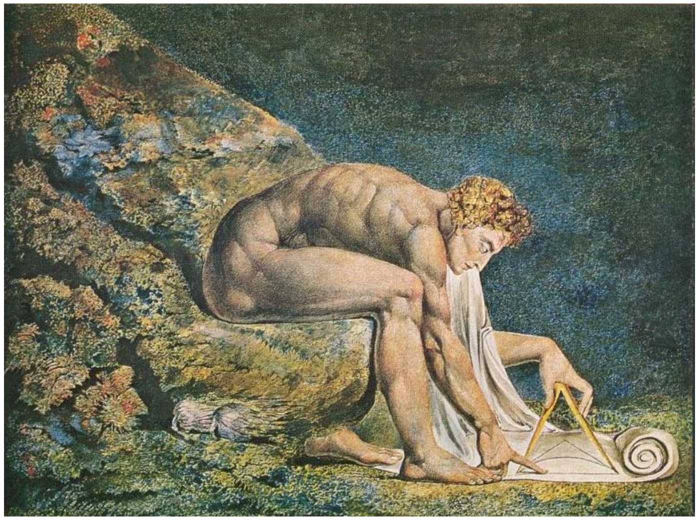
“If I have seen further it is by standing on the shoulders of giants.”



Newton, the “divine geometer”, by William Blake (1795)

“I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.”

Isaac Newton (1642 - 1727)

PHY100 - Some Reminders

- Homepage
  - → http://www.atmosp.physics.utoronto.ca/people/strong/phy100/phy100.html
- Portal/Blackboard
  - → I have activated the course on the Portal, but will be using the external homepage to provide course content
- Textbook
  - → *Physics: Concepts and Connections*, Fifth Edition, Art Hobson, Pearson Education (2010) – in the Bookstore
- Tutorials
  - → Begin this week: January 15, 16, 17
- Office hours: 3-4 PM Tuesdays and Thursdays

Tutorials

- Six groups / four time slots:

SECTION	DAY & TIME	DATES	ROOM	TUTOR
T0101	Tues, 12-1	Jan 15 – April 2	RW 142	Ben Mossbarger
T0102	Tues, 12-1	Jan 15 – April 2	LM 155	Alma Bardon
T0201	Weds, 12-1	Jan 16 – April 3	SS 2128	Rikki Landau
T0301	Weds, 1-2	Jan 16 – April 3	RW 142	Jaspreet Sahota
T0401	Thurs, 12-1	Jan 17 – April 4	RW 142	Yunsheng (Bob) Tian
T0402	Thurs, 12-1	Jan 17 – April 4	UC 177	Graham Edge

- Tutorial groups are capped at 33 students
- Last day to register on ROSI is January 20 but tutorials (and quizzes) start today
- Please enroll and attend this week!

NOTE-TAKING SERVICES: ONLINE!

Volunteering will be more convenient than ever before – a new online repository of notes that can be accessed 24 hrs a day, 7 days a week!

Accessibility Services requires dependable volunteer note-takers in this course to assist students with disabilities. Benefits of volunteering:

- The quality and consistency of your notes will improve
- Gain valuable (and useful!) experience
- Receive a certificate of recognition

Want to volunteer as a note-taker?
Volunteer with the service through the Accessibility Services website (http://www.accessibility.utoronto.ca/)
or review which courses have requests for note-takers at https://www.studentlife.utoronto.ca/accessibility/pcourselist.aspx
(You can also add your courses if they are not on the list, and you will be notified if your services are required.)
Currently a volunteer?
Log in to the new system at
https://www.studentlife.utoronto.ca/accessibility/vollogin.aspx

Contact as.notetaking@utoronto.ca if you have any questions, concerns, or require assistance.

Current Assignments ...

For today:

- Read Sections 4.1, 4.2, 4.3

For Lecture 4:

- Read Sections 4.4, 4.5, 5.1
- Note: Homework #1 will be assigned Jan. 17

Suggested Conceptual Exercises:

- Ch 4: 3, 5, 9, 11, 23, 25, 27, 33, 35, 37,39, 43

Attend your first tutorial this week

- There will be a weekly quiz, starting today!

