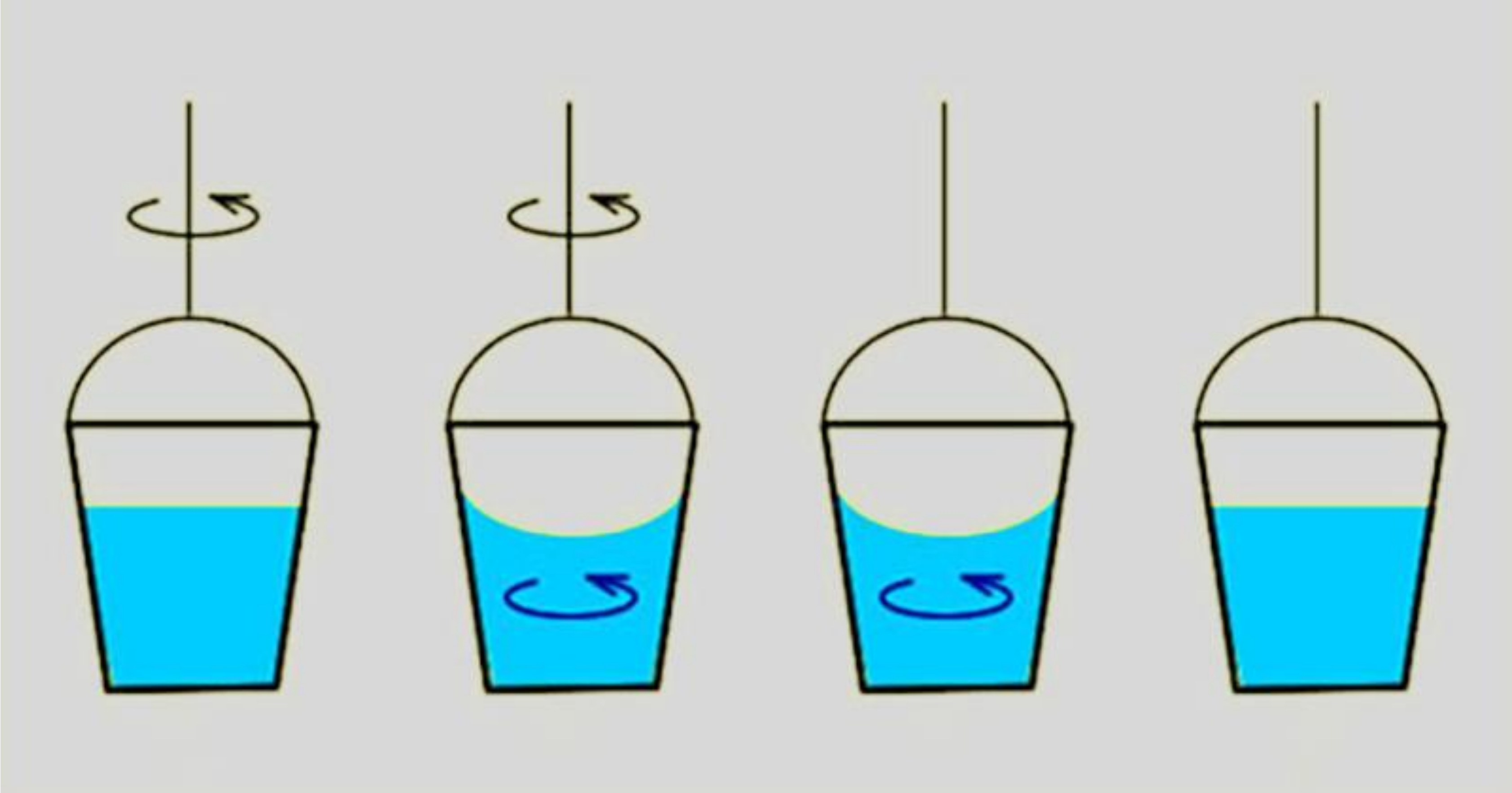
Imagine water in a bucket which can spin, and consider the following sequence of events.



If motion is relative, what is the water rotating with respect to?

