 2* from Planck's law [2.1]. Be sure to take advantage of the hint given in the handout, and the knowledge that

$$\int_0^\infty \frac{u^3}{e^u - 1}\,\mathrm{d}u = \frac{\pi^4}{15}.$$

   (throughout the course, you'll always be given assistance for tricky integrals like this!)   **3 points**

7. Toward the end of the Sun's life, it will evolve into a red giant with luminosity $3.2 \times 10^3\,\mathrm{L_\odot}$ and effective temperature $2600\,\mathrm{K}$. Will it engulf the Earth?   **3 points**

8. Sketch a Hertzsprung-Russell diagram (with appropriate axes), showing the main sequence, giant and white dwarf regions, and illustrating with arrows how stars move between these regions as they evolve.   **3 points**

9. The Sun is a G2 main-sequence star, while Betelgeuse is an M1 supergiant. Which star is the hotter of the two? Which star is the redder? Which star is the more luminous? Which star is the larger?   **4 points**