Physics 1A, Section 2

October 14, 2010

Frautschi, Problem 6.4

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- Answer: Equal force; acceleration greater for bug

Frautschi, Problem 6.1

1. Suppose you have two identical cans, one filled with lead and the other empty, which are in an orbiting spacecraft where everything is weightless. How can you tell which can is empty without looking inside?

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- Answer: Accelerate equally, and compare the force required.

Frautschi, Problem 6.5

5. Discuss whether the following pairs of forces are action–reaction forces:

(a) An athlete standing on a scale pushes down on it; the scale pushes up on the athlete.

(b) The earth attracts a stone; the stone attracts the earth.

(c) The tires of a car push on the road; the earth pulls down on the tires.

(d) A chair pushes down on the floor; gravity pulls down on the chair.

Frautschi, Problem 6.5

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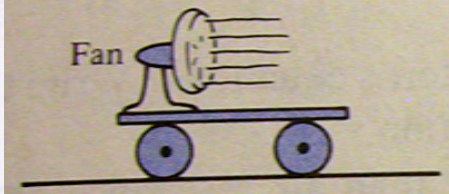
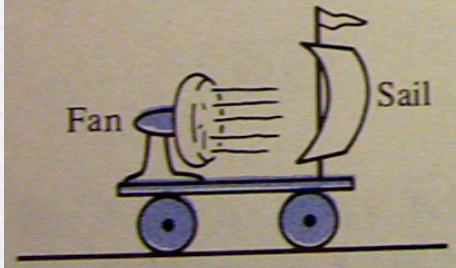
- Answer: (a) and (b) are reaction pairs; (c) and (d) are not

Frautschi, Problem 6.6

6. A fan is mounted on a cart as shown below. If the fan is turned on, does the cart move? If so, in which direction?



Suppose a sail were added to the cart. What would be the motion of the cart if the fan were now turned on?



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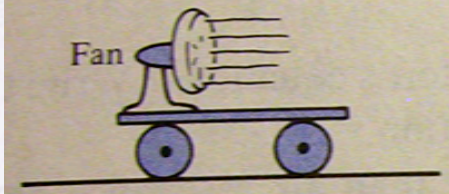

accelerates to the left

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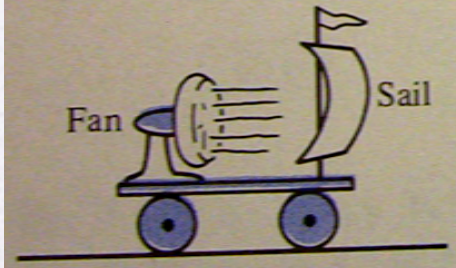


doesn't accelerate

Frautschi, Problem 6.3

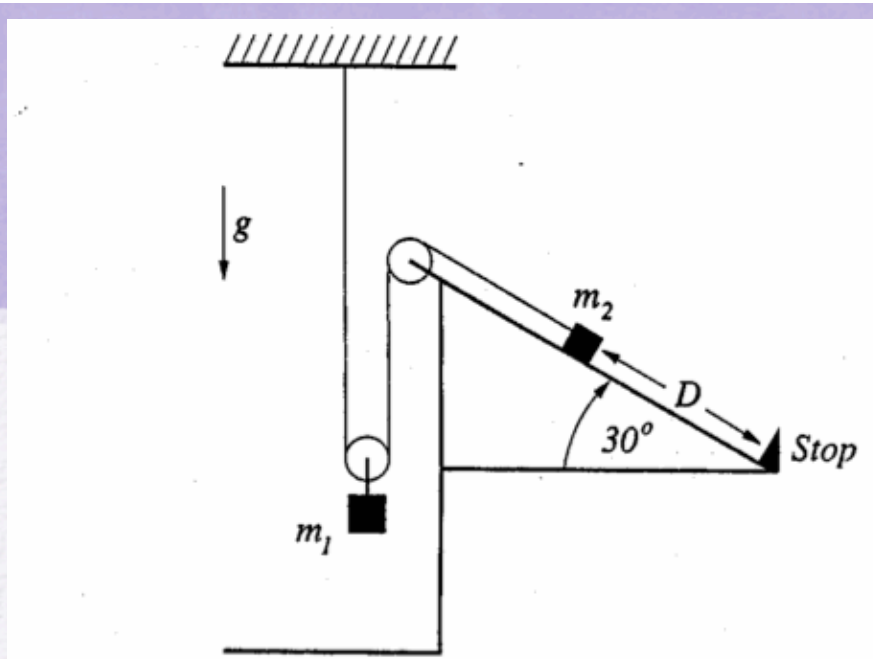
3. A train consisting of an engine and three boxcars moves down the track with a constant acceleration. Between which two cars is the tension in the coupling the greatest? the least? why? If the boxcars have equal mass, what are the ratios among the tensions between the three cars?

