-- Force: ↔ interraction

* units of force – N (newton) = $1\ kg\,m/s^2$

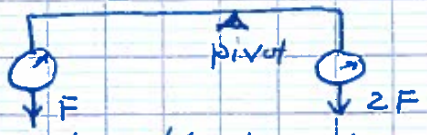
* How to measure: spring

Hook's law: $F = kx$

Force field (vector field)

spring balance

by adjasting the pivot we can calibrate it.



-- Mass – measure of the object's inertia – its resistance to being accelerated.

What is the origin of mass? CM is not concerned with this philosophical question.

* inertial balance – a way how we can compare masses

* Units of mass: just pick some reference mass and call it a kilogram. All other masses are measured in units of the ref. mass.

* mass ~~kg~~ weight – what is the difference?

"inertia" ↔ "force" due to Earth gravity.

* Inertial mass vs gravitational mass

1) no measurable difference

2) $IM \equiv GM$ – the equivalence principle.

-- Newton's First & Second Laws

* the Law of inertia (see the book)

* $\vec{F} = m\vec{a}$ $\vec{a} = \vec{F}/m$ $\vec{F}$ is the sum of all forces acting on the particle.

$m\ddot{\vec{r}} = \vec{F}$ diff. equation (Chapter 1.4)

$\vec{F} = m\vec{a} = m\dot{\vec{v}} = \dot{p}$ – rate of change of the particle momentum

momentum: $p = mv$

* Reference frames (chapter 1.4)

the role of the first law → distinguish between "inertial" and "non-inertial" frames

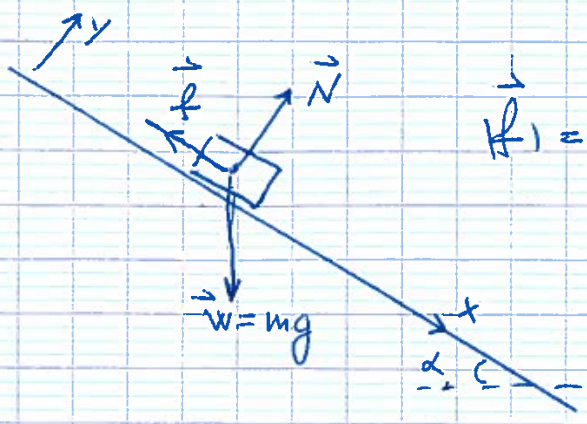
Validity of N1 & N2 Laws (chapter 1.4)

FIGURE 1.4 from the book.

The laws of nature do not depend on selection of the ref. frame, but our formulation of Laws of nature do

L3

Example 1.1 a block sliding down an incl
(for details see the textbook)



$\vec{f}_1 = \mu \vec{N}$

a) $\ddot{y} = 0 \rightarrow F_y = 0 = N - mg\cos\alpha = 0$

$N = mg\cos\alpha$

b) $f = \mu N = \mu mg\cos\alpha$

c) $F_x = mg\sin\alpha - f = mg(\sin\alpha - \mu\cos\alpha) = m\ddot{x}$

$\ddot{x} = g(\sin\alpha - \mu\cos\alpha)$ - diff. eq. for

$\ddot{x} = \text{const.}!$

$\dot{x} = g(\sin\alpha - \mu\cos\alpha)t + V_0$ ($= 0$ at $t = 0$)

$x = \frac{1}{2}gt^2(\sin\alpha - \mu\cos\alpha) + x_0$ ($= 0$ at $t =$

Caveat: What if $\sin\alpha - \mu\cos\alpha < 0$?

$f(\alpha) \leq \mu N$