Newton's Law of Motion

Physics 211
Syracuse University, Physics 211 Spring 2015
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February 17, 2016

Announcements

- Homework 3 due tomorrow
- Regrade requests due tomorrow
- Exam 1 makeup/retake on Tuesday; same format as before (different questions)
- If you are happy with your grade, you don't have to come
- Extra credit assignment posted
- Review sessions:
  - Julian, Thursday 4-6, room 208
  - Me, Friday 2-4, location TBA

A problem-solving recipe (remember this!)

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"Ask physics the question, don't tell it the answer"

A sample problem (9:30)

A stack of three books sits on a table. Each book weighs 10 newtons. Draw a force diagram for each one, and calculate the size of all the forces.

(Your answer should match what you know about how this works!)

Sample questions

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

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- What is the tension in the string?

Sample questions

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

A new force: Friction

- Friction: stops two surfaces from sliding past each other
- Can either make things move or make things stop; opposes *relative* motion
- Two types:
  - Static friction: keeps two things that aren't sliding stuck together
  - Kinetic friction: opposes the relative motion of two things sliding

Coulomb's friction model

Friction is really complicated!

- Depends on details of surfaces, molecular forces, etc.
- No way to create a completely accurate general principle

There are a few general principles, though:

- Friction is higher if the normal force is higher
- Kinetic friction doesn't depend that much on the speed of travel

Simple model: often pretty close

- Friction depends on a property of the surfaces called the coefficient of friction μ
- Force of kinetic friction $= \mu_k F_N$
- Max force of static friction $= \mu_s F_N$

Coefficients of friction

TABLE 6.1 Coefficients of friction

Materials	Static μ_s	Kinetic μ_k	Rolling μ_r
Rubber on concrete	1.00	0.80	0.02
Steel on steel (dry)	0.80	0.60	0.002
Steel on steel (lubricated)	0.10	0.05	
Wood on wood	0.50	0.20	
Wood on snow	0.12	0.06	
Ice on ice	0.10	0.03	

Sample questions

A block slides down a track elevated at angle θ with μ_k known; what is its acceleration?

Sample questions

A block with mass m on a track is connected by a rope to a hanging weight of mass M. The coefficients of friction are μ_s and μ_k. What is the acceleration of both objects?