Recap:

Prelecture Review: Galileo's Ship and Dynamics

Galileo's ship

4 languages

Article Talk

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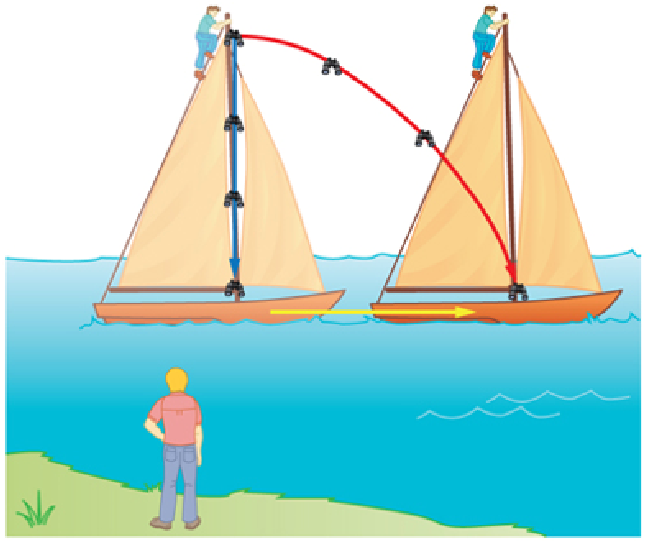
From Wikipedia, the free encyclopedia

Galileo's ship refers to two physics experiments, a thought experiment and an actual experiment, by Galileo Galilei, the 16th- and 17th-century physicist and astronomer. The experiments were created to argue the idea of a rotating Earth as opposed to a stationary Earth around which rotated the Sun, planets, and stars.

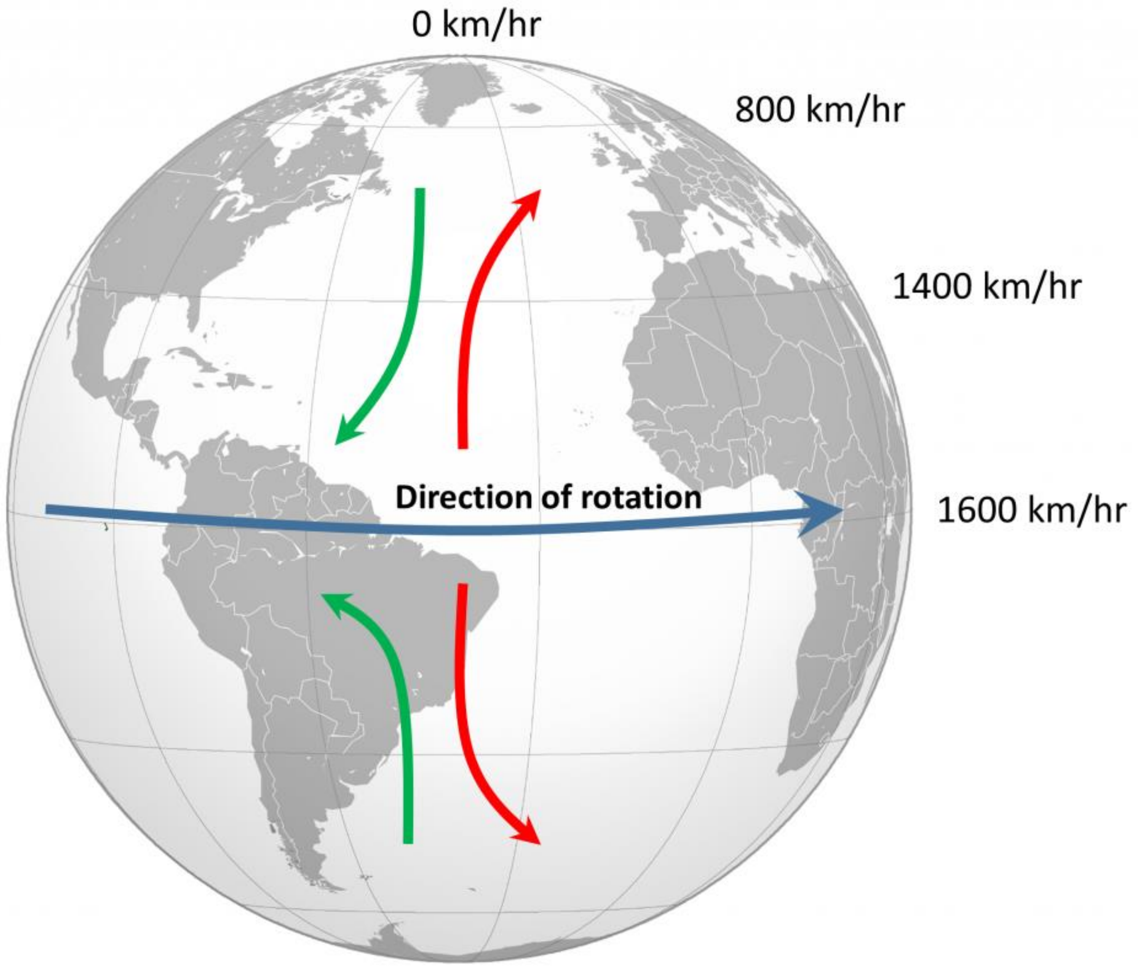
An argument that was used at the time was that if Earth were rotating, there would be detectable effects on the trajectories of projectiles or falling bodies.



