Phys 100 2024

Lecture 14

Thurs: Seminar 12:30

Wubben 218

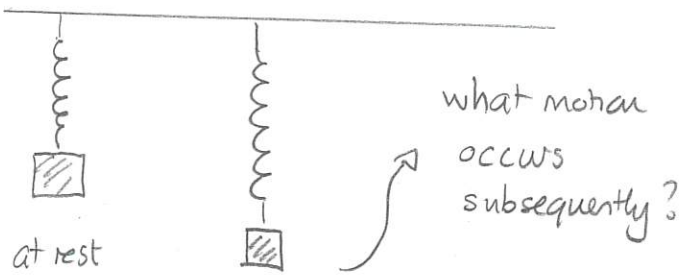
Fri: Read

Monday: HW by 5pm

## Newtonian mechanics

Newton's system of mechanics considers questions about the motion of objects. For example consider a mass suspended from a spring.

DEMO: Spring / mass




Broadly what Newton's system tells us to do is:

Find all the forces on an object

Describe initial state of system.

→ Use Newton's Second Law to determine subsequent motion.

The scheme is

Spring force

Earth's gravitational force

Provide all forces

→ Calculate net force

net force

→ Determine acceleration by

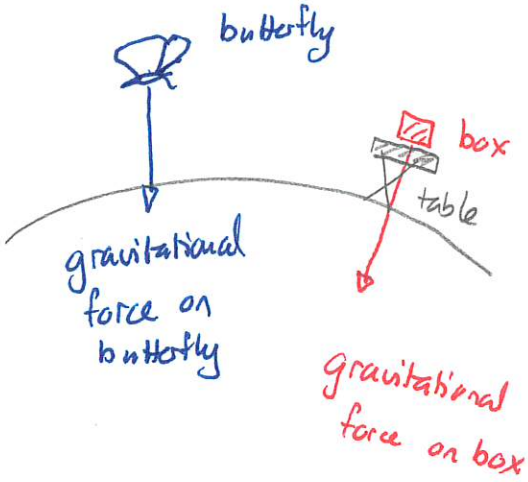
acceleration = net force / mass

→ Lets us determine subsequent motion

# Gravitational Force

We now consider special forces.

First the bulk of the Earth always exerts a gravitational force on any object.




Observations indicate that

1) for any given object the gravitational force is independent of the object's motion
2) the gravitational force always points to Earth's center.

Near to Earth's surface the magnitude of the gravitational force is given by

$$\underbrace{\text{gravitational force}}_{\text{in Newtons N}} = \underbrace{\text{mass of object}}_{\text{in kg}} \times \underbrace{9.8}_{\text{in m/s}^2}$$

$$F_{grav} = m \times g \quad 9.8$$

The gravitational force is sometimes called weight.

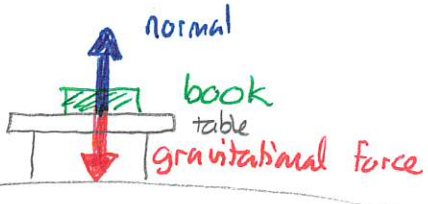
Quiz 1 80 - 100%

Quiz 2 30% - 60%

DEMO: Spring / mass scale

## Normal forces

One object can exert a force on another as a consequence of the contact between objects. Consider a book at rest on a table. Then we know:




The book is at rest $\Rightarrow$ acceleration $= 0$ $\Rightarrow$ net Force $= 0$

There is a gravitational force downward on the book.

There must be another upward force to cancel the gravitational force.

The upward force can only be exerted by the table on the book. The force is the result of interactions between the table surface and the book surface. It is called a normal force and has properties:

1) normal force is perpendicular to the surface
2) size of the normal force adjusts depending on the circumstances

Quiz 3 90%

Quiz 4 80%

Quiz 5 80%

Note that, when sitting the "feeling" one gets from the chair is the normal force. This, then informs us about what we might sense in various motions.

