You may find it helpful to consult a galactic astronomy text, such as Binney & Merrifield’s *Galactic Astronomy*, to determine certain stellar values for this problem set.

1. **Carroll & Ostlie, Problem 7.6:**
   From the light and velocity curves of an eclipsing, spectroscopic binary star system, it is determined that the orbital period is 6.31 years, and the maximum radial velocities of stars A and B are 5.4 km s\(^{-1}\) and 22.4 km s\(^{-1}\) respectively. Furthermore, the time period between first contact and minimum light \((t_b - t_a)\) is 0.58 \(d\), the length of the primary minimum \((t_c - t_b)\) is 0.64 \(d\), and the apparent bolometric magnitudes of maximum, primary minimum, and secondary minimum are 5.40 magnitudes, 9.20 magnitudes, and 5.44 magnitudes respectively. From this information, and assuming circular orbits, find the
   
   (a) Ratio of the stellar masses. (3 pts)
   
   (b) Sum of the masses (assume \(i \approx 90^\circ\)). (3 pts)
   
   (c) Individual masses. (3 pts)
   
   (d) Individual radii. (5 pts)
   
   (e) Ratio of the effective temperatures of the two stars. (5 pts)

2. Use the Hertzsprung-Russell diagram and the stellar spectra within the lecture notes to answer the following questions.
   
   (a) If a K-type star has a luminosity of \(10^4 L_\odot\), what is its luminosity class? (3 pts)
   
   (b) If a Main Sequence star is three times as hot as the Sun, estimate (roughly) its luminosity, spectral type, B-V colour, and radius. (5 pts)
   
   (c) What key parameter determines the position of a white dwarf along the temperature sequence? (*Hint: consider the narrow range of progenitor star characteristics.*) (2 pts)

3. The center of the Milky Way is at (1950 epoch) \(\alpha = 17^h 42^m 29.3^s \pm 0.15^s, \delta = -28^d 50' 18'' \pm 3''\). What are its Galactic coordinates? (3 pts)

4. **Carroll & Ostlie, Problem 24.8:** Prove that for \(z \gg z_o\)
   
   \[ L(R, z) \sim 4L_o e^{-\frac{z}{H}} e^{-\frac{z}{2z_o}} \]
   
   and so \(z_o = 2z_{\text{thin}}\) is the effective scale height of the luminosity density function. (3 pts)

5. **Carroll & Ostlie, Problem 27.9:** Assuming that the Sculptor group of galaxies (see Carroll & Ostlie, pg. 1061) occupies a spherical volume of space, find the difference in magnitude between two identical objects located at the very front and back of the group. (6 pts)