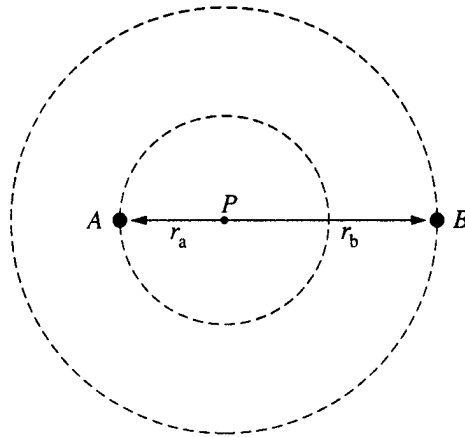


Name _____ Date _____ Period _____



Two stars, A and B, are in circular orbits of radii r_a and r_b , respectively, about their common center of mass at point P, as shown above. Each star has the same period of revolution T.

Determine expressions for the following three quantities in terms of r_a , r_b , T, and fundamental constants.

- a. The centripetal acceleration of star A

$$v = \frac{2\pi r}{T} \text{ and } a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

- b. The mass M_b of star B

The centripetal force on star A is due to the gravitational force exerted by star B.

$$M_a a_a = \frac{GM_a M_b}{(r_a + r_b)^2} \text{ and substituting part (a) gives } M_b = \frac{4\pi^2 r_a (r_a + r_b)^2}{GT^2}$$

- c. The mass M_a of star A

The same calculations can be performed with the roles of star A and star B switched.

$$M_a = \frac{4\pi^2 r_b (r_a + r_b)^2}{GT^2}$$

- d. Determine an expressions for the angular momentum of the system about the center of mass in terms of M_a , M_b , r_a , r_b , T, and fundamental constants.

$$L_{\text{total}} = M_a v_a r_a + M_b v_b r_b = M_a \frac{2\pi r_a}{T} r_a + M_b \frac{2\pi r_b}{T} r_b = \frac{2\pi}{T} (M_a r_a^2 + M_b r_b^2)$$