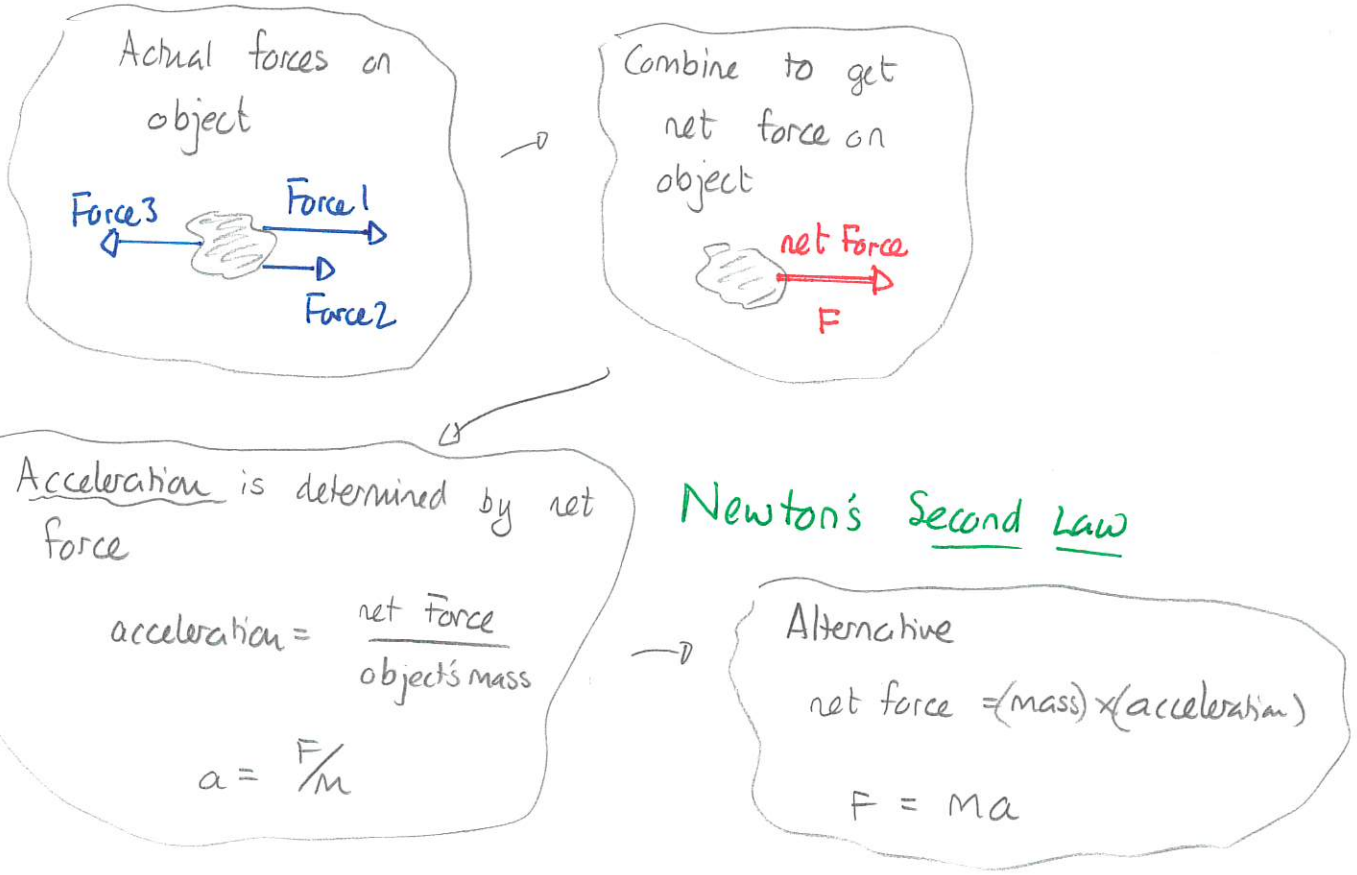
Fri: Read

Monday: HW 4 by 5pm

This class: Newton's 2nd Law Grav force

Forces and Motion

We saw that forces describe interactions between objects. The forces dictate the acceleration of the object. Schematically



