Vp140 Recitation II

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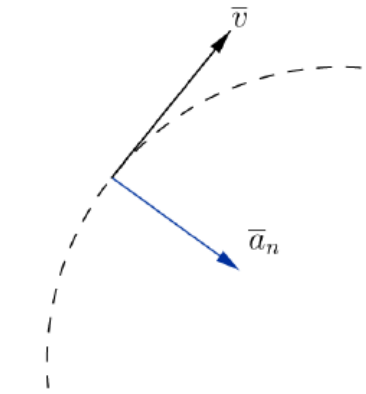
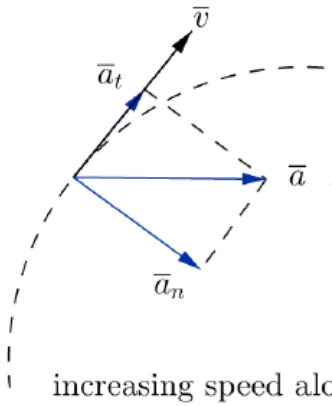
Overview

Instantaneous acceleration

Different cases

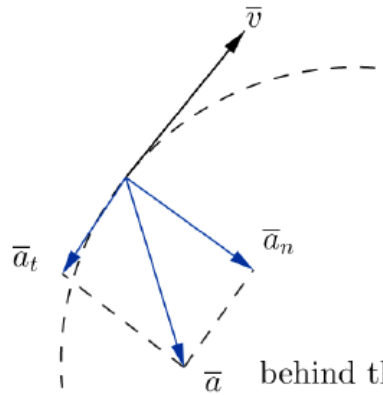


constant speed along curved path



