Answer on Question#56940 - Physics – Mechanics | Relativity

Two bodies of same mass tied with an inelastic string of length l lie together. One of them is projected vertically upwards with velocity $v_i = \sqrt{6gl}$. Find the maximum height up to which the centre of mass of system of the two masses rises.

<u>Solution:</u>

Applying the law of conservation of energy to the initial moment and the moment when the first body reaches the height l we obtain:

$$\frac{mv_i^2}{2} = \frac{mv^2}{2} + mgl,$$

Where v – is the speed of the first body at height l.

Thus

$$v = \sqrt{v_i^2 - 2gl} = \sqrt{6gl - 2gl} = 2\sqrt{gl}$$

At this moment both bodies start to move as one piece with its centre of mass at height $l/2$. According to the law of conservation of energy the new speed of the system (mass is twice the mass of one body) is given by (the process is inelastic)

$$v' = \frac{v}{2} = \sqrt{gl}$$

After this moment the centre of mass of the system is elevated by the height Δh, which is given by

$$\Delta h = \frac{v'^2}{2g} = \frac{gl}{2g} = \frac{l}{2}$$

Thus the maximum elevation of the centre of mass is

$$h_{\max} = \frac{l}{2} + \Delta h = \frac{l}{2} + \frac{l}{2} = l$$

<u>Answer:</u> l.