Physics 1a, Section 2

October 25, 2010

Second Quiz

- Was due 3 hours ago.

Problem Solving Hints: Normal Force and Friction

- suggested order:

  1) draw gravity and other fixed external forces (direction and magnitude are unambiguous)

  2) draw normal force (prevents interpenetration of objects)

  3) draw friction force (perpendicular to normal force)

- kinetic friction:

  $F = \mu_k N$

  direction opposite to relative velocity

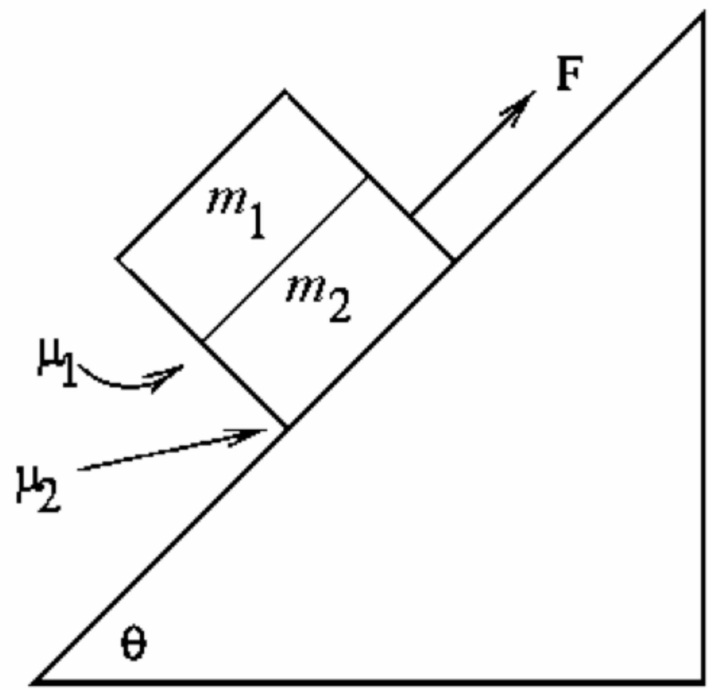
- static friction:

  $F \leq \mu_s N$

  direction and magnitude to prevent relative acceleration

Quiz Problem 11: static & kinetic friction

Upon an inclined plane of angle is placed a block of mass m_2. Upon m_2 is placed another block of mass m_1.
The coefficient of static friction between m_2 and the inclined plane is μ_{2s} and the coefficient of sliding friction is μ_{2k}.
Likewise, the coefficient of static friction between m_1 and m_2 is μ_{1s} and the coefficient of sliding friction is μ_{1k}.
A force F upward and parallel to the plane is applied to $m2$.



(**2 points**) (a) What is the acceleration of m_2 when m_1 just starts to slip on it?

(**2 points**) (b) What is the maximum value of F before this slipping takes place?

Quiz Problem 11

- Answer:

a) $a = g(\mu_{1s}\cos\theta - \sin\theta)$

b) $F = (m_1+m_2)g(\mu_{2k} + \mu_{1s})\cos\theta$

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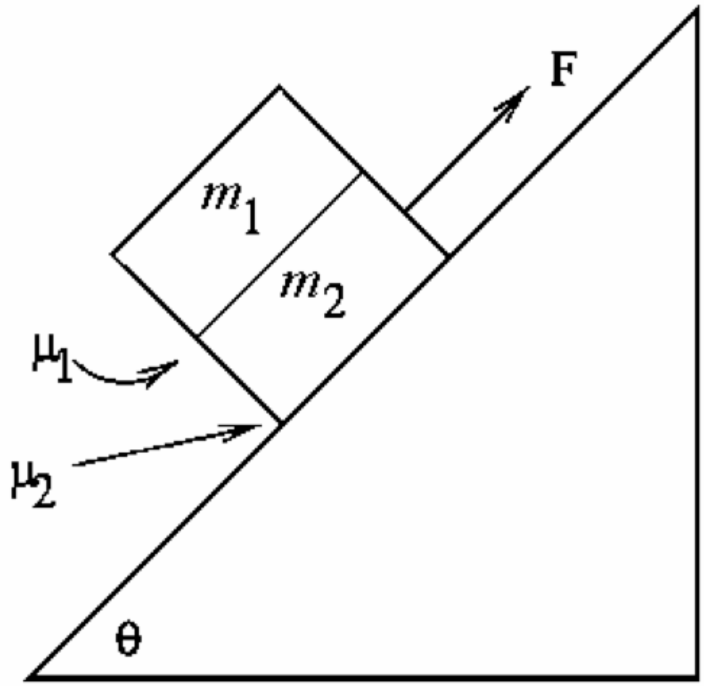

