Answer on Question 50224, Physics, Mechanics — Kinematics — Dynamics

Question Show that on a hypothetical planet having half the diameter of the earth but twice its density, the acceleration of free fall is same as on earth.

Solution Acceleration of free fall is related to diameter and density of planet as

$$mg = G\frac{mM}{r^2} = G\frac{4\pi r^3 \rho m}{3r^2} = G\frac{4\pi m \rho r}{3}$$

$$g = G\frac{4\pi M \rho r}{3}$$

Hence, if we take half of mass $M/2$ and twice the density 2ρ:

$$g_1 = G\frac{4\pi M/2 \cdot 2\rho r}{3} = G\frac{4\pi M \rho r}{3} = g$$

the acceleration will not change at all.