Answer on Question#56930 - Physics - Mechanics - Relativity

A particle of mass m is hanging with the help of an elastic string of unstretched length a and force constant mg/a.The other end is fixed to a peg on vertical wall. String is given an additional extension of $2a$ in vertical downward direction by pulling the mass and released from rest. Find the maximum height reached by it during its subsequent motion above point of release. (Neglect interaction with peg if any)

Solution:

Since the force constant is $k = \frac{mg}{a}$, the string is by $\frac{mg}{k} = a$ from its unstretched position. Therefore, when the string is stretched for additional $2a$ the total potential energy of the string becomes

$$U = \frac{k(3a)^2}{2} = \frac{9}{2}mga$$

According to the law of conservation of energy, the maximum height of elevation h is related to this energy by the following expression

$$mgh = U$$

$$h = \frac{U}{mg} = \frac{\frac{9}{2}mga}{mg} = 4.5a$$

Answer: $4.5a$.