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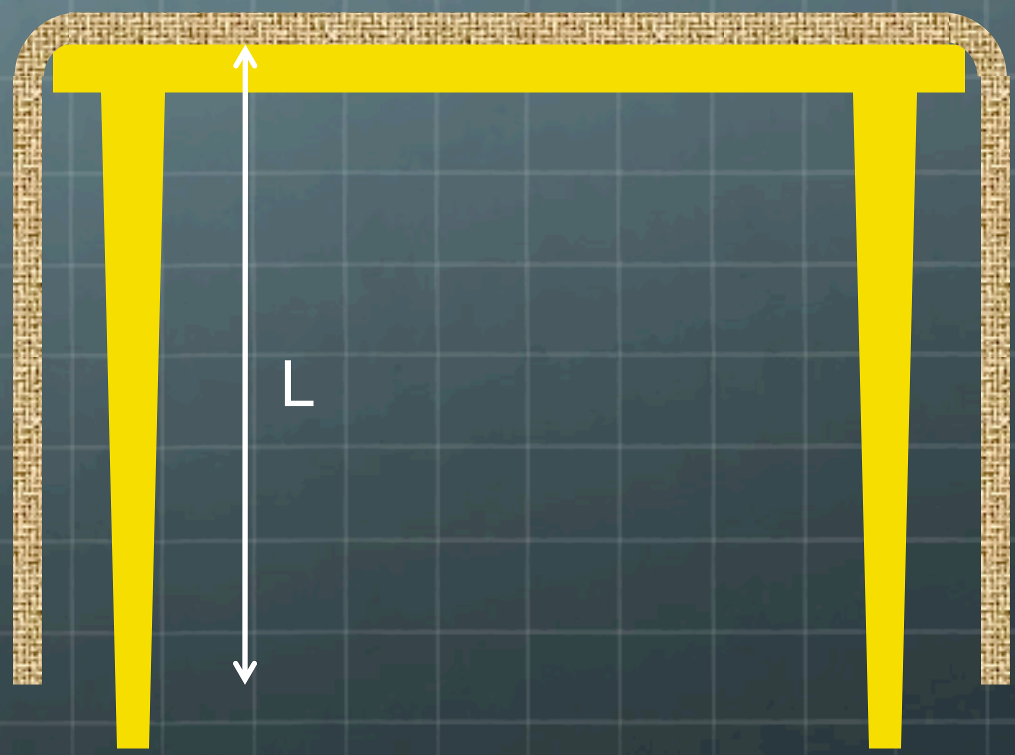
Tension in a Rope Draped over a Table

