

# Newton's Law of Motion

Physics 211  
Syracuse University, Physics 211 Spring 2017  
Walter Freeman

February 22, 2022

- Homework 3 due Friday
- You will get new groups in recitation tomorrow
- Exam misgrades/grade appeals: talk to your TA's
- I got a migraine on Friday and didn't get the check-in done :(
  - If you have any comments for me, please send them to me by email and I'll answer
  - I still owe you answers to the things you sent in last week; I'll do that today

## Clinic hours this week

My availability in the Physics Clinic is a bit limited this week because of other commitments.

You can find me in the Clinic:

- Today (Tuesday), 1:30-3:30 pm
- Wednesday, 2-4 pm
- Thursday, 9:45-10:30 am

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Brendan Parlee is a very experienced coach and will be helping people in the Physics Clinic **Thursday night, 5:15-7:00 pm**.

*Rational mechanics must be the science of the motions which result from any forces, and of the forces which are required for any motions, accurately propounded and demonstrated. For many things induce me to suspect, that all natural phenomena may depend upon some forces by which the particles of bodies are either drawn towards each other, and cohere, or repel and recede from each other: and these forces being hitherto unknown, philosophers have pursued their researches in vain. And I hope that the principles expounded in this work will afford some light, either to this mode of philosophizing, or to some mode which is more true.*

-Isaac Newton, *Philosophiae Naturalis Principia Mathematica* (1687), translated from the Latin by Whewell (1837)

*Mechanics involves figuring out how things move from knowing the forces that act on them, and figuring out what forces act on them if we know how they move. I suspect that all physical things involve things exerting forces on each other, and since we don't know what forces these are, nobody's been able to figure much out. Hopefully someone will read this book and figure this stuff out, either following my suspicion that it's all forces under the hood (**classical physics!**), or with some deeper understanding of nature (**quantum physics!**)*

-Isaac Newton, *Philosophiae Naturalis Principia Mathematica*, in modern English

## Summary from last time

- Forces: anything that pushes or pulls
- Forces cause accelerations:  $\sum \vec{F} = m\vec{a}$ 
  - If  $\sum \vec{F} = 0$ ,  $\vec{a} = 0$ : motion at a constant velocity
- Forces come in pairs: if A pushes on B, B pushes back on A
- It's the vector sum  $\sum \vec{F}$  that matters
- Draw force diagrams to keep all of this straight

# An important note

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- If two things don’t touch, or interact by gravity, electricity, etc., they don’t exchange forces
- “A force is something that can send you to the doctor”

# Questions from homework or last week's recitation?

Force is a vector; handle it like any other

One copy of Newton's second law in each direction (per object)

$$\vec{F} = m\vec{a} \rightarrow \begin{pmatrix} F_x = ma_x \\ F_y = ma_y \end{pmatrix}$$

# Forces in 2D (and 3D)

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“Ask physics the question, don't tell it the answer”

## Sample questions: dealing with two dimensions

A stone hangs from the roof of a car by a string; the car accelerates forward at  $3 \text{ m/s}^2$ .

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- What angle does the string make with the vertical?
- What is the tension in the string?

## Sample questions: dealing with two dimensions

A cart slides down a frictionless track elevated at angle  $\theta$ ; what is its acceleration?

## Sample questions: dealing with multiple objects

Two masses of  $m_1$  and  $m_2$  kg hang from a massless pulley on either side. How do they move?

## Sample questions: dealing with multiple objects

What if we put one object on a ramp and another object suspended from the table?

Nothing changes here – just follow the same procedure as always!

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