12.25. Model: Model the sun (s) and the earth (e) as spherical masses.
Visualize: The earth orbits the sun with velocity v_e in a circular path with a radius denoted by r_{s-e}. The sun's and the earth's masses are denoted by M_s and m_e.
Solve: The gravitational force provides the centripetal acceleration required for circular motion.

$$\frac{GM_s m_e}{r_{s-e}^2} = \frac{m_e v_e^2}{r_{s-e}} = \frac{m_e (2\pi r_{s-e})^2}{r_{s-e} T_e^2}$$

$$\Rightarrow M_s = \frac{4\pi^2 r_{s-e}^3}{GT_e^2} = \frac{4\pi^2 (1.50\times 10^{11}\ \text{m})^3}{(6.67\times 10^{-11}\,\text{N}\cdot\text{m}^2/\text{kg}^2)(365\times 24\times 3600\ \text{s})^2} = 2.01\times 10^{30}\ \text{kg}$$

Assess: The tabulated value is 1.99×10^{30} kg. The slight difference can be ascribed to the fact that the earth's orbit isn't exactly circular.