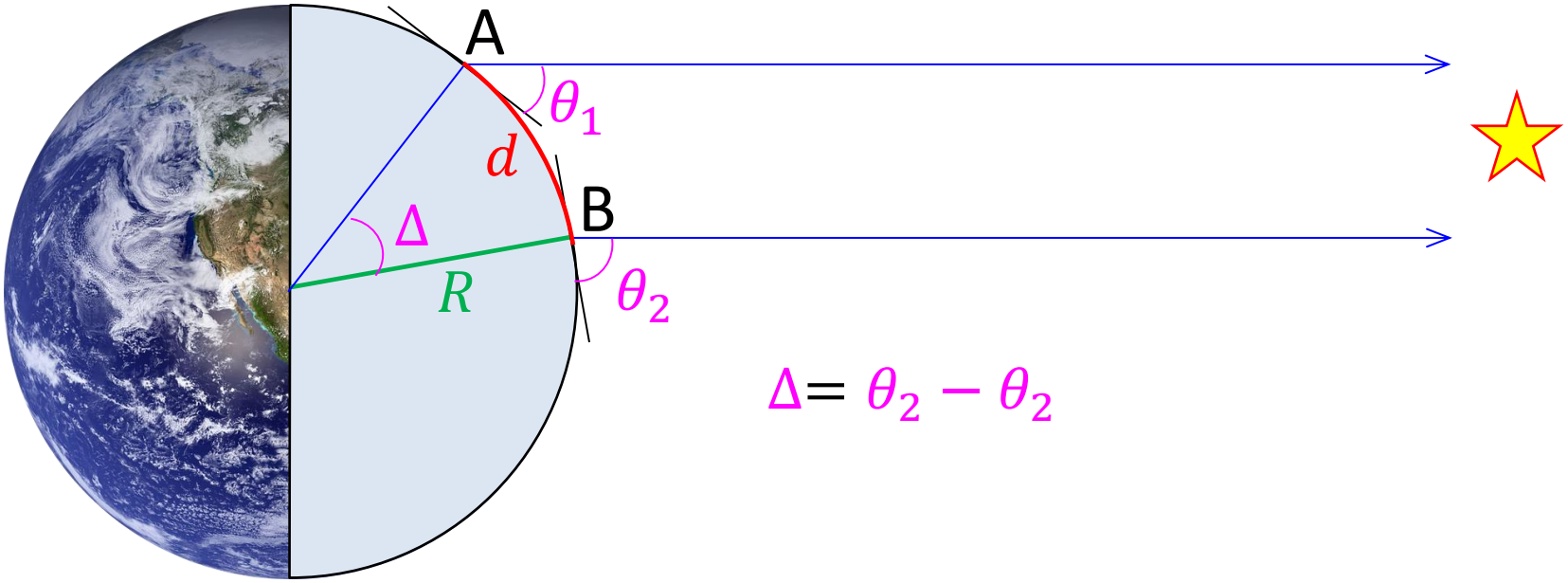
地球の半径を求める

方法1

$$R = \frac{\text{地球の赤道の長さ}}{2\pi} = \frac{40{,}000km}{2\pi} \fallingdotseq 6{,}370km$$