Review of Lecture 2

Textbook, Sections 3.2, 3.3, 3.4, 3.5

- Galileo's Law of Falling
- Galileo's thought experiment: inclined plane
- The Law of Inertia (Newton's First Law)
- Kinematics: describing motion
  - → speed
  - → velocity
  - → acceleration

Plan for Lecture 3

Textbook, Sections 4.1, 4.2, 4.3

- Why do things move?
  - → Dynamics - relation between force and motion
- Force and acceleration
- Newton's Law of Motion (his Second Law)

Introduction

- Newton - one of the most influential men in history
- 1687 - “Philosophiæ Naturalis Principia Mathematica”
  - → one of most influential books in history of science
  - → laid groundwork for classical mechanics
  - → described universal gravitation & laws of motion
  - → dominated the scientific view of the physical universe for the next three centuries
  - → showed that the motions of objects are governed by a set of <u>natural laws</u>
  - → this had implications far beyond science

THE ROYAL SOCIETY

http://royalsociety.org/news.asp?id=3880

How Influential?

Latest press releases

Newton beats Einstein in polls of scientists and the public

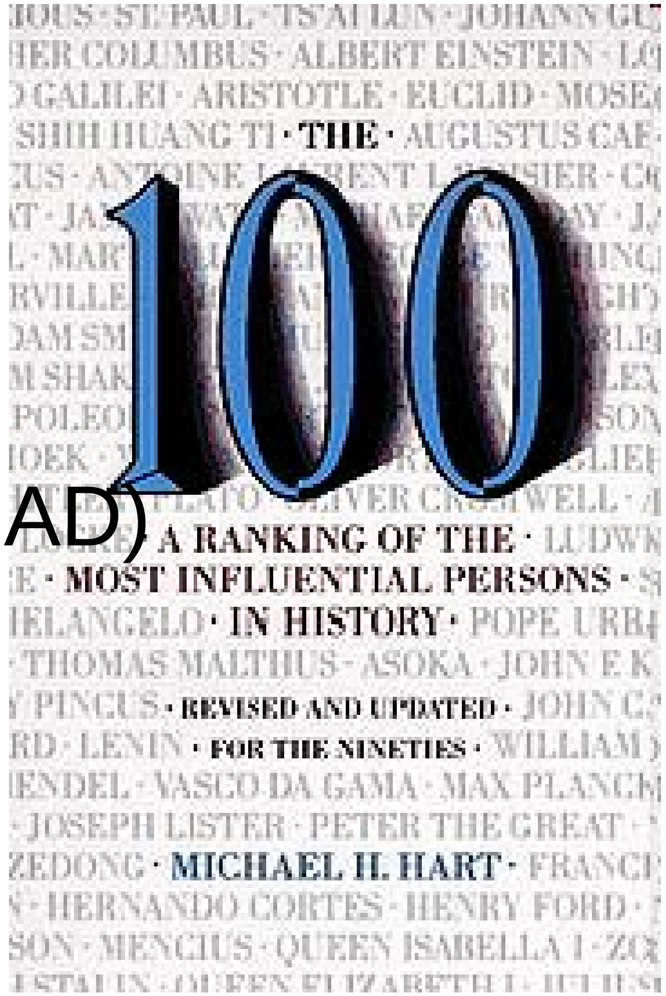
23 Nov 2005

The results showed Newton to be the winner on all counts, although opinion was much closer on the overall contribution to humankind. When asked who made the bigger overall contribution to science the public voted 61.8% for Newton and 38.2% for Einstein and the scientists voted 86.2% for Newton and 13.8% for Einstein.

When asked who made the bigger positive contribution to humankind the public voted extremely closely with 50.1% for Newton and 49.9% for Einstein and the scientists voted 60.9% for Newton and 39.1% for Einstein.

And Another Opinion...

1. Muhammad (570-632)
2. Isaac Newton (1643-1727)
3. Jesus Christ (7-2BC–26-36 AD)
4. Buddha (563-483 BC)
5. Confucius (551-479 BC)
6. St. Paul (5-67)
7. Ts'ai Lun (50-121)
8. Johannes Gutenberg (1398-1468)
9. Christopher Columbus (1451-1506)
10. Albert Einstein (1879-1955)



External Influences = Forces

The Law of Inertia, version 2

- An object subject to no external influences will be unaccelerated.