$\overline{a}$ ahead of the normal

increasing speed along curved path

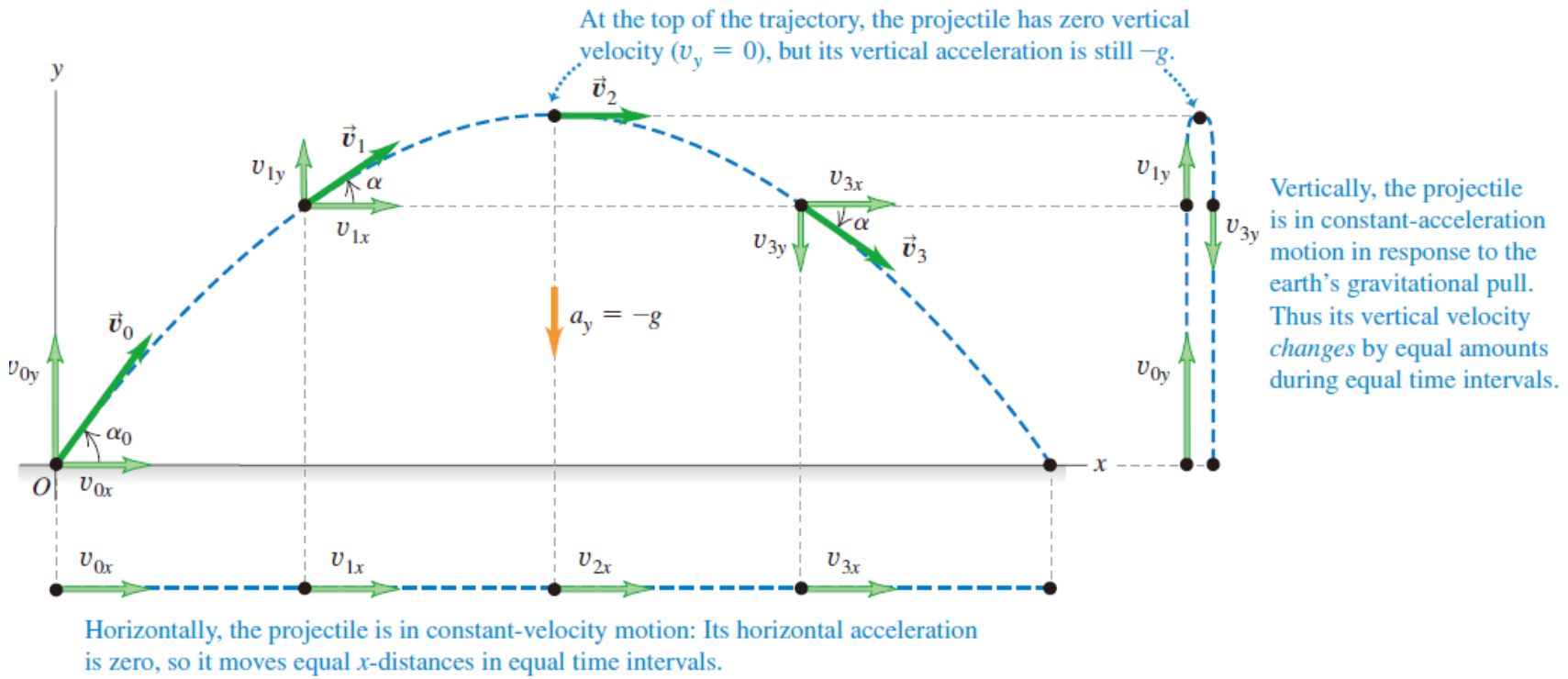


$\overline{a}$ behind the normal

decreasing speed along curved path

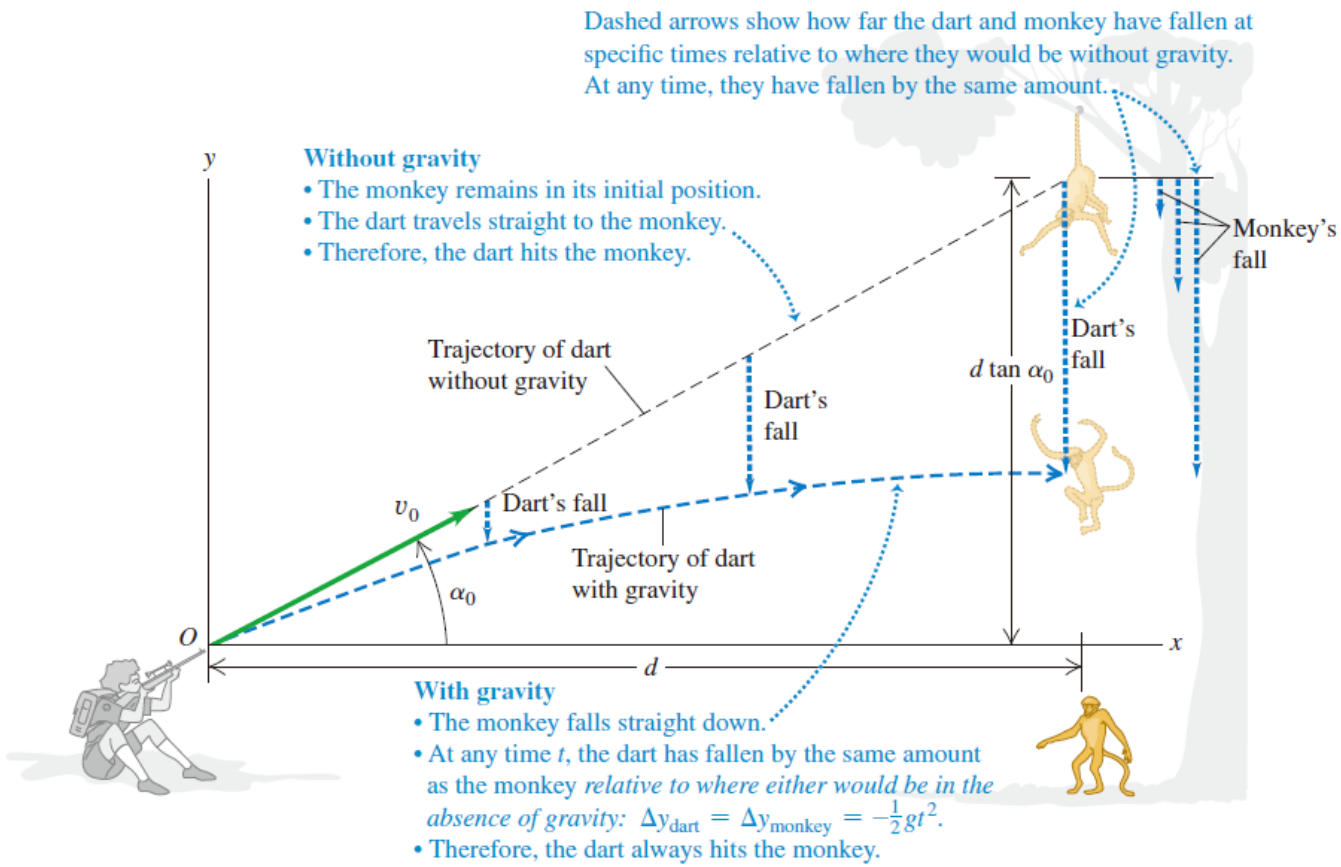
Projectile motion

Figure



Example

Shooter and monkey



