Answer on Question #49669-Physics-Mechanics-Kinematics-Dynamics

Two particles of masses $M = 6\ kg$ and $m = 2\ kg$ are conceded by a light inextensible string passing over a smooth pulley. The system is released from rest with the string taut. Find the speed of the particles when the heavier one has descended $h = 2m$.

Solution

The equations of motion for two particles are

$$\begin{cases} ma = T - mg \\ Ma = Mg - T \end{cases}$$

where T is a tension in the string, g is acceleration of gravity and a is acceleration of particles.

Thus,

$$a = \frac{M - m}{M + m} g.$$

From the kinematics we know formula:

$$v_f^2 - v_i^2 = 2aS,$$

where $v_i = 0$ is initial speed of the particles, $v_f = v$ is final speed of the particles and $S = h = 2m$.

So,

$$v = \sqrt{2ah} = \sqrt{2\frac{M - m}{M + m} gh} = \sqrt{2 \cdot \frac{6 - 2}{6 + 2} \cdot 10 \cdot 2} = 4.5 \frac{m}{s}.$$

Answer: $4.5\ \frac{m}{s}$.