

Answer on Question #84729 - Physics - Mechanics | Relativity

Problem

If the 0.15 kg tennis ball starts at 1.4 meters off the ground what is the tennis ball's beginning gravitational potential energy?

Solution.

$$\begin{array}{l} h = 1,4 \text{ m} \\ m = 0,15 \text{ kg} \\ \hline U = ? \end{array}$$

Gravitational energy is the potential energy a body with mass has in relation to another massive object due to gravity ^[1]:

$$U = -\frac{GMm}{R}, \quad (1)$$

where U – Gravitational potential energy, G – gravitational constant, m is the mass of the first object accelerating (tennis ball), M is the mass of the second object accelerating (Earth), R – the radius of Earth.

Expression (1) is useful for the calculation of escape velocity, energy to remove from orbit, etc. However, for objects near the earth the acceleration of gravity g can be considered to be approximately constant and the expression for potential energy relative to the Earth's surface becomes ^[2]:

$$U = mgh, \quad (2)$$

where h – the height above the surface of Earth, g is the surface value of the acceleration of gravity ($g = 9,8 \text{ m/s}^2$).

So,

$$U = mgh = 0,15 * 9,8 * 1,4 = 2,06 \text{ (J)}.$$

Answer:

$$U = 2,06 \text{ (J)}$$

Notes:

1. https://en.wikipedia.org/wiki/Gravitational_energy
2. https://en.wikipedia.org/wiki/Potential_energy