方法2

$$R = \frac{d}{\Delta}$$



$$\Delta = \theta_2 - \theta_2$$

方法1

地球の質量を求める

$$F = G\frac{m_1 m_2}{R^2}$$

$$F = m_2 g$$

$$G\frac{m_1 m_2}{R^2} = m_2 g$$

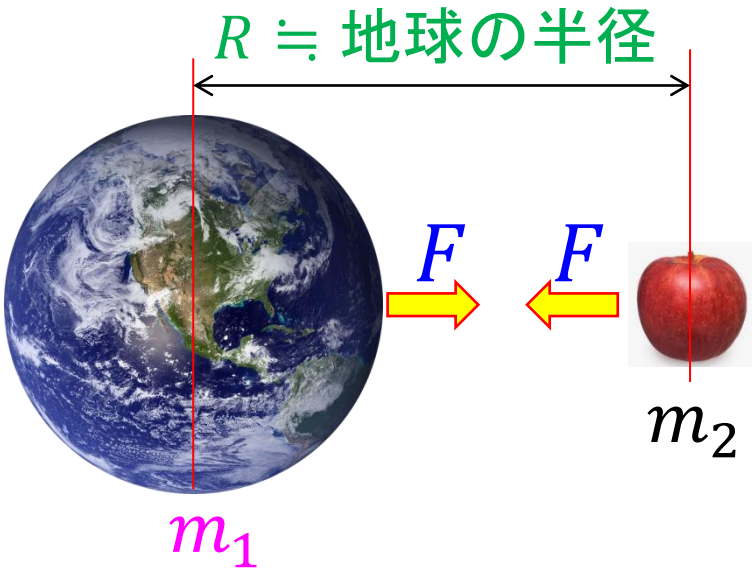
$$m_1 = \frac{gR^2}{G}$$

$$= \frac{9.807}{6.67\times10^{-11}} \times (6378 \times 1000)^2$$

$$\fallingdotseq 6.0\times 10^{24} kg$$

万有引力定数G: $6.67 \times 10^{-11} m^3 \cdot kg^{-1} \cdot s^{-2}$

重力加速度g: 9.807m$\cdot s^{-2}$



地球の質量を求める

方法2

万有引力 $F = G\dfrac{m_1 m_2}{R^2}$

遠心力 $F = m_2 r\omega^2 = m_2 r\left(\dfrac{v}{R}\right)^2 = \dfrac{m_2 v^2}{R}$

遠心力F ＝ 万有引力F

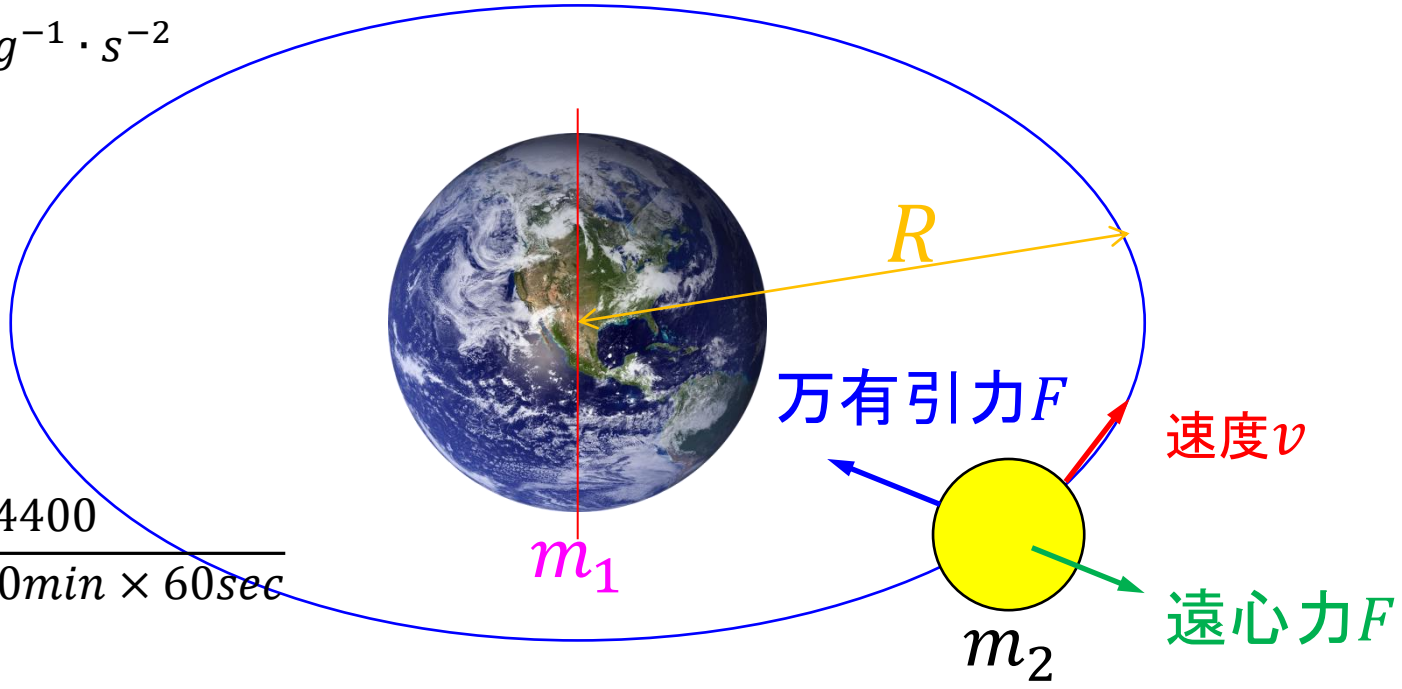
$$\frac{m_2 v^2}{R} = G\frac{m_1 m_2}{R^2}$$

$$m_1 = \frac{Rv^2}{G} = \frac{384400\times10^3\times\left(1.02\times10^3\right)^2}{6.67\times10^{-11}} \fallingdotseq 6\times10^{24}kg = 6\times10^{21}\text{トン}$$

G=6.67 × $10^{-11}m^3\cdot kg^{-1}\cdot s^{-2}$

R =384,400km

$$v = \frac{2\pi\times384400}{27.3\text{日}\times24\text{h}\times60min\times60sec} \fallingdotseq 1.02km/sec$$



太陽の質量を求める

$$m_1 = \frac{Rv^2}{G} = \frac{1.5\times10^8 km\times10^3\times\left(30\times10^3\right)^2}{6.67\times10^{-11}} \fallingdotseq 2.0\times10^{30} kg$$

$$G=6.67\times10^{-11} m^3\cdot kg^{-1}\cdot s^{-2}$$

$$R = 1.5\times10^8\ km$$

$$v = \frac{2\pi\times1.5\times10^8 km}{365\text{日}\times24\text{h}\times60min\times60sec} \fallingdotseq 30.0 km/sec$$

	太陽	地球	月
質量 kg	2.0×10^{30}	6×10^{24}	7.35×10^{22}
体積 km^3	1.43×10^{18}	1.08×10^{12}	2.40×10^{10}
密度 g/cm^3	1.4	5.5	3.1