

Chapter 8 Problem 25 †

Given

$$r_p = 1.47 \times 10^{11} \text{ m}$$

$$r_a = 1.52 \times 10^{11} \text{ m}$$

$$m_e = 5.97 \times 10^{24} \text{ kg}$$

$$m_s = 1.99 \times 10^{30} \text{ kg}$$

Solution

Find the change in potential energy from perihelion to aphelion.

$$\Delta U = U_a - U_p = \left(-\frac{Gm_s m_e}{r_a} \right) - \left(-\frac{Gm_s m_e}{r_p} \right)$$

$$\Delta U = Gm_s m_e \left(-\frac{1}{r_a} + \frac{1}{r_p} \right)$$

$$\Delta U = (6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2)(1.99 \times 10^{30} \text{ kg})(5.97 \times 10^{24} \text{ kg}) \left(-\frac{1}{1.52 \times 10^{11} \text{ m}} + \frac{1}{1.47 \times 10^{11} \text{ m}} \right)$$

$$\Delta U = 1.77 \times 10^{32} \text{ J}$$

†Problem from Essential University Physics, Wolfson