Frautschi, Problem 6.3

3. A train consisting of an engine and three boxcars moves down the track with a constant acceleration. Between which two cars is the tension in the coupling the greatest? the least? why? If the boxcars have equal mass, what are the ratios among the tensions between the three cars?

- Answer: Tension greatest between engine and front boxcar. Tension is **3ma**, **2ma**, **ma** from front to back.

Final Problem 9



Two masses are connected by a string as shown. m_2 slides without friction on a fixed incline at an angle of 30° with respect to the horizontal. Neglect the mass and friction of the pulleys, and the mass of the string.

(a) (2 points) Find the ratio of the masses m_2/m_1 such that the masses will remain stationary, if they are initially at rest.

(b) (1 points) If the mass m_2 moves a small distance ΔD_2 along the incline, find the distance ΔD_1 that the mass m_1 moves.

(c) (3 points) If $m_2 = 2m_1$, and the masses are initially at rest as shown, find the acceleration of m_2.

(d) (3 points) If m_2 slides a distance D down the incline before encountering the stop at the bottom, what are the speeds of m_2 and m_1 just before encountering the stop.

(e) (1 point) When the moments of inertia of the pulleys are taken into account, do the speeds of the masses in part (d) increase, decrease, or remain the same?

Helpful hints

- Free body diagrams – a good start.
- Be consistent with signs.
- massless strings – tension is constant along the free length
- frictionless/massless pulleys – rope tension is constant over the pulley