Note that the net force does not determine velocity. It determines how velocity changes

We saw the skating dog exercises

net force 100N $\Rightarrow$ accel = 2.0 m/s²

total mass 50kg

This means that the velocity increases by 2.0 m/s² every second.

time	velocity	
0s	0m/s	← If at rest at initial moment.
1s	2m/s	↑ 2m/s
2s	4m/s	↑ 2m/s
3s	6m/s	↑ 2m/s
4s	8m/s	↑ 2m/s
5s	10m/s	↑ 2m/s
6s	12m/s	↑ 2m/s

same change for same force.

note a variety of velocities all for same force

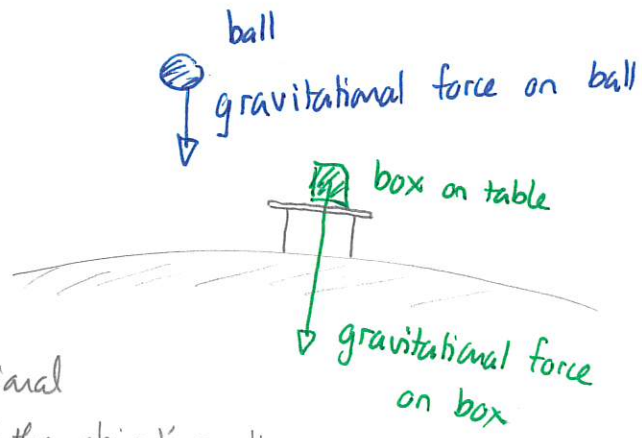
Quiz 1 80% - 100%

Weight / gravitational force

The bulk of the Earth always exerts a gravitational force on any object with mass.

Observations indicated

1) for any given object the gravitational force is (approximately) independent of the object's motion. It is never "off."
2) the gravitational force always points to Earth's center



Quiz 2 100%

Quiz 3 60% - 70%

DEMO: Spring / Mass ...

Near to Earth's surface the magnitude of the gravitational force can be determined by:

> Gravitational force (in Newtons) = mass (in kg) x 9.8 (in m/s^2)
>
> $W = F_{grav} = m \times 9.8$
>
> weight

We can apply this to free-fall motion. Here there is only one force and we can use this to determine facts about the object's acceleration.

Quiz 4

Here.

$$\text{acceleration} = \frac{\text{net force}}{\text{mass}} = \frac{\text{gravitational force}}{\text{mass}}$$

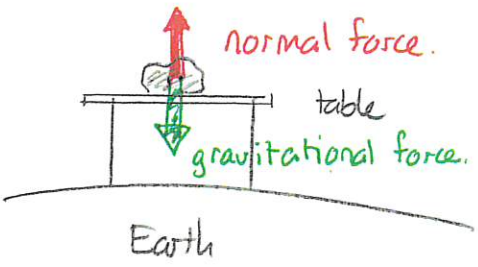
} stays constant

} stays constant

implies acceleration stays constant

Forces exerted by surfaces

Consider an object at rest on a table. We know that



1) the acceleration of the object is zero.
2) there is a gravitational force acting on the object.

Then we can reason that there must be another force acting on the object

accel = 0 ⇒ net force = 0 ⇒ must be a force to subtract. from grav. force.

This force must be exerted by the surface of the table, as a result of the contact with the table. This is called a normal force and

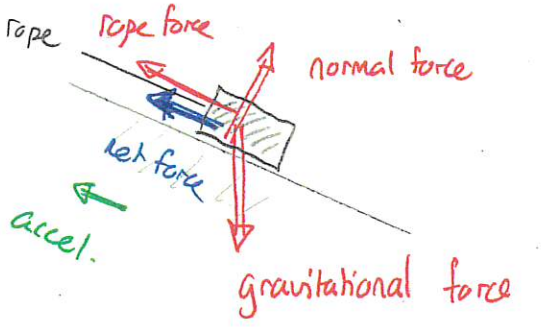
1) normal force is perpendicular to surface
2) magnitude of normal force adjusts to circumstances.

