# Physics 1A, Section 6

October 27, 2008

# Section Business

- Section 6 for Monday, Nov. 3 is ***canceled***.
  - Visit another section if you wish.
  - Office hour for Nov. 4 is unchanged.

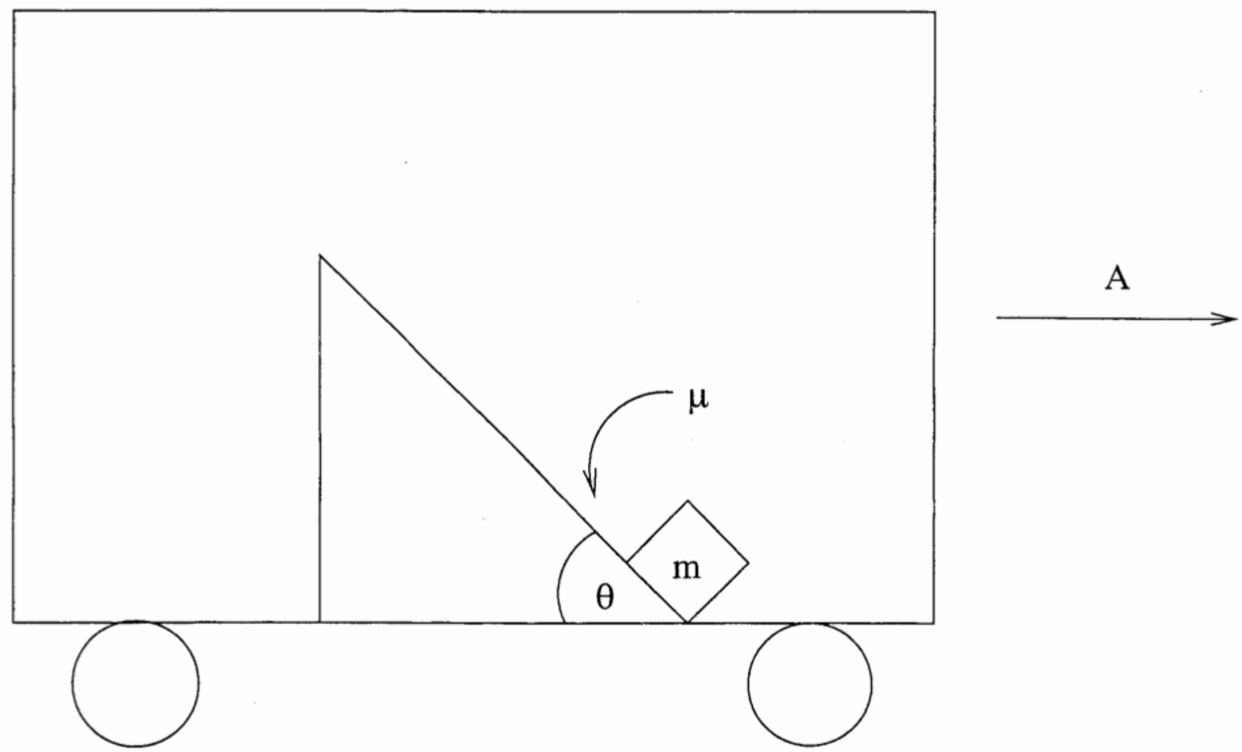
- Homework due Wednesday:
  - Consider solving problems QP21 and QP28 in *non-inertial frames with pseudoforces*.

# Week 4 Reading/Lecture Recap

- T.M.U. chapters 8-9 + lectures:
  - gravity: $F = GM_1M_2/r^2$, always attractive
  - electric charges: $F = K_e q_1 q_2/r^2$, attractive or repulsive
  - springs: $\mathbf{F} \approx -k\mathbf{x}$
  - normal forces
  - kinetic friction: $F \approx \mu_k N$, opposes relative velocity
  - static friction: $F \leq \mu_s N$, opposes relative acceleration
  - viscous force: $\mathbf{F} \approx -K\eta\mathbf{v}$
  - pseudoforce in linearly accelerating frame: $-m\mathbf{a_0}$
  - pseudoforce in rotating frame: $m\omega^2 r$ outward
    - There is also a Coriolis force on moving objects (Chapter 14).

# Quiz Problem 29

A block of mass $m$ sits on the bottom of an inclined plane of angle $\theta$ and friction $\mu$. 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 $A$, $\theta$, $\mu$ and $g$. If $A = 2g$ and the coefficient of friction $\mu = 0.5$, what is the condition on $\theta$ so that the block will indeed move up the incline?