relevant for HW QP20

mass per unit length ρ



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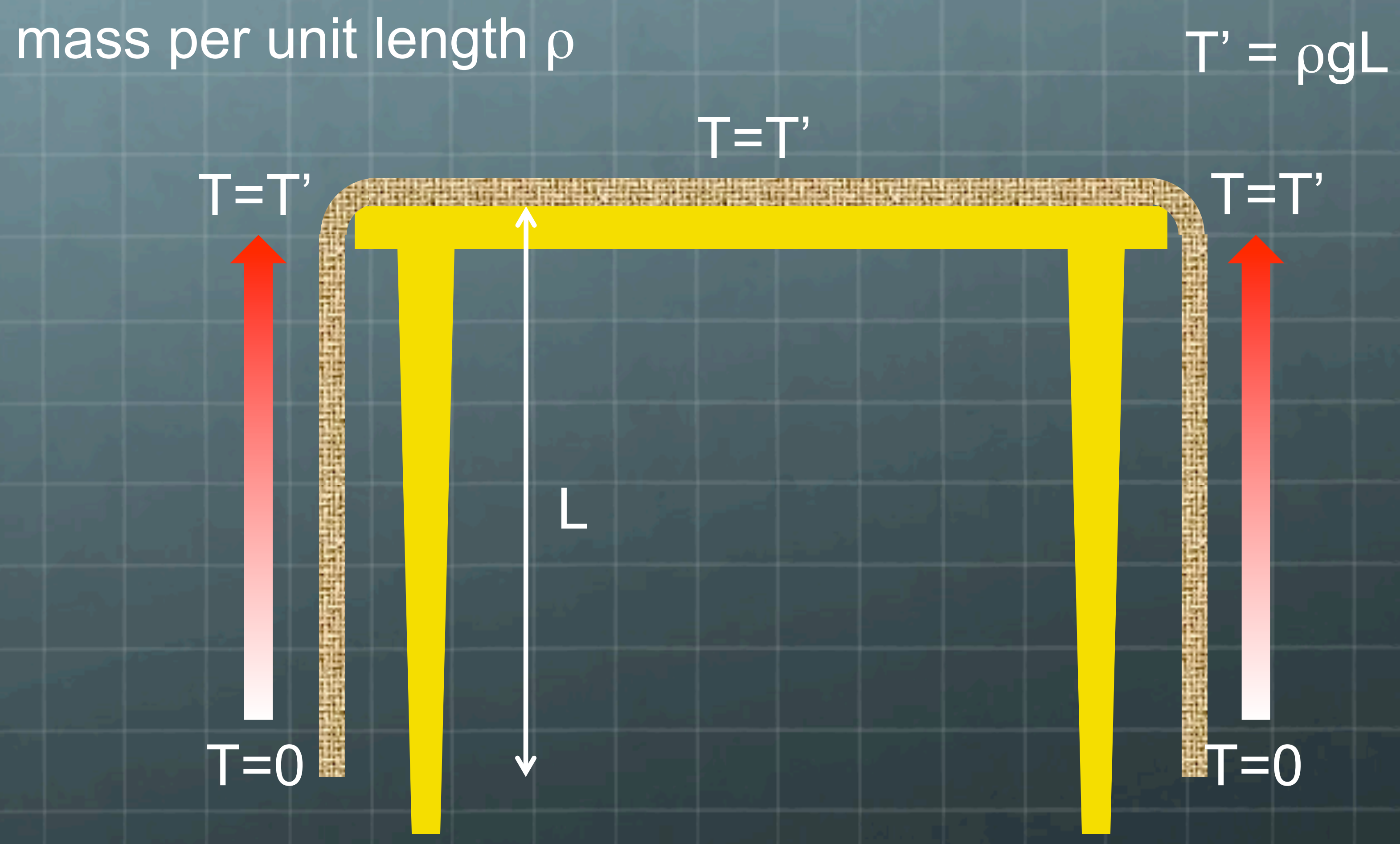
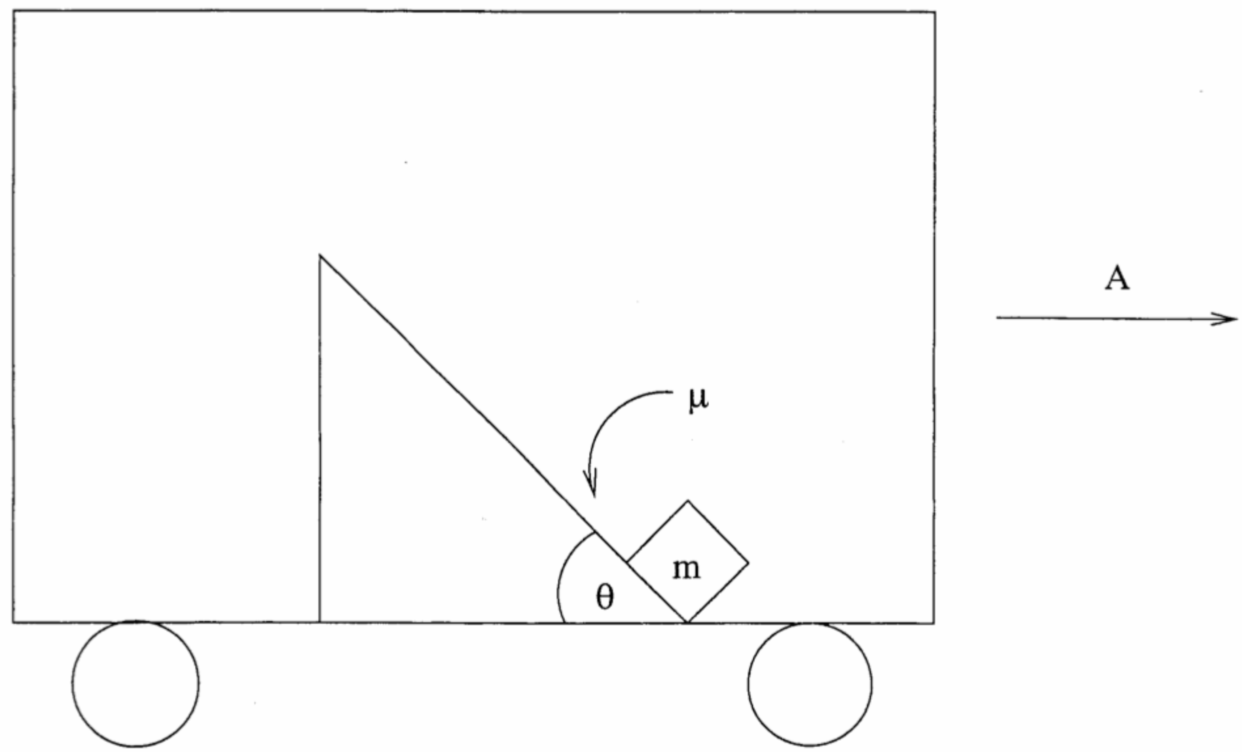


Fictitious (Inertial) Forces

- Accelerating (non-inertial) frames:
  - Linear acceleration:
    - Fictitous force ma opposite direction of acceleration
  - Rotating frame:
    - Fictitious force $m\omega^2 r$ outward
    - (If an object is moving with respect to the rotating frame, there is also a fictitious Coriolis force on it.)
- Why introduce fictitious forces and work in non-inertial frame?
  - Often simplifies solution of the problem.

