
Worksheet 17: Angular Momentum

1. Two matching space stations of mass m are tethered by a cable to be a distance $d_1 = 800$ m apart. They rotate about their mutual center of mass with a period of $T_1 = 40.0$ s.
 - a. What is their radius of rotation r_1 ?
 - b. What is the moment of inertia I_1 of the pair of space stations? Treat them as point masses.
 - c. What is their angular speed ω_1 ?
 - d. What is their centripetal acceleration a_1 ?
 - e. What is their angular momentum L_1 ?
 - f. What is their kinetic energy K_1 ?
 - g. How would your answers to parts b and f change if you did not approximate the space stations as point masses, but took their center-of-mass moments of inertia into account?

2. The tether connecting the space stations of question 1 is lengthened to $5/4$ of its initial length, 1000 m.
 - a. What is the new radius of rotation r_2 of the space stations?
 - b. What is the new moment of inertia I_2 of the pair? Continue to treat them as point masses.

- c. What is their new angular momentum L_2 ?
 - d. What is their new angular speed ω_2 ?
 - e. What is their new centripetal acceleration a_2 ?
 - f. What is their new kinetic energy K_2 ?
3. The tether connecting the space stations of question 1 is shortened to 4/5 of its initial length, 640 m.
- a. What is the new radius of rotation r_3 of the space stations?
 - b. What is the new moment of inertia I_3 of the pair? Continue to treat them as point masses.
 - c. What is their new angular momentum L_3 ?
 - d. What is their new angular speed ω_3 ?
 - e. What is their new centripetal acceleration a_3 ?
 - f. What is their new kinetic energy K_3 ?

4. Two different space stations, of unequal masses m_A and m_B , tethered a distance d apart, rotate about their center of mass with a period of T .
- Where along the cable is their center of mass? Express in terms of d , m_A , and m_B .
 - What are their radii of rotation r_A and r_B ?
 - What are their angular speeds ω_A and ω_B ?
 - What are their individual angular momenta L_A and L_B ?
 - What are their individual kinetic energies K_A and K_B ?