

7. At the point where the forces balance $GM_em/r_1^2 = GM_sm/r_2^2$, where M_e is the mass of Earth, M_s is the mass of the Sun, m is the mass of the space probe, r_1 is the distance from the center of Earth to the probe, and r_2 is the distance from the center of the Sun to the probe. We substitute $r_2 = d - r_1$, where d is the distance from the center of Earth to the center of the Sun, to find

$$\frac{M_e}{r_1^2} = \frac{M_s}{(d - r_1)^2} .$$

Taking the positive square root of both sides, we solve for r_1 . A little algebra yields

$$r_1 = \frac{d\sqrt{M_e}}{\sqrt{M_s} + \sqrt{M_e}} = \frac{(150 \times 10^9 \text{ m})\sqrt{5.98 \times 10^{24} \text{ kg}}}{\sqrt{1.99 \times 10^{30} \text{ kg}} + \sqrt{5.98 \times 10^{24} \text{ kg}}} = 2.6 \times 10^8 \text{ m} .$$

Values for M_e , M_s , and d can be found in Appendix C.