Answer on Question #73984, Physics / Mechanics | Relativity

Question. One end of a cord is fixed and a small $0.500\ kg$ object is attached to the other end, where it swings in a section of a vertical circle of radius $2.00\ m$ as shown in the Figure. When $\theta = 20.0°$, the speed of the object is $8.00\ m/s$. At this instant, find

(a) the tension in the string;

(b) the tangential and radial components of acceleration, and

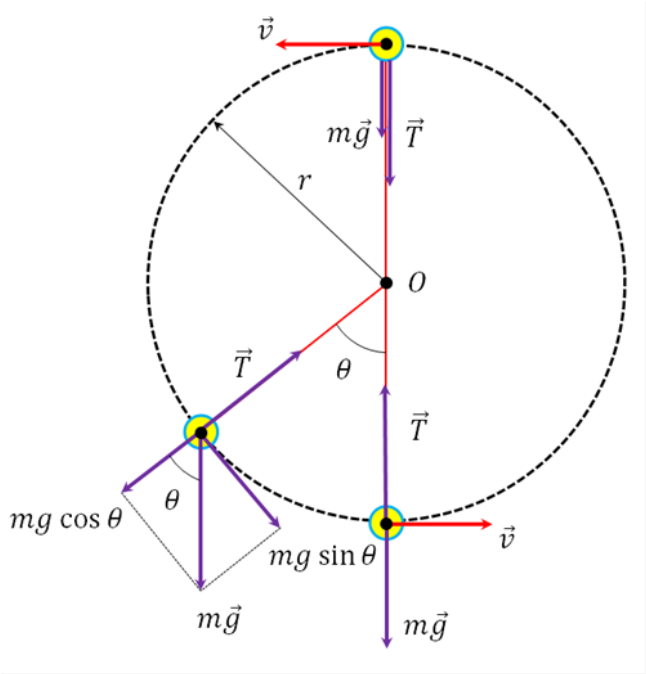
(c) the total acceleration.

Solution.

Given. $m = 0.500\ kg; r = 2.00\ m; \theta = 20.0°; v = 8.00\ m/s.$

Find. $T, a_n, a_\tau, a-?$

Solution.



(a) the tension in the string

According to the Second Newton's law

$$\sum \vec{F} = m\vec{a}.$$

We have

$$T - mg\cos\theta = m\frac{v^2}{r} \rightarrow T = m\frac{v^2}{r} + mg\cos\theta = 0.5 \cdot \frac{8^2}{2} + 0.5 \cdot 9.81 \cdot \cos 20° = 20.609\ N$$

(b) the tangential and radial components of acceleration

the tangential component

$$mg\,sin\,\theta = ma_\tau \;\rightarrow\; a_\tau = g\,sin\,\theta = 9.81 \cdot sin\,20° = 3.35\;m/s^2.$$

the radial component

$$a_n = \frac{v^2}{r} = \frac{8^2}{2} = 32\;m/s^2.$$

(c) the total acceleration

$$a = \sqrt{{a_n}^2 + {a_\tau}^2} = \sqrt{32^2 + 3.35^2} = 32.2\;m/s^2.$$

Answer. $T = 20.609\;N;\; a_\tau = 3.35\;m/s^2;\; a_n = 32\;m/s^2;\; a = 32.2\;m/s^2.$