Quiz 45 ~~xx/xx/xxxx~~ 60–90%

General forces

In general Newton's mechanics requires

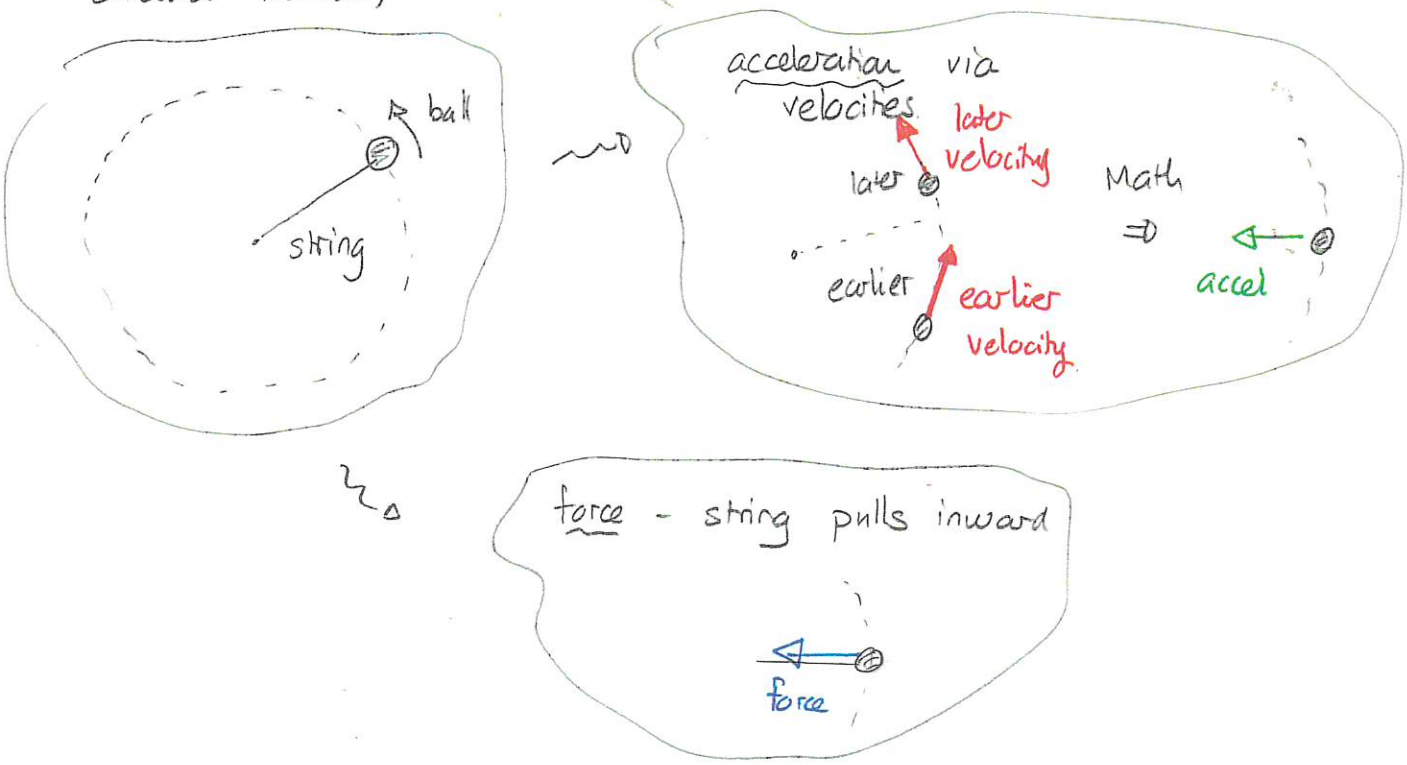
1) specification of forces
2) determining net force
3) determining acceleration



Demo: PhET ramp with crate

Circular motion

A special example of motion, and one which Newton originally consider is motion in a circle with constant speed (uniform circular motion)



Thus

> The acceleration of an object that moves with constant speed in a circle is not zero and points radially inward.