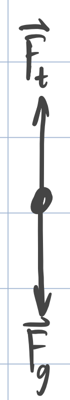
A child of mass 30 kg swings at the end of an elastic cord. At the bottam of the swing, the child's velocity is horizontal, and the speed is 6 m/s. At this instant the cord is 4.70 m long.

At this instant, what is the parallel component of the rate of change in momentum?

There is no parallel component to the rate of change of momentum at that instant.

At this instant, what is the perpendicular component of the rate of change in momentum?



$$|\vec{p}|\frac{d\hat{p}}{dt} = \vec{F}_\perp$$

$$= |\vec{F}_\perp| \hat{F}_\perp$$

$$= \frac{mv^2}{r}\langle 0,1,0\rangle$$

$$= \langle 0, 229.787, 0\rangle \text{ N}$$

At this instant what is the net force acting on the child?

$$\vec{F}_{net} = \langle 0, 229.787, 0\rangle \text{ N}$$

What is the magnitude of the force that the elastic string exerts on the child?

$$\vec{F}_{net} = \vec{F}_t + \vec{F}_g$$

$$\vec{F}_{net\,y} = |\vec{F}_t| - mg$$

$$|\vec{F}_t| = \vec{F}_{net\,y} + mg$$

$$= 523.787 \text{ N}$$

The relaxed length of the elastic cord is 4.62m. What is the stiffness of the cord?

$$|\vec{F}_t| = k|s|$$

$$|\vec{F}_t| = k(L - L_0)$$

$$k = \frac{|\vec{F}_t|}{L - L_0}$$

$$= 7547.34 \text{ N/m}$$

A ferris wheel is vertical, with a radius of 10 m. The wheel rotates at a constant rate, going around once in 11s. Consider a rider whoes mass is 58 kg.

At the bottom of the ride what is the parallel component of the rate of change?

$$|\vec{F}_{\parallel}| = \langle 0, 0, 0 \rangle \text{ N}$$

At the bottom of the ride what is the perpendicular component of the rate of change?

$$\vec{F}_\perp = |\vec{F}_\perp| \hat{F}_\perp$$

$$= \left(\frac{mv^2}{r}\right)\langle 0,1,0\rangle$$

$$= \left(\frac{m\left(\frac{d}{t}\right)^2}{r}\right)\langle 0,1,0\rangle$$

$$= \left(\frac{m\left(\frac{2\pi r}{t}\right)^2}{r}\right)\langle 0,1,0\rangle$$

$$= \left(\frac{m\,\frac{4\pi^2 r^2}{t^2}}{r}\right)\langle 0,1,0\rangle$$

$$= \left(\frac{\frac{4\pi^2 m r^2}{t^2}}{r}\right)\langle 0,1,0\rangle$$

$$= \left(\frac{4\pi^2 m r^{\cancel{2}}}{t^2} \cdot \frac{1}{\cancel{r}}\right)\langle 0,1,0\rangle$$

$$= \left(\frac{4\pi^2 m r}{t^2}\right)\langle 0,1,0\rangle$$

$$= \langle 0, 189.235, 0\rangle \text{ N}$$

At the bottom of the, vector gravatational force exerted by the Earth on the rider?

$$\vec{F}_g = |\vec{F}_g| \hat{F}_g$$

$$= mg\langle 0,-1,0\rangle$$

$= \langle 0, -568.4, 0 \rangle$ N

At the bottom of the ride, what is the vector force exerted by the seat on the rider?

$$\vec{F}_{net\ y} = \vec{F}_{seat} + \vec{F}_g$$

$$\vec{F}_\perp = \vec{F}_{seat} + \vec{F}_g$$

$$\vec{F}_{seat} = \vec{F}_\perp - \vec{F}_g$$

$$= \langle 0, 757.635, 0 \rangle \text{ N}$$

At the top of the ride what is the parallel component of the rate of change?

$$|\vec{F}_\parallel| = \langle 0, 0, 0 \rangle \text{ N}$$

At the top of the ride what is the perpendicular component of the rate of change?

$$\vec{F}_\perp = |\vec{F}_\perp| \hat{F}_\perp$$

$$= |\vec{F}_\perp| \langle 0, -1, 0 \rangle$$

$$= \langle 0, -189.235, 0 \rangle \text{ N}$$

At the top of the ride, what is the vector gravitational force exerted by Earth on the rider?

Same as above

$$\vec{F}_g = \langle 0, -568.4, 0 \rangle \text{ N}$$

At the top of the ride, what is the vector force exerted on the rider by the seat?

$$\vec{F}_\perp = \vec{F}_{seat} + \vec{F}_g$$

$$\vec{F}_{seat} = \vec{F}_\perp - \vec{F}_g$$

$$= \langle 0, 379.165, 0 \rangle \text{ N}$$

In space a rock of mass 4 kg is attached to a long spring and swung at a constant speed in a circle of radius 9. The spring exerts a force of constant magnitude 700 N.

$$|\vec{F}_\perp| = \frac{mv^2}{r}$$

$$mv^2 = r|\vec{F}_\perp|$$

$$v^2 = \frac{r|\vec{F}_\perp|}{m}$$

$$v = \sqrt{\frac{r|\vec{F}_\perp|}{m}}$$

$V = 39.686 \, m/s$