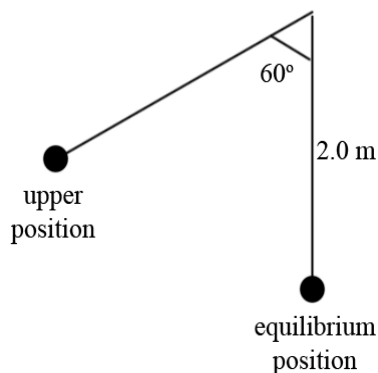Question #77543, Physics / Classical Mechanics

the length of the ropes on a playground swing is 2.0 m. a) what is the maximum speed attainable on the swing if the maximum value of theta is 60 degrees?. b) if a 50 kg person is playing the swing, what is the maximum kinetic energy he/she can reach?

Solution

a) The swing has the maximum speed at the equilibrium point.

Using the law of conservation of the energy,

$$E_k = E_{GP},$$

Where E_k is the swing's kinetic energy at the equilibrium point,

E_{GP} is the swing's gravitational potential energy at the upper point.

Plugging the values of the energies,

$$\frac{mv_{max}^2}{2} = mgh_{max}$$

Hence $v_{max} = \sqrt{2gh_{max}}$

The height of the swing at the upper position above the equilibrium position is

$$h_{max} = l(1 - \cos\theta) = 2.0 \times (1 - \cos 60°) = 1.0$$

$$v_{max} = \sqrt{2 \times 9.81 \times 1.0} = 4.4 \text{ m/s}$$

b) $E_{k\_max} = \dfrac{mv_{max}^2}{2} = \dfrac{50 \times 4.4^2}{2} = 484 \text{ J}$

Answer: a) 4.4 m/s; b) 484 J.