

Physics 201 - Lecture 12

How things move

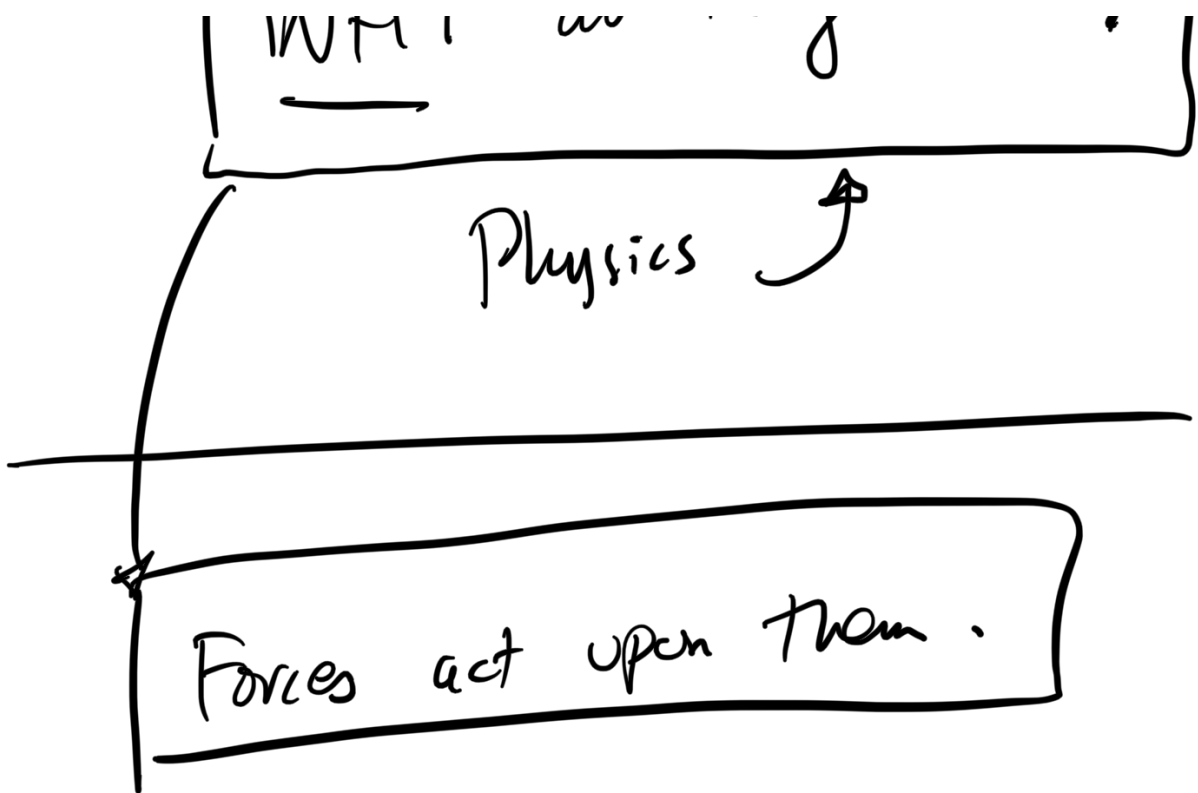
\vec{x} , \vec{v} , \vec{a} (function of time)

$$\begin{array}{l|l} \vec{v} = \frac{d\vec{x}}{dt} & \vec{v} = \int \vec{a} dt \\ \vec{a} = \frac{d\vec{v}}{dt} & \vec{x} = \int \vec{v} dt \end{array}$$

Isaac Newton

How do we calculate the acceleration?

Why do things move?



1st Law: Things don't move
unless there are forces acting
on them from the outside.

NO MAGIC!

