Ex 27.1 Acceleration and the force of gravity

a) Consider a mass m falling toward the earth, whose mass is M. Using Newton's 2nd law, m's acceleration is given by $a = \frac{F}{m}$

Now, using Newton's law of gravity, $F = G\frac{Mm}{r^2}$

$$a = \frac{GMm/r^2}{m} = \frac{GM}{r^2}$$

This is independent of the body's mass, m. It depends only on the mass of Earth, M, how far it is from Earth's center, r, and the constant, G.

b) Since $F_G \propto \frac{1}{r^2}$

$$\frac{F_{G2}}{F_{G1}} = \left(\frac{r_1}{r_2}\right)^2 \qquad r_1 = 6.37 \text{ km}$$

Thus $\frac{r_1}{r_2} = \sqrt{0.9}$ to make $a_2 = 0.9\,a_1$

$$r_2 = 6.37\text{km}/\sqrt{0.9} = 6.71 \text{ km}$$

So at an altitude of 340 km, the acceleration is reduced by 10%.