Chapter 10
Motion in a noninertial Reference frame
Fictitious Forces

"Centrifugal force" $= -m\vec{\omega}\times(\vec{\omega}\times\vec{r})$

"Coriolis force" $= -2m\vec{\omega}\times\vec{v}_r$

If acceleration $\vec{a}_r$ is measured in a rotating reference frame, it differs from the acceleration $\vec{a}_i$ measured in an inertial frame.

$$\vec{a}_r = \vec{a}_i - \vec{\omega}\times(\vec{\omega}\times\vec{r}) - 2\vec{\omega}\times\vec{v}_r$$

$\vec{\omega}$ is the angular velocity of the rotation, and $\vec{v}_r$ is velocity relative to the rotating reference frame.

Since $m\vec{a}_i = \vec{F}$ we get

$$m\vec{a}_r = \vec{F} - \underbrace{m\vec{\omega}\times(\vec{\omega}\times\vec{r})}_{\text{centrifugal}} - \underbrace{2m\vec{\omega}\times\vec{v}_r}_{\text{Coriolis}}$$

Centrifugal force $= \frac{mv^2}{r}$, perpendicular to and outward from the rotation axis, where v is the frame's rotation speed at distance r from the axis.

Coriolis force is zero for objects stationary in the rotating frame. Facing forward with your feet-to-head aligned with $\vec{\omega}$, the force is to your right

Chapter 9: Dynamics of a System of Particles

$M = \sum_\alpha m_\alpha$, $\vec{R} = (\sum_\alpha m_\alpha \vec{r}_\alpha)/M$ (or $\frac{1}{M}\int \vec{r}\,dm$), $\vec{P} = M\vec{V} = M\dot{\vec{R}}$

De-coupling the center-of-mass motion (sections 9.2 – 9.5)

- Linear momentum
- Angular momentum
- Energy

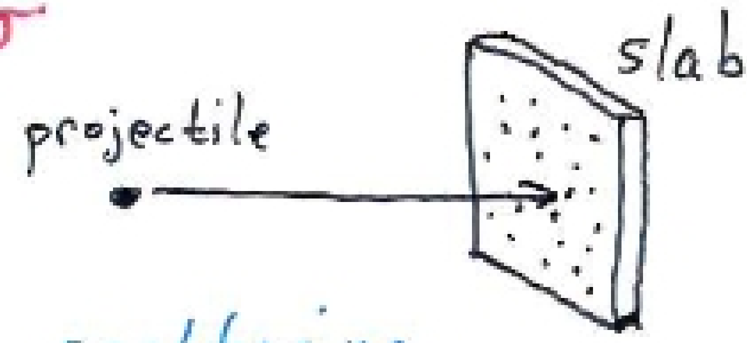
Collisions of two particles (sections 9.6 – 9.10)

- Elastic collisions
- Inelastic collisions
- Scattering cross sections

Rocket motion (section 9.11)

- In free space
- Against gravity

Cross section σ



σ = effective area for scattering a projectile by a target particle

Define $\mu \equiv$ number of target particles per unit area

Then $\mu\sigma$ = fraction of slab area that results in scattering

Suppose N projectiles enter the slab and n scatter.

The fraction $\frac{n}{N}$ must be the fraction of slab area that results in scattering

So $\frac{n}{N} = \mu\sigma \Rightarrow \boxed{\sigma = \frac{n}{N}\frac{1}{\mu}}$

σ has units of area (1 barn = 10^{-24} cm^2)

Note: σ pertains to collisions of a specific projectile type and specific target type. It does <u>not</u> define an area for the projectile or target separately.