What are our questions and/or comments?

Recap: Earth's Rotation and Coriolis Effect

- At Earth's equator, $v \approx 1{,}670\frac{km}{h} \approx 465\frac{m}{s}$
- The Earth's radius is $r \approx 6{,}378{,}000m$ so $a_c = \frac{v^2}{r} \approx .034\frac{m}{s^2}$
- But v depends on latitude!
- This causes the Coriolis effect!



Recap: My Comments and Questions

- Comment: This means that *velocity* is like *displacement* in the sense that only relative values make any sense.

Just as we set up a coordinate system for position by e.g. choosing an origin, we must set up a reference frame for velocity by choosing a constant velocity observer.

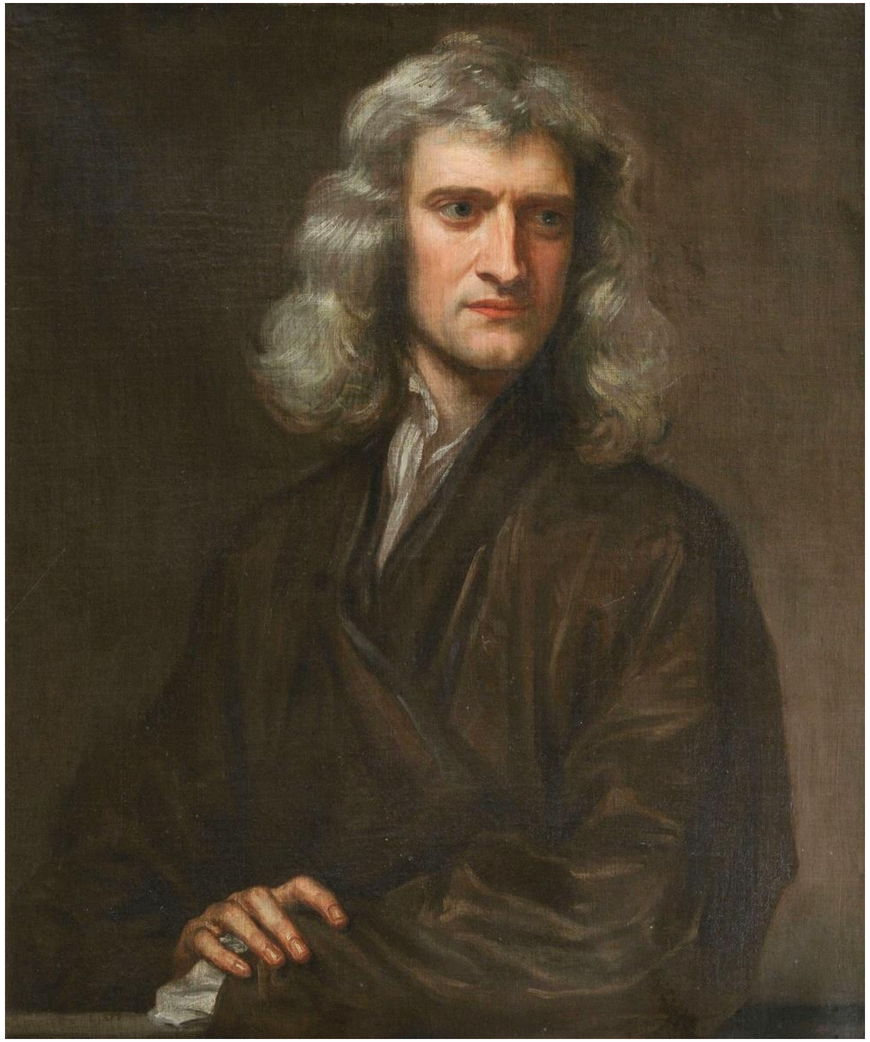
How do we know which observers are constant velocity? We’d feel it otherswise.