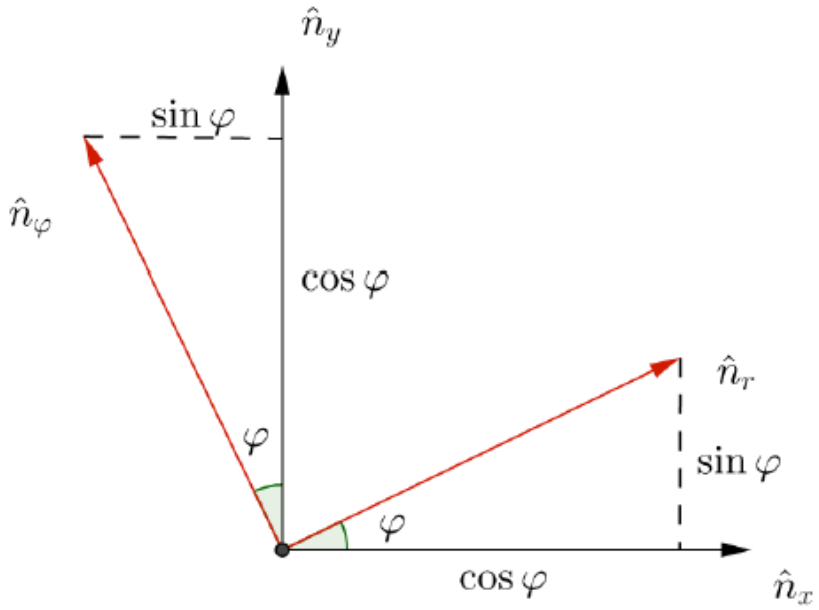
Exercise I

Exercise I

A projectile thrown from a point P moves in such a way that its distance from P is always increasing. Find the maximum angle above the horizontal with which the projectile could have been thrown. Ignore air resistance.

