Q. The Earth has a mass of 5.98×10^{24} kg, and its radius is 6.37×10^{6} m. Using these values, calculate the acceleration due to gravity at the surface of the earth.

A. According to Newton's law of universal gravitation, the force F between Earth's mass M and arbitrary mass m is

$$F = G\,\frac{Mm}{r^2}$$

where

G is the gravitational constant ($G \approx 6.674 \times 10^{-11}$ N m^2 kg^{-2}) and
r is the distance from Earth's center.

In other hand, the force equals the mass multiplied by its acceleration (Newton's 2nd law):

$$F = ma$$

Therefore we can rewrite first expression:

$$ma = G\,\frac{Mm}{r^2} \qquad \Rightarrow \qquad a = G\,\frac{M}{r^2}$$

and, finally,

$$a = \frac{GM}{r^2} = \frac{6.674 \times 10^{-11} \cdot 5.98 \times 10^{24}}{(6.37 \times 10^{6})^2} = 9.83 \text{ m/s}^2$$