New Idea: The First Law of Motion

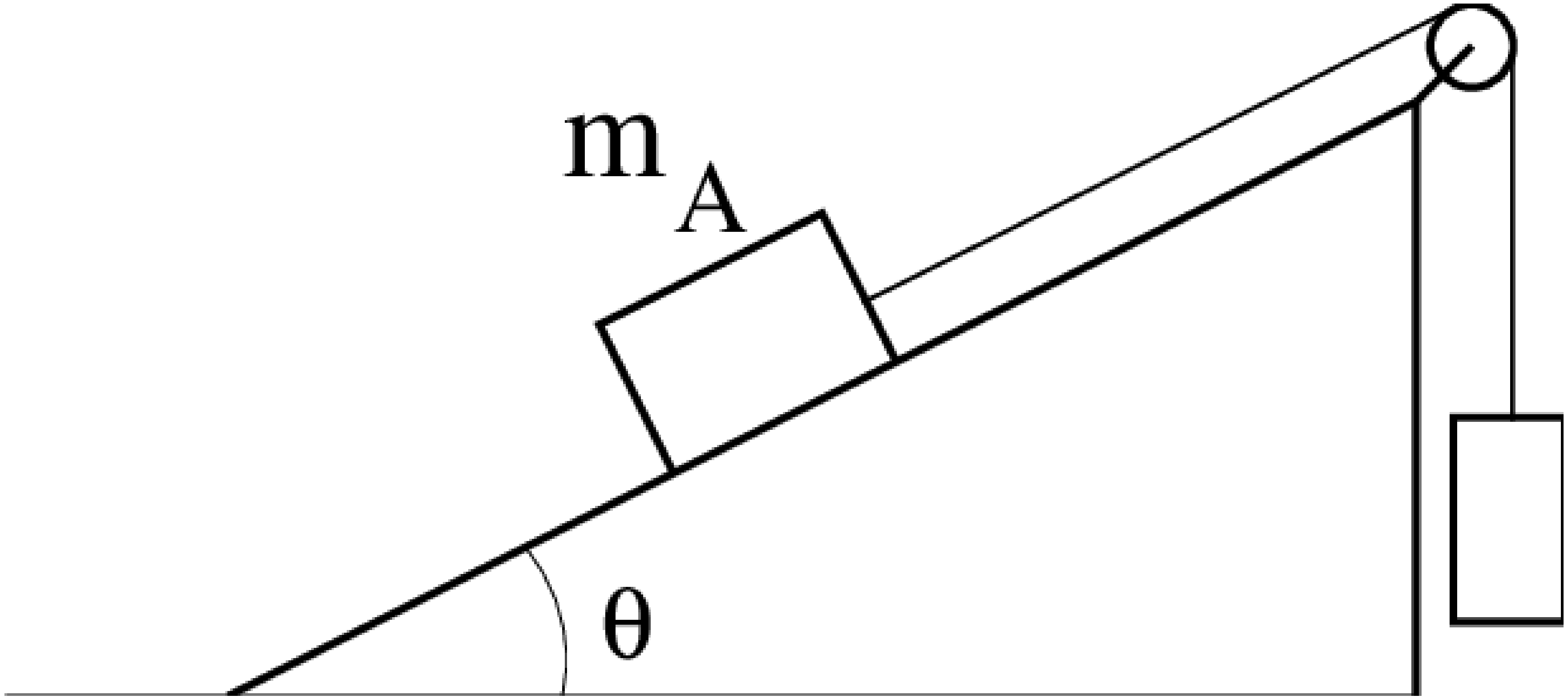
Translated from Latin, Newton's first law reads:

Every object perseveres in its state of rest, or of uniform motion in a right line, except insofar as it is compelled to change that state by forces impressed thereon.