Quiz Problem 29

A block of mass m sits on the bottom of an inclined plane of angle θ and friction μ. The whole assembly is inside a car, and the incline is fixed to the car's floor. Throughout the problem, assume the block remains in contact with the incline.



(a) **(1 point)** The car takes off with acceleration A to the right. Describe the ficticious force needed in the rest frame of the car. What is its magnitude and direction on the block?

(b) **(2 points)** Assuming the block begins to move up the incline, draw a force diagram and write down Newton's laws.

(c) **(3 points)** Solve for the acceleration of the block up the incline, in terms of A, θ, μ and g. If $A = 2g$ and the coefficient of friction $\mu = 0.5$, what is the condition on θ so that the block will indeed move up the incline?

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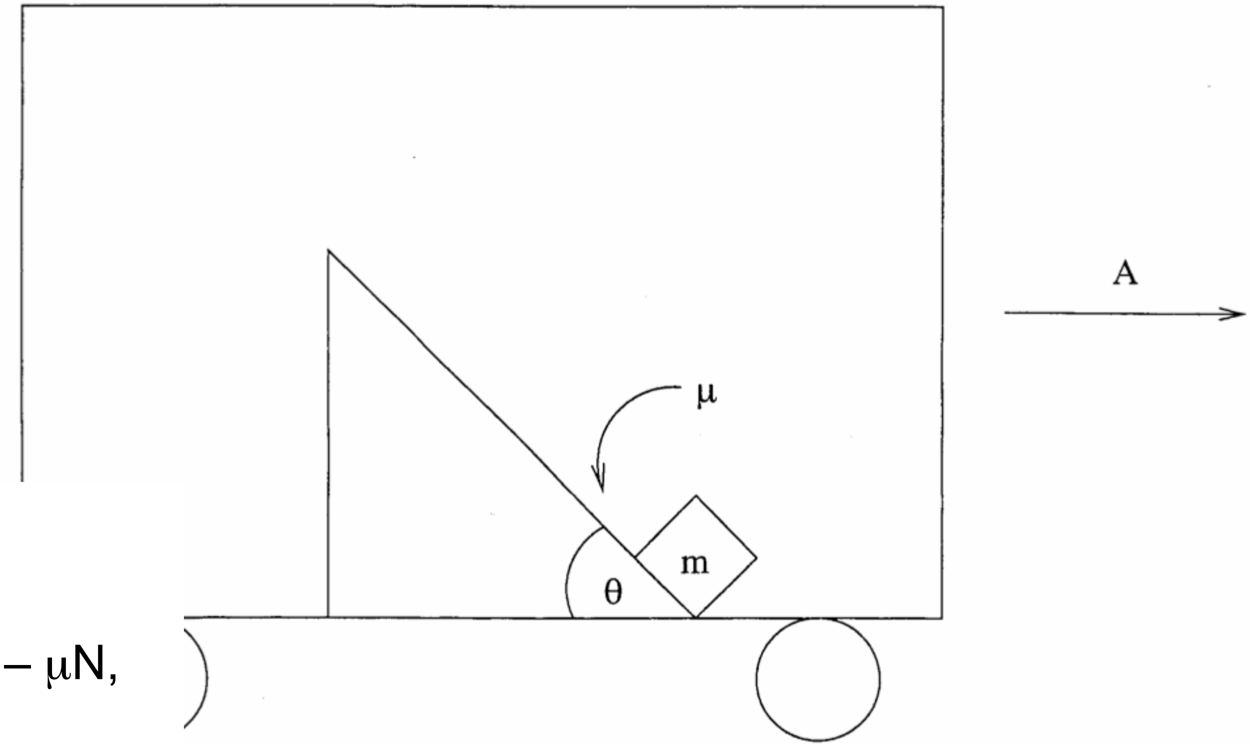

- Answer:

a) mA to the left

b) $ma = mA\cos\theta - mg\sin\theta - \mu N$, $N = m(A\sin\theta + g\cos\theta)$

c) $a = A(\cos\theta - \mu\sin\theta) - g(\mu\cos\theta + \sin\theta)$; $\theta < 37°$

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Homework due Wednesday

- I think the intention is for you to work these problems in *non*-inertial frames with fictitious forces:
  - QP21
  - QP28
- but they can be solved without that.
- Good practice to try in non-inertial frame.

Thursday, October 28:

- Quiz Problem 49 (springs)
- Quiz Problem 50 (energy)

- *Optional, but helpful, to try these in advance.*