Homework #5

1. a). The period of Jupitor $P = 11.86$ *tropical years*. The average distance of Jupitor from the Sun is $a = 5.2\ AU = 5.2{\times}1.5{\times}10^8\ km = 7.8{\times}10^8\ km$. The velocity of Jupitor in the orbit is $v = \frac{2\pi a}{P} = \frac{2{\times}3.14{\times}7.8{\times}10^8\ km}{11.86{\times}365{\times}24{\times}3600\ sec} = 13.1\ km{\cdot}sec^{-1}$.

b). Both Jupitor and the Sun orbit around their center of mass, we have $M_{Sun}{\times}r_{Sun} = m_J{\times}r_J$ and $r_{Sun} + r_J = a$. Here, r_{Sun} and r_J are the distances from the center of mass to the Sun and Jupitor respectively. Since $m_J{\approx}9.5{\times}10^{-4}M_{Sun}{\approx}10^{-3}M_{Sun}$(from HW#3), $r_{Sun}{\approx}9.5{\times}10^{-4}r_J$ or $r_J{\approx}1052.6r_{Sun}$. From $r_{Sun} + 1052.6r_{Sun} = a = 5.2\ AU$, we get $r_{Sun} = 0.004935AU = 7.4{\times}10^5\ km$.

c). Using the formula for orbital velocity $v = \frac{2\pi r_{Sun}}{P}$, we can get the Sun's speed in the circle is $v_{Sun} = \frac{2{\times}3.14{\times}7.4{\times}10^5\ km}{11.86{\times}365{\times}24{\times}3600\ sec} = 0.01243\ km{\cdot}sec^{-1} = 12.43m{\cdot}sec^{-1}$. This proves that the statement in the textbook (page #396) is correct.