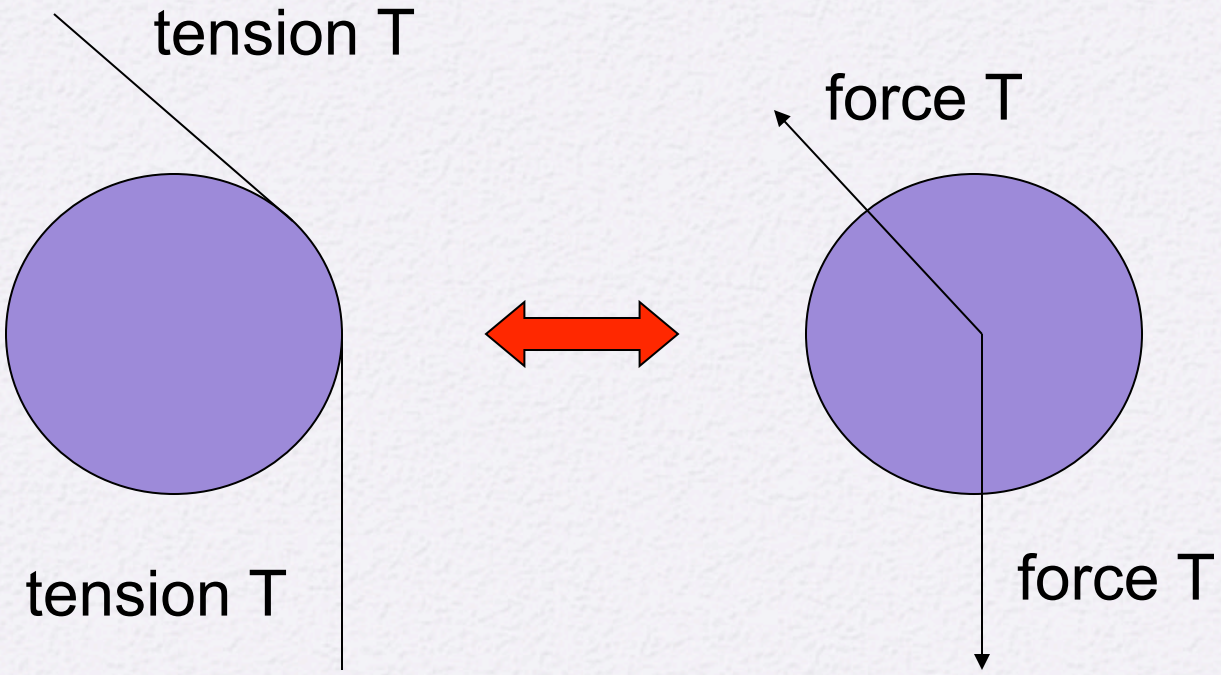
Pulley

**55. A flexible massless rope is placed over a cylinder of radius R. A tension T is applied to each end of the rope, which remains stationary (see Fig. 5.56). Show that each small segment $d\theta$ of the rope in contact with the cylinder pushes against the cylinder with a force $T\,d\theta$ in the radial direction. By integration of the forces exerted by all the small segments, show that the net vertical force on the cylinder is $2T$ and the net horizontal force is zero.

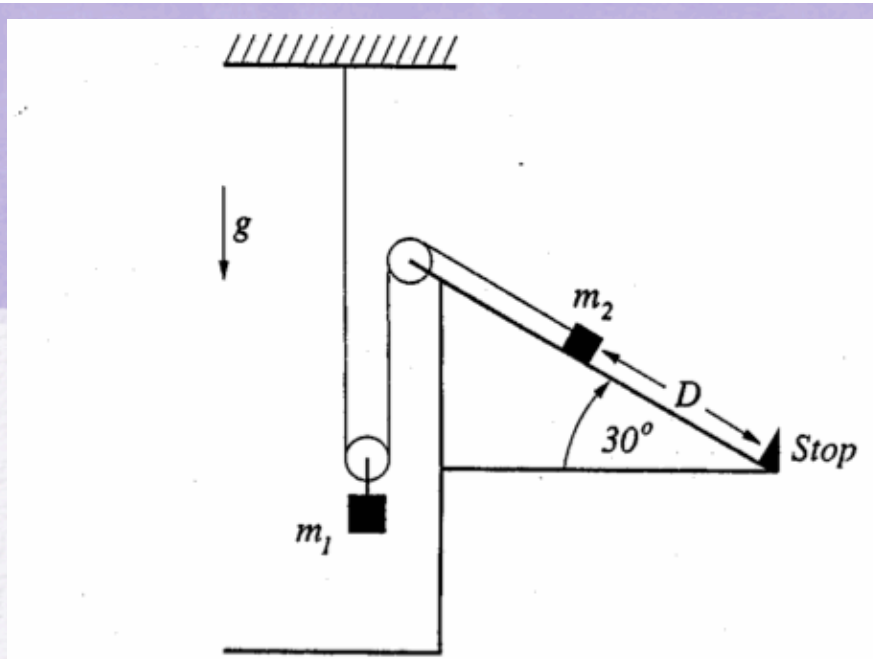
FIGURE 5.56 Rope and cylinder.

Pulley

- Answer in more general case:



Final Problem 9



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- Answer:
  - a) $m_2/m_1 = 1$
  - β) $\Delta D_1 = \Delta D_2/2$
  - c) $a_2 = 2g/9$
  - d) $v_2 = 2/3\ (gD)^{1/2}$, $v_1 = 1/3\ (gD)^{1/2}$
  - e) decrease

Monday, October 18:

- a gravity/circular orbit problem of some sort
- Quiz Problem 37

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

Frautschi, Problem 6.2

2. What physical principles are behind the reasoning for making wrecking cranes with massive weights at the end of a cable?