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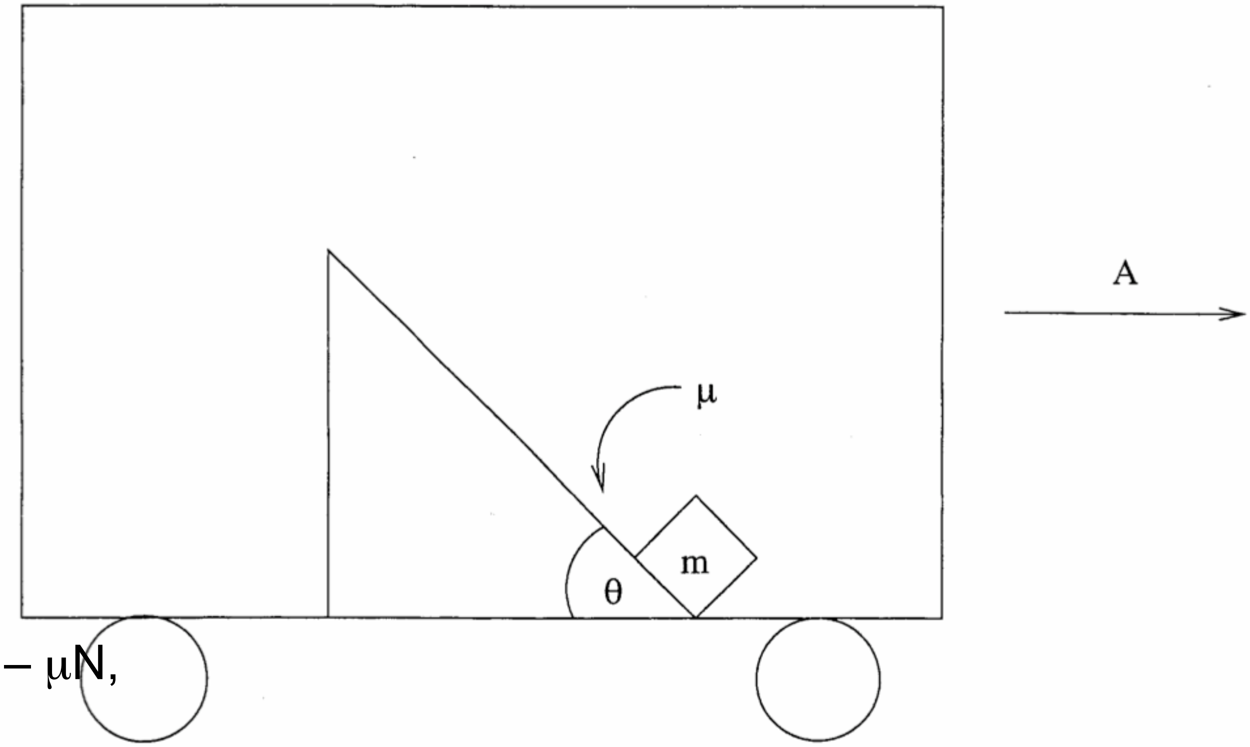


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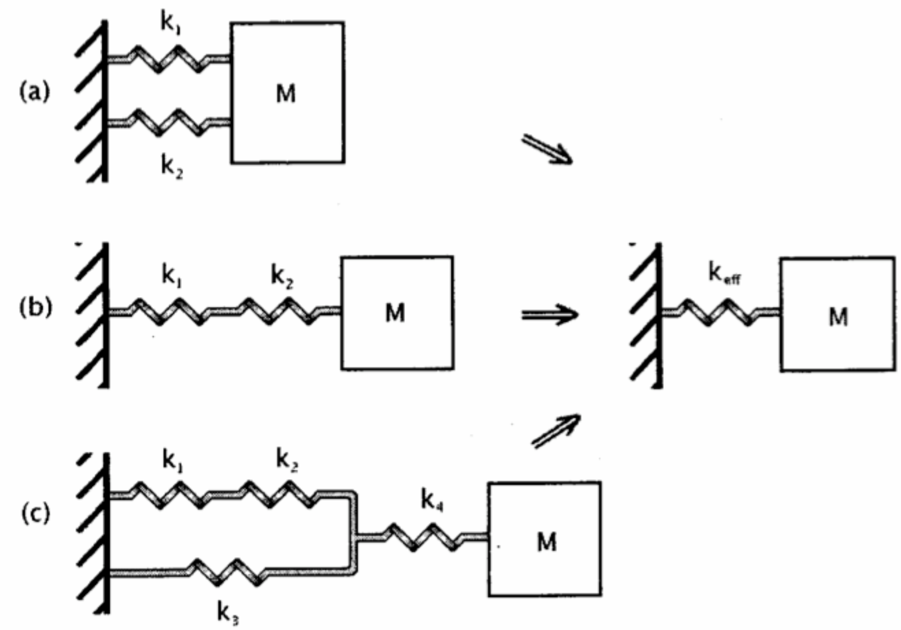
- Answer:

a) $mA$ to the left

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

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

# Quiz Problem 49




The restoring force on a spring is governed by Hooke's Law, $F = -kx$. Springs are linear devices, so any combination of springs can be modelled as a single spring with an effective spring constant $F = -k_{\text{eff}}x$. Refer to the diagram for parts (a), (b), and (c). Your final answers will not depend on $M$.

