Homework 10

Due December 3 by 11:59pm via Canvas upload
Please show all work, writing solutions/explanations clearly, or no credit will be
given. You are encouraged to work together, but everyone must turn in
independent solutions; do not copy from others or from any other sources.

1. Suppose the Milky Way consisted of 2.7×10^{11} stars, each of solar luminosity
   $M_B = 4.7$. What would the absolute magnitude of the whole Galaxy be?

2. The star Rigel has a radial velocity $v_r = 20.7$ km s^{-1}, parallax $\pi'' = 4.22$ mil-
   liarcseconds (mas), and proper motion components $\mu_\alpha = 1.67$ mas yr^{-1} in right
   ascension and $\mu_\delta = 0.56$ mas yr^{-1} in declination. What are its total proper
   motion, tangential velocity, and space motion (total magnitude of its velocity)?

3. The star S2 orbits the supermassive black hole ($M = 4.6 \times 10^6 \ M_\odot$) at the center
   of the Galaxy on an orbit with semimajor axis $a = 920$ AU and eccentricity
   $e = 0.867$.

   (a) How large is the Schwarzschild radius of the black hole?

   (b) What is the star's distance from the black hole at the perigee of its orbit
       (in units of the black hole's Schwarzschild radius)?

   (c) How much closer would the star need to get to be tidally disrupted?