

PHYS121 Notes

Yash Thakur

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5.1 Friction

There are three kinds of friction:

- Static friction: $\vec{f}_s \leq \mu_s n$. Applies when object is not moving. It adjusts itself so that the net force is 0, but it can only increase to $\mu_s n$ at most.
- Kinetic friction: $\vec{f}_k = \mu_k n$. Applies when object is moving.
- Rolling friction: $\vec{f}_r = \mu_r n$. Applies when object is rolling.

Interacting Objects

According to Newton's Third Law:

- Every force occurs as one member of an action/reaction pair of forces.
- The two forces act on **different** objects.
- The two forces point in opposite directions and have the same magnitude.

5.2 Ropes and Pulleys

Ropes

Massless string approximation: Mass of rope is 0.

Generally, **the tension in a massless string/rope equals the magnitude of the force pulling on the end of the string/rope**. As a result:

- A massless string/rope “transmits” a force undiminished from one end to the other, i.e., if you pull on one end of a rope with force F , the other end pulls on whatever it's attached to with the same force.
- The tension in a massless string/rope is the same from one end to the other.

Pulleys

The tension in a massless string is unchanged by passing over a massless, frictionless pulley (assume such a pulley for problems in Chapter 5).

6 Chapter 6

6.1 Uniform Circular Motion

Speed is constant but not velocity, because direction is constantly changing.

Centripetal acceleration for uniform circular motion: $a = \frac{v^2}{r} = \left(\frac{2\pi}{T}\right)^2 r$

Period: Time taken to go around circle one time.

Frequency: Number of revolutions per second: $f = \frac{1}{T}$ (unit is s^{-1})

Angular velocity: $\omega = 2\pi f$

Speed: Time taken to make one revolution: $v = \frac{2\pi r}{T} = 2\pi f r = r\omega$

6.2 Dynamics of Uniform Circular Motion

Net force producing the centripetal acceleration of uniform circular motion: $\vec{F}_{net} = m\vec{a}$ (towards the center of the circle)

When a car turns in a circle, static friction is the force that causes centripetal acceleration.

6.3 Apparent Forces in Circular Motion

Apparent weight equals normal force.

Critical speed: v_c is the speed for which $\vec{n} = 0$.

For roller coaster, $v_c = \sqrt{gr}$

The critical speed is the slowest speed at which the car can complete a roller coaster circle.

6.4 Circular Orbits and Weightlessness

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