1. The Sun rotates with a period of 24.47 days and has a mass of 1.09 x 10^30 kg. It has a radius of 6.96x10^8m. The Sun can be approximated as a sphere of uniform density. Calculate the angular momentum of Jupiter, 7.79x10^11 m as its distance from the Sun, and that it makes one full trip around the Sun every 4.332x10^3 days. Which value of angular momentum is larger.

$T_S = 24.47\ days = 2.114 \cdot 10^6\ s$

$m_S = 1.09 \cdot 10^{30}\ kg$

$r_S = 6.96 \cdot 10^8\ m$

$d = 7.79 \cdot 10^{11}\ m$

$T_J = 4.332 \cdot 10^3\ days = 3.742 \cdot 10^8\ s$

$m_J = 1.899 \cdot 10^{27}\ kg$

$L_J, -?$

Solution.

The angular momentum of Jupiter is $L_J = d \cdot m_J v$,

where the velocity is $v = \frac{2\pi d}{T_J}$. So, $\boxed{L_J = \frac{2\pi d^2 m_J}{T_J}}$.

The angular momentum of Sun is $L_S = I \cdot \omega$,

where the moment of inertia of a uniform sphere during rotation is $I = \frac{2m_S r_S^2}{5}$ and the angular velocity is $\omega = \frac{2\pi}{T_S}$.

So, $\boxed{L_S = \frac{4\pi m_S r_S^2}{5T_J}}$.

Let check the dimensions: $[L_J] = \frac{m^2 \cdot kg}{s} = kg \cdot \frac{m^2}{s}$, $[L_S] = \frac{kg \cdot m^2}{s}$.

Let evaluate the quantities:

$$L_J = \frac{2 \cdot 3.14 \cdot (7.79 \cdot 10^{11})^2 \cdot 1.899 \cdot 10^{27}}{3.742 \cdot 10^8} = 1.93 \cdot 10^{43} \left(kg \cdot \frac{m}{s^2} \right),$$

$$L_S = \frac{4 \cdot 3.14 \cdot 1.09 \cdot 10^{30} \cdot (6.96 \cdot 10^8)^2}{5 \cdot 2.114 \cdot 10^6} = 6.27 \cdot 10^{41} \left(kg \cdot \frac{m}{s^2} \right).$$

Answer: $1.93 \cdot 10^{43}\ kg \cdot \frac{m}{s^2}$. The angular momentum of the Jupiter is larger.