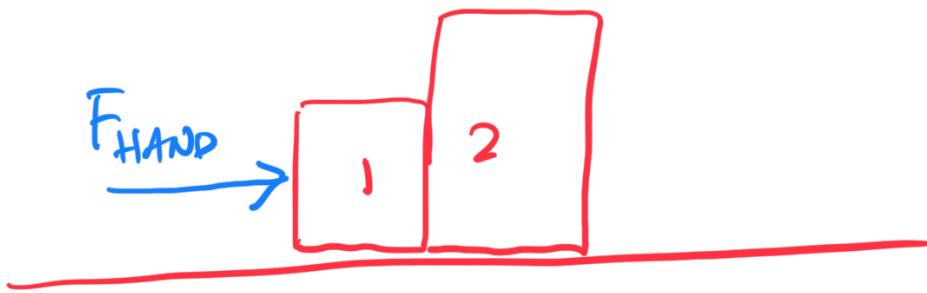
① Gravity!

Natural force in
the universe between
any two objects that
have mass.

② Contact Forces

↳ something, actually transmits
the object.


- friction → hand
- rope → foot
- cable

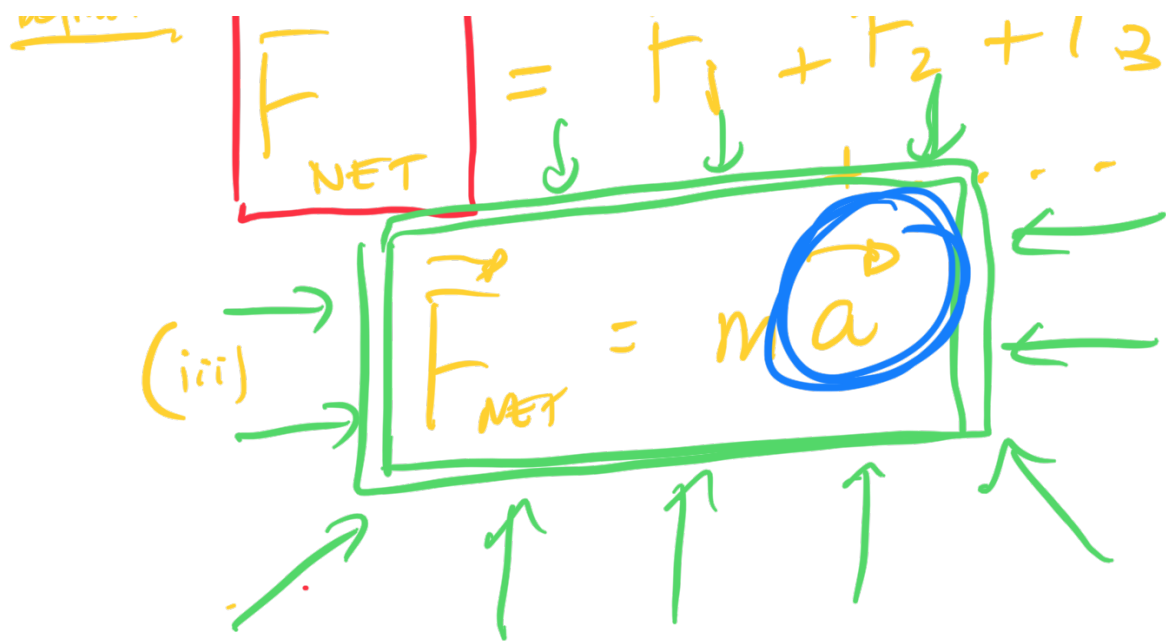


2nd Law :

(i) Forces are vectors !

(ii) If I have multiple forces
on an object :

Definition :    



3rd Law: If I punch you in the face, your face punches my fist back just as hard!

Forces always come in pairs!

$$\vec{F}_{A/B} = -\vec{F}_{B/A}$$

"For every action, there is an equal and opposite reaction."

