Class 5 - Sept 26/05

Small loose end.

SI: \( \text{kg, m, s} \)

Laws of physics define secondary units:

\[ F = ma \]

\[ = \text{kg m/s}^2 \equiv \text{newton N} \]

\[ \S 4.3 - \text{Identifying Forces} \]
\[ \S 4.7 - \text{Free Body Diagrams} \]

FBD
useful visualisation tool.

Example 4.4 - Elevator Accelerates Up

Pictorial

model: particle
by cable
by earth

system-environment boundary

Model
Newton's 1st Law

\[ \vec{F}_{\text{net}} = m \vec{a} \quad (2\text{nd Law}) \]

\[ \vec{F}_{\text{net}} = 0 \quad \Rightarrow \quad \vec{a} = 0 \]

Uniform motion

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Only true in

\[ \text{inertial reference frames} \]

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Newton's absolute space

Master inertial frame
Any frame in uniform motion \( \text{wrt} \) is also inertial. "with respect to" "fixed stars" stationary \( \text{wrt} \) absolute space.

Einstein (1905): concept of abs space "superfluous"

Circular argument"
Cinematics: describe motion

Dynamics: include causes of motion

CHAPTER 6 - Dynamics

1 Dimension

§5.1 - Equilibrium

uniform motion

\[ \vec{F}_{\text{net}} = 0 \]
§ 5.2 - Apply 2nd Law

\[ \sum F = \sum ma \]

**TABLE**

particle

\[ N = w \quad F > f \]
\[ \vec{F}_{\text{net}} = m \vec{a} \]
\[ F_{\text{net}, x} = F - f = m_{\text{system}} a_x \]

\[ F - f = (m + M) a_x \]

\[ a_x = \frac{F - f}{m + M} \]

Diagram:
- Particle
- Force \( F \)
- Normal force \( N \)
- Weight \( \overrightarrow{w} \)
- Force exerted by \( M \) on \( m \)
x components: $f = ma$

§ 5.3 - Mass & Weight

mass ~ amount of matter

oper. def'n! 1 over slope of an $a$ vs $F$ graph.

Near Earth's Surface

$\vec{w} = m\vec{a}$

free fall $\vec{a} = \vec{g}$

$\vec{w}$ "weight"
Extend Example 44.

\[ \text{particle} \]

\[ \text{scale} \]

\[ F_{\text{net}} = m a_y \]

\[ F_s - w \]

\[ F_s - mg = m a_y \]

\[ F_s = mg \left(1 + \frac{a_y}{g}\right) \]

*apparent weight*