(Compare with what we had said before about Static Conditions)

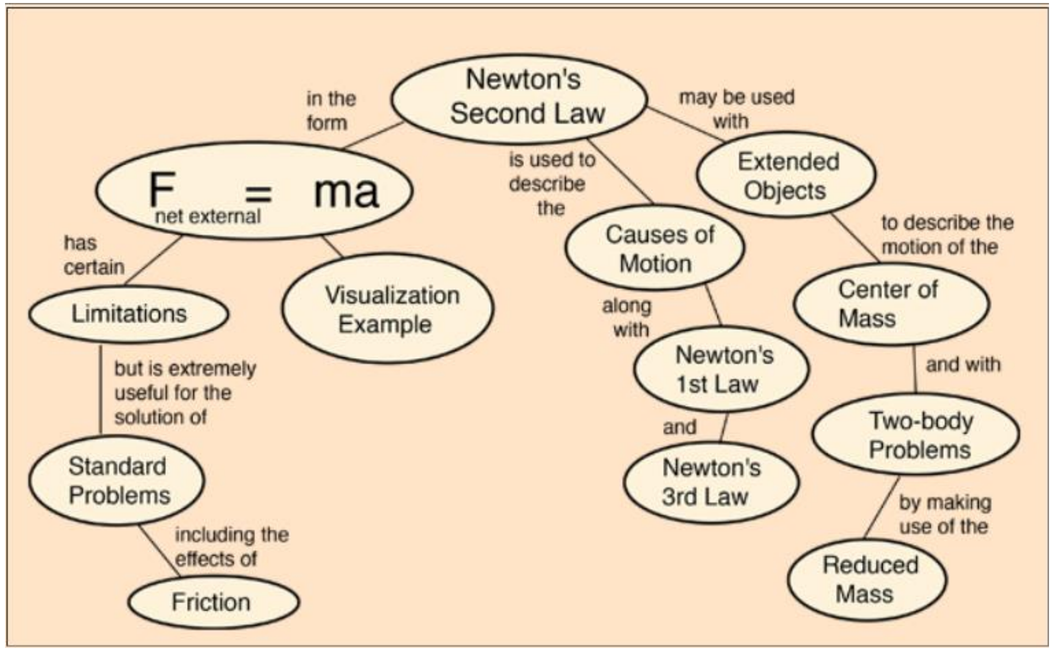


Concept Check: Imagine we see a snapshot picture of the following setup. We compute the forces and find they are all balanced.



What can we conclude about the motion of the block A?

Prelecture Review: Newton's Second Law and Determinism



"The change of motion of an object is proportional to the force impressed; and is made in the direction of the straight line in which the force is impressed."

$$F = \frac{d(mv)}{dt} = ma$$

Abstract

After briefly discussing the contributions of Copernicus, Kepler, and Galileo, the main contributions of Newton are presented. His major contributions, including the law of gravitation and the laws of motion, initiated the modern age of science. Newtonian laws painted a deterministic picture of the universe—if the location of all the objects in the universe and the forces acting upon them at a given time are known then the future can be predicted precisely. Newton's views on space and time are also presented. Most of these ideas were challenged by the modern theories of nature, namely the special and general theories of relativity and quantum mechanics.

What are our questions and/or comments?

Comments and Questions

- How do "fictional forces" we previously discussed factor into the second law?
- The idea that Newton's laws correspond with the ideas of determinism seems a little far fetched to me-just because I throw a ball and know where it will land does not mean that my throwing the ball was predetermined-I made the decision to throw it.
- It's kind of interesting how knowledge develops over time. A college student may very much well know more than Newton at least superficially, despite Newton being one of the most influential persons of the last millenium.
- I don't understand the second law of motion in like non-inertial frames of reference.

My Comments and Questions

- Comment: Newton argued that the a in $F = ma$ was compared with “absolute space”. This was not exactly correct but not entirely wrong either. The modern point of view is that it is in reference to the geometry of space (General Relativity)

Example: Atwood Machine

Let's say $m_1 = 10kg$ and $m_2 = 5kg$. What's the acceleration of the masses and what's the tension in the string connecting them?