

What is the velocity of the moon as it circles the earth? Using Newton's variation of Kepler's 3rd Law to find the mass of the earth and sun.

$$v = \sqrt{\frac{G m_e}{r_{em}}}$$

$$v = \sqrt{\frac{6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \times 5.98 \times 10^{24} \text{ kg}}{3.84 \times 10^8 \text{ m}}}$$

$$v = 1020 \text{ m/s}$$

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mass of earth

$$\frac{r^3}{T^2} = \frac{Gm}{4\pi^2}$$

$$m_e = \frac{4\pi^2 r^3}{GT^2}$$

$$m_e = \frac{4\pi^2 (3.84 \times 10^8 \text{ m})^3}{6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \times (2.36 \times 10^6)^2}$$

$$m_e = 6.0 \times 10^{24} \text{ kg}$$

$$\frac{r^3}{T^2} = \frac{Gm}{4\pi^2}$$

$$m_s = \frac{4\pi^2 r^3}{GT^2}$$

$$m_s = \frac{4\pi^2 (1.5 \times 10^{11} \text{ m})^3}{6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \times (3.16 \times 10^7)^2}$$

$$m_s = 2.0 \times 10^{30} \text{ kg}$$