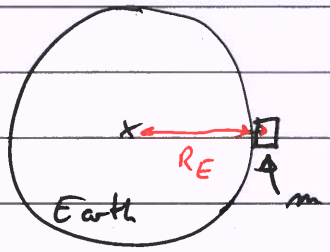
Friday, February 6, 2026

Example: Force of Earth on an object of mass m at the Earth's surface.

According to Newton: $F_{E\to m} = \frac{G M_E m}{r^2} = \frac{G M_E m}{R_E^2}$ (1)

$F_{E\to m}$: Force of Earth on m

r = Earth–object distance $= R_E$ = radius of Earth



According to Newton's 2nd law: $F_{E\to m} = m a_m$ (2)

a_m: acceleration of m

Combine (1) & (2): $m a_m = F_{E\to m} = \frac{G M_E m}{R_E^2}$

m cancels on both sides!!!

$\Leftrightarrow$ $a_m = \frac{G M_E}{R_E^2}$

$M_E = 5.972 \times 10^{24}$ kg

$R_E = 6371 \times 10^3$ m

acceleration a_m is independent of the mass m

$$\Rightarrow a_m = \frac{(6.6743\times10^{-11})(5.972\times10^{24})}{(6371\times10^3)^2}$$

$$\Rightarrow \boxed{a_m = 9.82\ m/s^2 = g}$$

acceleration due to gravity at Earth's surface