Recipe:

① Identify all of the forces acting on an object.

$$\begin{aligned} \vec{F}_{\text{NET}} &= \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \dots \\ &= \sum_{i=1}^N \vec{F}_i \end{aligned}$$

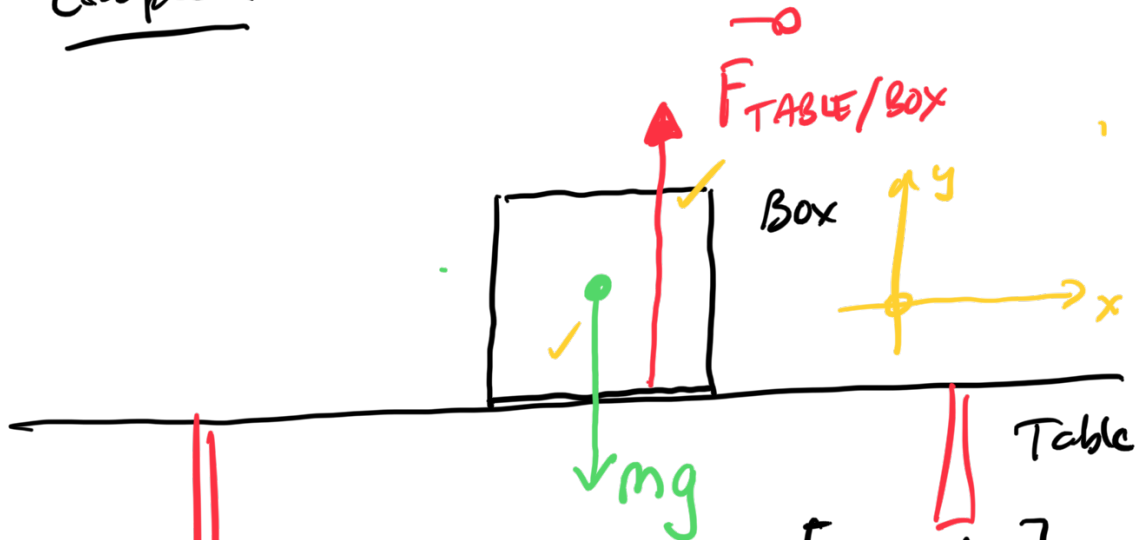
$$\vec{F}_{\text{NET}} = m \boxed{\vec{a}} \quad \begin{array}{l} \text{Kinematic} \\ \uparrow \\ \vdots \end{array}$$

$$\boxed{\vec{v}} = \int \vec{a} dt \quad \begin{array}{l} \text{Practice} \\ \vdots \end{array}$$

$$\boxed{\vec{r}} = \int \vec{v} dt \quad \begin{array}{l} \vdots \end{array}$$

③. $\boxed{\vec{x}''} = \int v \, dt$

Example 1: Simplest Problem Ever.



Goal: calculate $\vec{a}(t)$ $[0!]$

①

I identify all Forces.

on the obj
of interest

→ gravity.

$$\vec{F}_g = -mg \hat{j}$$

→ contact forces.