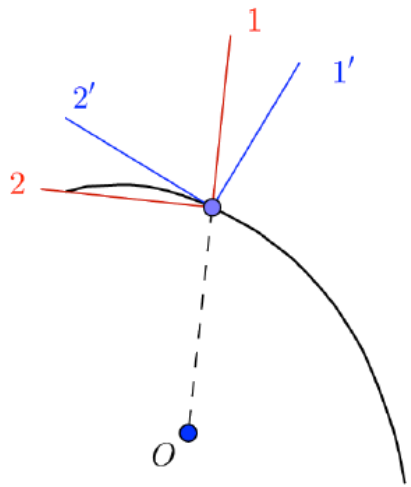
Polar Coordiantes

Figure



Directions

Figure



$1'$ normal direction

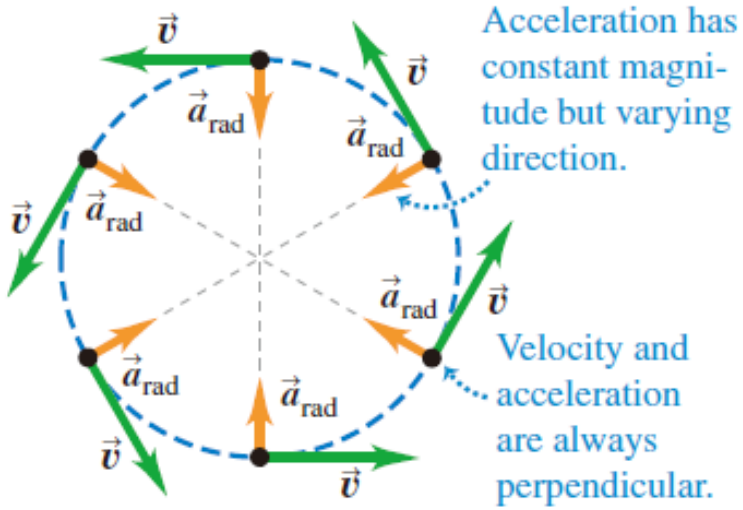
$2'$ tangential direction

1 radial direction

2 transverse direction

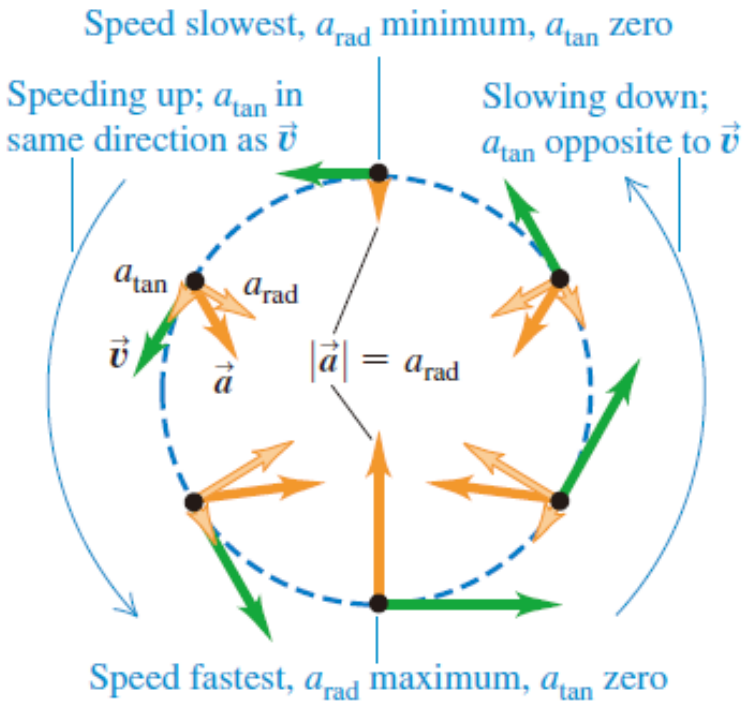
Uniform circular motion

Figure



Non-uniform circular motion

Figure



Exercise II

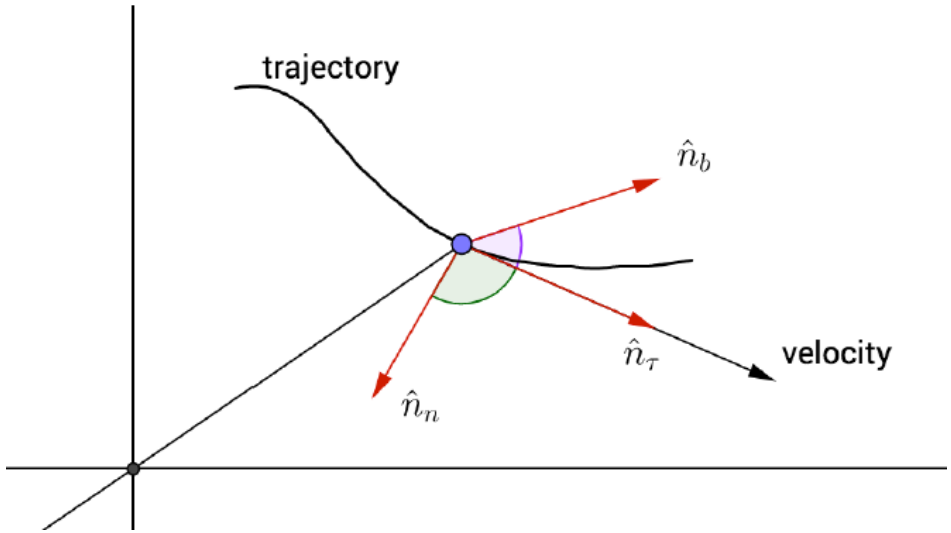
Exercise II

A disc of radius R rotates about its axis of symmetry (perpendicular to the disk surface) with constant angular velocity $\dot{\varphi} = \omega = \text{const}$. At the instant of time t = 0 a beetle starts to walk with constant speed v_0 along a radius of the disk, from its center to the edge. Find:

