V Orbiting satellites (komp. exerc. 1.3)

$$M_1 = \frac{4\pi R_1^3}{3}\cdot \rho_1$$
$$M_2 = \frac{4\pi R_2^3}{3}\cdot \rho_2$$
} spheres

Gravitational force $= G\,\frac{M_1 m}{R_1^2} \equiv m\cdot\frac{v_1^2}{R_1}$ = centripetal force; analogously for M_2

We get $v_1^2 = G\cdot\frac{M_1}{R_1}$ and $v_2^2 = G\cdot\frac{M_2}{R_2}$

Orbital period T: $v = \frac{2\pi R}{T}$ in general

The ratio T_1/T_2:

$$\frac{2\pi R_1}{v_1}\Big/\frac{2\pi R_2}{v_2} = \frac{R_1}{R_2}\cdot\frac{v_2}{v_1} = \frac{R_1}{R_2}\cdot\frac{\sqrt{G\cdot\frac{M_2}{R_2}}}{\sqrt{G\frac{M_1}{R_1}}}$$

$$= \frac{R_1}{R_2}\sqrt{\frac{R_2^3\rho_2}{R_2}\Big/\frac{R_1^3\rho_1}{R_1}}$$

$$= \frac{R_1}{R_2}\cdot\frac{R_2}{R_1}\cdot\sqrt{\frac{\rho_2}{\rho_1}}$$

$$\Rightarrow T_1/T_2 = \sqrt{\rho_2/\rho_1}$$

So, knowing T_1 and ρ_1 for the Earth we can calculate ρ_2 by measuring T_2! If $\rho_1 = \rho_2$ then T is independent of R! (Cf. exercise 1.4 in compendium!)