**(a)** **(2 points)** Derive the relation between $k_1$, $k_2$, and $k_{\text{eff}}$ for springs attached in parallel. You should find:

$$k_{\text{eff}} = k_1 + k_2 \tag{1}$$

**(b)** **(3 points)** Derive the relation between $k_1$, $k_2$, and $k_{\text{eff}}$ for springs attached in series. You should find:

$$\frac{1}{k_{\text{eff}}} = \frac{1}{k_1} + \frac{1}{k_2} \tag{2}$$

Hint: Consider the balance of forces at the junction of the two springs.

**(c)** **(2 points)** Find $k_{\text{eff}}$ for the illustrated system. The springs are attached by rigid rods and do not bend.

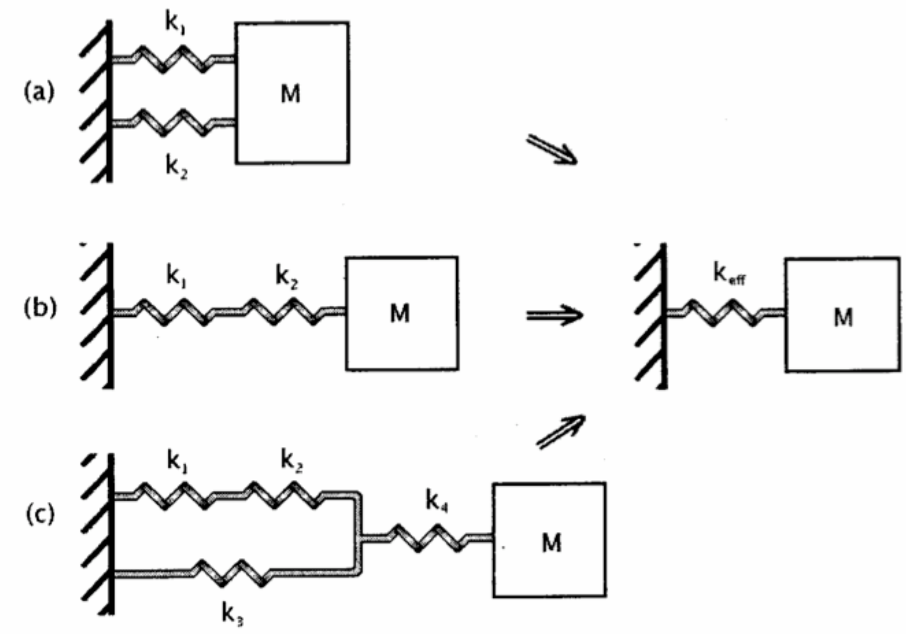
# Quiz Problem 49

- Answer:

a)

b)

c) $\{[k_3 + (k_1^{-1} + k_2^{-1})^{-1}]^{-1} + k_4^{-1}\}^{-1}$

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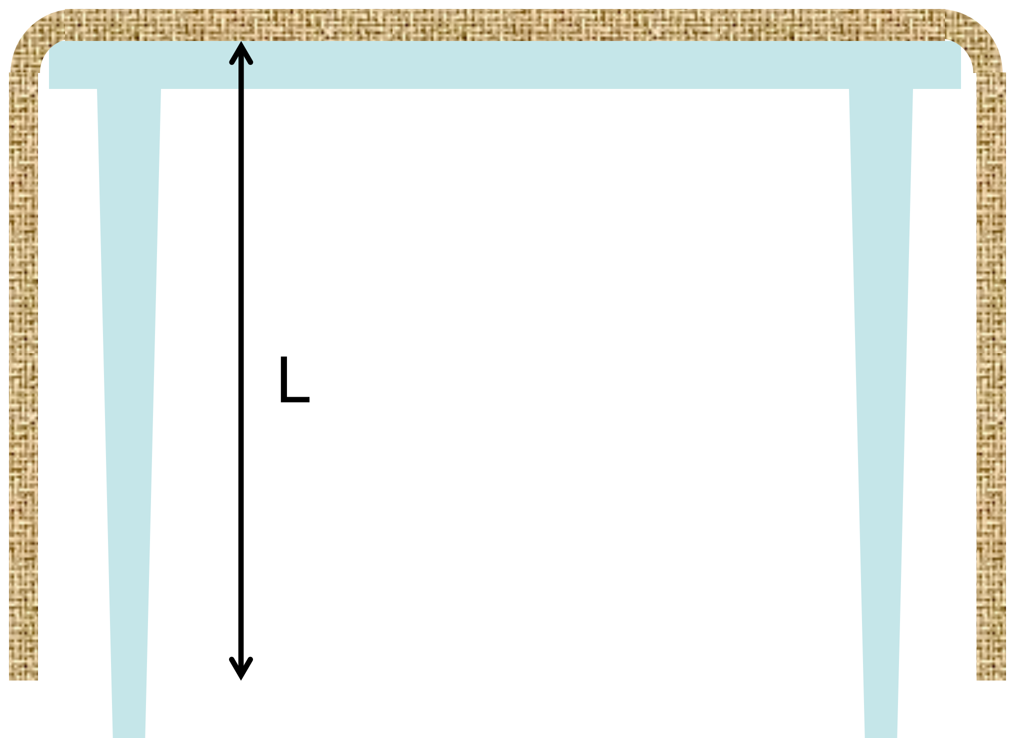
# Tension in a Rope Draped over a Table

