PHYS 320 ANALYTICAL MECHANICS

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TODAY

- Vectors
- Newton's Laws

Rolling motion

- How describe …
  - linear motion?

$$\vec{r}_1 = \hat{i}\, b\omega t + \hat{j}\, b$$

  - circular motion?

$$\vec{r}_2 = \hat{i}\, b\sin\omega t + \hat{j}\, b\cos\omega t$$

  - the combination of circular and linear motion: rolling motion?

$$\vec{r} = \vec{r}_1 + \vec{r}_2 = \hat{i}\, b(\omega t + \sin\omega t) + \hat{j}\, b(1 + \cos\omega t)$$

NEWTON'S LAWS

Valid only in INERTIAL reference frames!

I Every body continues in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impresses upon it.

II The change of motion is proportional to the motive force impresses; and is made in the direction of the line in which that force is impressed.

Note: these two refer to a specific body (mass).

Inertial Reference Frames

- Inertial reference frames are those in which Newton's first two laws are valid.
- Is the Earth an inertial reference frame?

$R_E = 6.4 \times 10^6\ m$

Newton's Second Law

$$\vec{F}_{net} = \sum_i \vec{F}_i = \frac{d\vec{p}}{dt}$$

include only *physical forces:*

$\vec{F}_{\text{on}\_\_\_\_\_\text{by}\_\_\_\_\_}$

If m = constant, then

$$\vec{F}_{net} = \sum_i \vec{F}_i = m\vec{a} = m\frac{d\vec{v}}{dt} = m\frac{d^2\vec{r}}{dt^2}$$