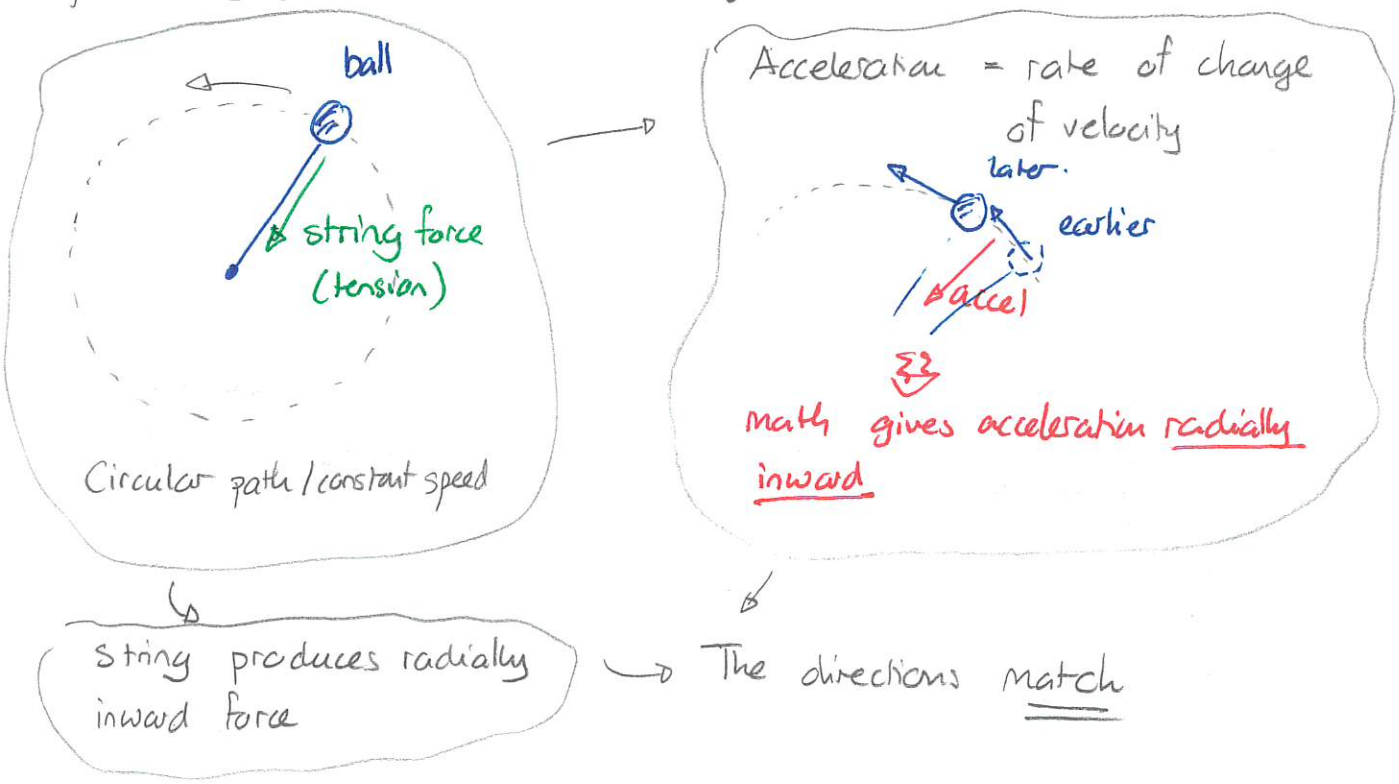
For example when ascending in an aircraft

* as the ascent commences acceleration is upward ⇒ normal force larger
* as the ascent ends " " downward ⇒ " " smaller

Similar experiences occur when riding an elevator

## Circular motion

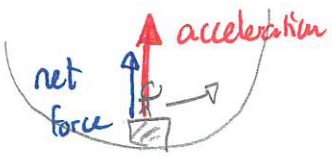
Newton's mechanics applies to objects that move in circles. Consider an object swinging on the end of a string with constant speed




This applies to amusement park rides, particularly rollercoasters. When a roller coaster does a loop, each passenger travels in a roughly circular path. Consider the bottom

* acceleration is radially inward
* net force is up
* net force = normal force − gravitational force

⇒ normal larger than gravitational force



* the net force is larger when the speed is larger.

* larger speed $\Rightarrow$ larger normal force !!