mass per unit length $\rho$



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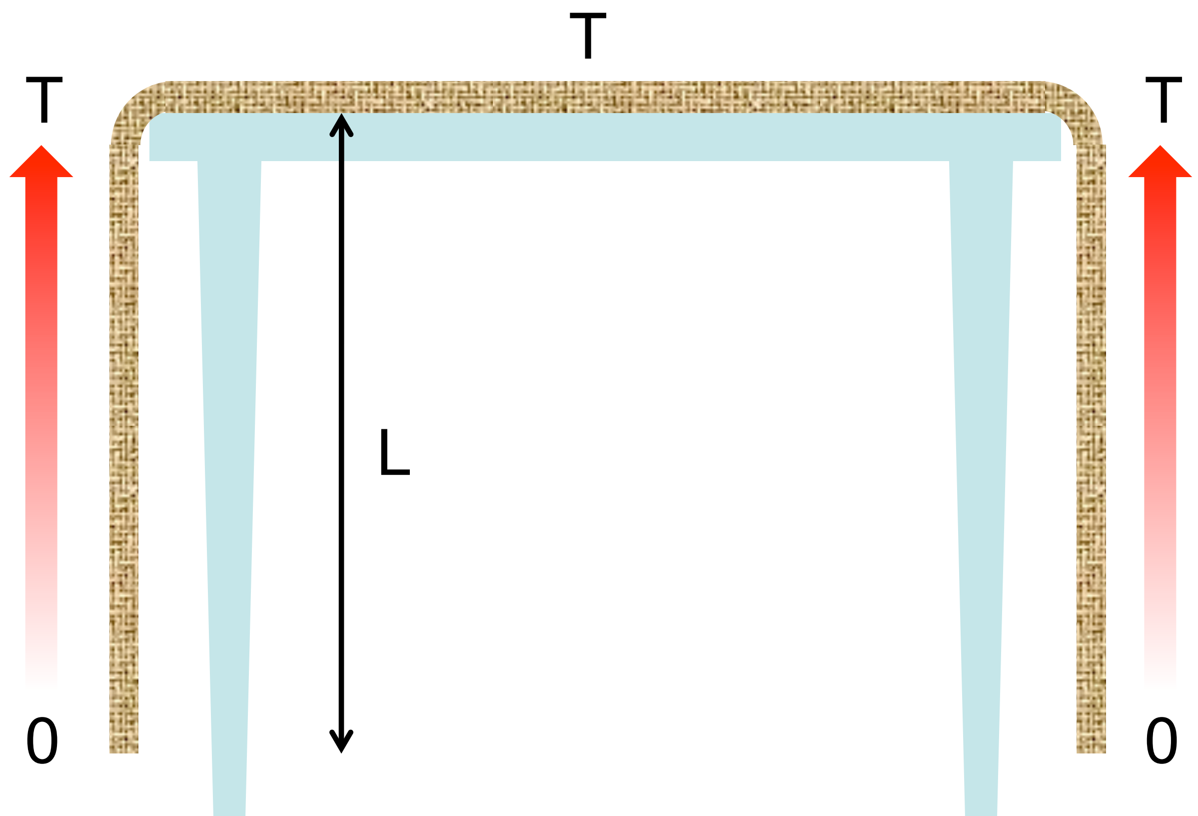
$T = \rho g L$



# Thursday, October 30:

- Quiz Problem 50 (energy and work)
- something about potential energy

- *Optional, but helpful, to look at these in advance.*