$\vec{F}_{\text{TABLE/BOX}}$

②
$$\vec{F}_{\text{Net}} = \vec{F}_1 + \vec{F}_2 + \dots$$

$$= -mg \hat{j} + F_{\text{TABLE/BOX}}$$

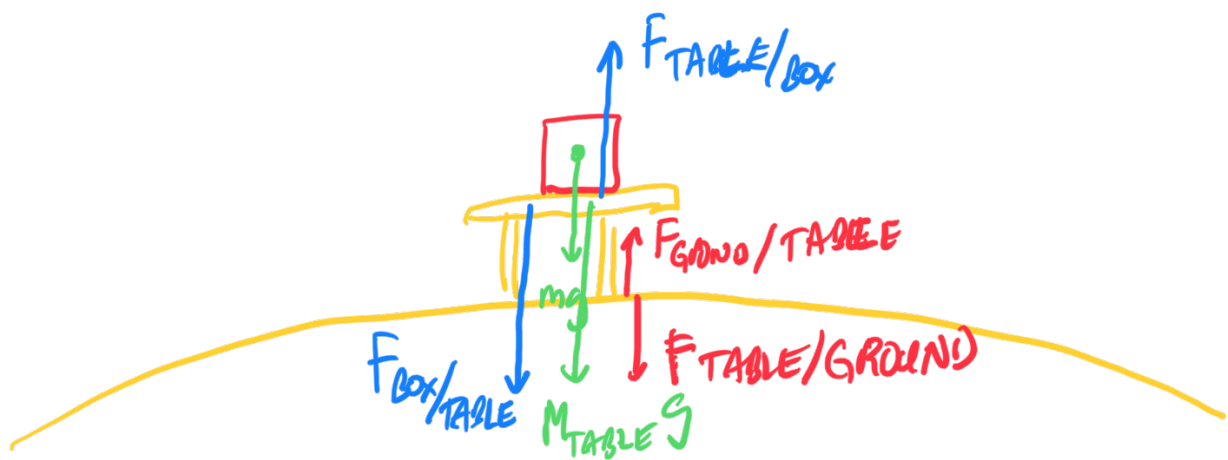
$$\vec{F}_{\text{NET}} = \boxed{F_{\text{TABLE/BOX}} - mg} \hat{j}$$

$$\textcircled{3} \quad \vec{F}_{\text{NET}} = m \vec{a} = 0$$

$$F_{\text{TABLE/BOX}} - mg = 0$$

$$\boxed{F_{\text{TABLE/BOX}} = mg}$$

Where did N32 come in?



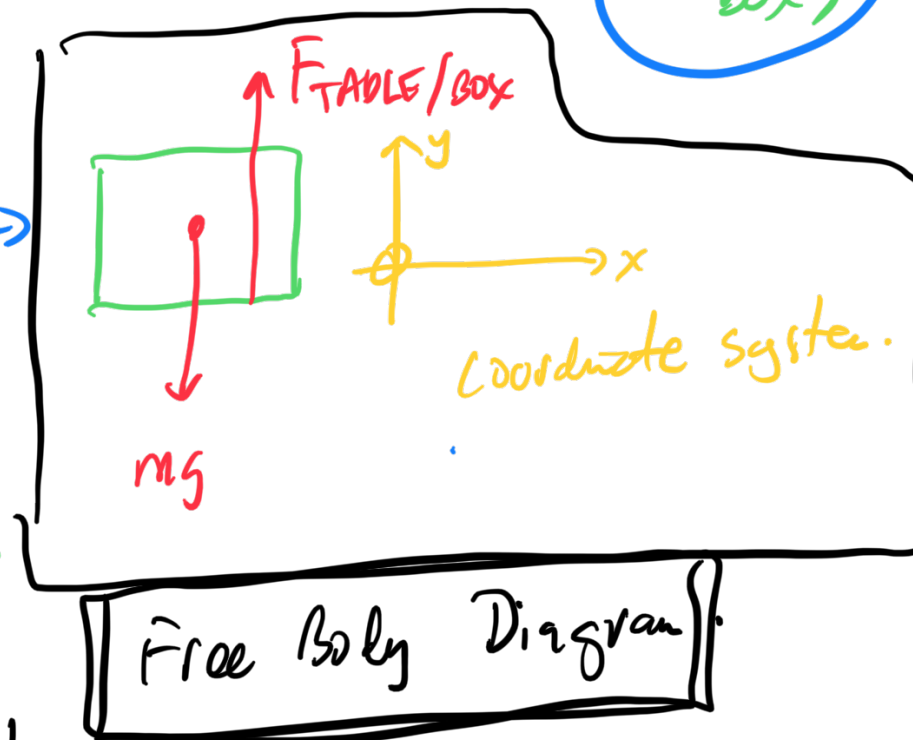
BODY

FREE
Bodied

Only concerned with the box

(Isolate the box)

Diagram →



KEY!

Free Body Diagram