1. the position of the beetle and its trajectory in the Cartesian and polar coordinate systems,
2. its velocity both systems,
3. its acceleration in both systems (Cartesian components, polar components, as well as tangential and normal components).

Natural Coordinate System

Figure



Force

What is a force?

- Vector
- Superposition
- Common forces

First law

Newton's First Law

A body acted on by no net force has a constant velocity (which may be zero) and zero acceleration.

Inertia

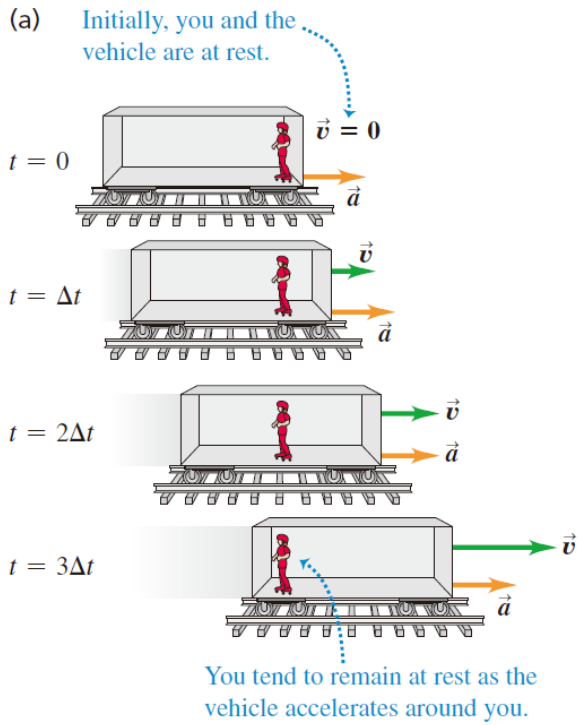
The tendency of a body to keep moving once it is set in motion.

Inertial frame of reference

Definition

A frame of reference in which Newton's first law is valid.

Example



Second and third laws

Newton's second law

$$\Sigma \vec{F} = m\vec{a}$$

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Newton's third law

$$\vec{F}_{A \text{ on } B} = -\vec{F}_{B \text{ on } A}$$

Exercise III

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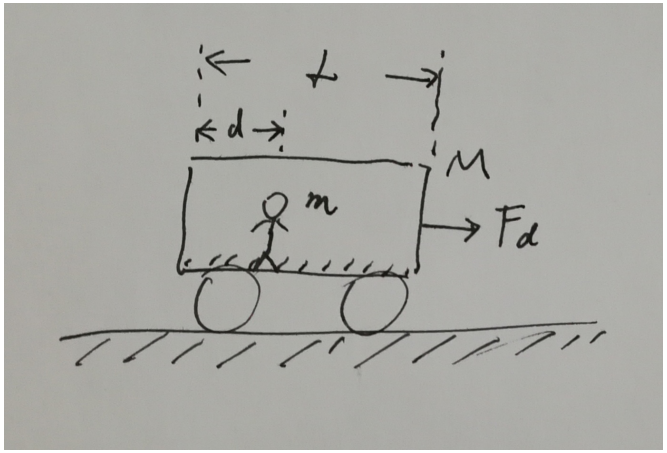
Analyze what will happen if the car starts to move under the constant driving force F_d with initial speed v_0=0. Both the ground and the floor in the car are smooth. The quantities involved are given in the figure.

Figure



The End

- Office hour: Wed 8:00-10:00 (Discussion Room 326I)
- Email: *zhanghaomeng@sjtu.edu.cn*