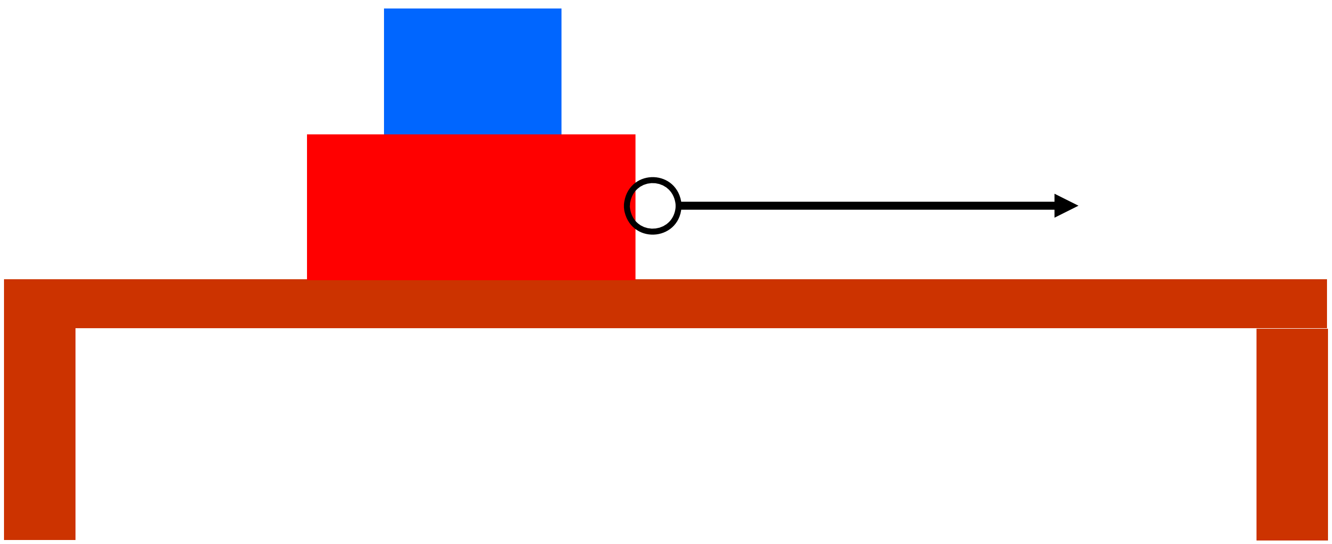
- Acceleration is caused by pushes and pulls
  → i.e, by forces

- A force is an action by one object on another
  → a force is not a thing

Let’s Try Some Experiments

What does friction do?

1. It always slows things down
2. It always speeds things up
3. It can do both



Can we have a force without acceleration?

1. Yes **if the forces cancel each other out**
2. No
3. Maybe - I'm not sure

Force and Acceleration - 1

Experimentation shows us:

- acceleration is proportional to force ($a \propto F$)
- a larger force results in larger acceleration

See Textbook, Figure 4.3

Force and Acceleration - 1

Experimentation shows us:

- acceleration is inversely proportional to mass ($a \propto 1/m$)
- same force produces a smaller acceleration of a greater mass

See Textbook, Figure 4.5

What Is Mass?

- Different objects have different amounts of resistance to acceleration - different amounts of inertia.
- The <u>mass</u> of an object is its amount of inertia.
  - → In the metric system, mass is measured in kilograms (kg).
- Inertia is not the same as weight – imagine being in space. Nothing has weight, but objects still have inertia – they will resist a pull or push.

Newton's Law of Motion (or Newton's Second Law)

$$\boxed{a = F / m}$$

In words: The acceleration of an object is equal to the force exerted on it divided by the mass of the object.

Note that I did not write: F = m a. Why not?

Newton's Law of Motion (or Newton's Second Law)

More generally: $\boxed{\boldsymbol{a = \text{net force} / m}}$

The <u>net force</u> is the sum or difference of all the forces acting on mass m.

And

The acceleration <u>is in the direction</u> of the net force.