

Answer on Question#37807, Physics, Mechanics

Question:

A 38.0 kg child is in a swing that is attached to ropes 1.50 long. The acceleration of gravity is 9.81 m/s<sup>2</sup>. Find the gravitational potential energy associated with the child relative to the child's lowest position under the following condition: when the rope makes a 34.0 degree angle with the vertical.

Answer:

The gravitational potential energy of the child relative to the child's lowest position is

$$U = mgh$$

where  $m$  – is the mass of the child,  $g$  – acceleration of gravity,  $h$  – the height of the child relative to the child's lowest position.

From the similarity of triangles that appears from the child's displacement from vertical we have

$$h = b \cos \alpha$$

where  $\alpha$  is angle that rope makes with the vertical and  $b$  is

$$b = \frac{l}{\cos \alpha} - l$$

where  $l$  the length of the rope.

So we have

$$h = l(1 - \cos \alpha)$$

and the potential energy is

$$U = mgl(1 - \cos \alpha)$$

$$U = 38.0 \cdot 9.81 \cdot 1.50 \cdot (1 - \cos 34.0^\circ) = 95.60 \text{ J}$$

**The answer is:  $U = 95.60 \text{ J}$**