Classical Mechanics
Lecture 6

Today's Concept:

Friction

Your "Lecture Thoughts"

	Answer
	I found that Sherlock's method of deduction helped for some of the multiple choice questions.
	How is the angle of the y-component of the gravitational force equivalent to the angle of the ramp? I've learned thi before but never quite understood geometrically why. I've been told that it just is, but would like to know how.
	The blocks and pulley question was aiight, but I would like to quickly go over this in class with some steps. Thank you for reading this comment. Goodbye.
	Why does the force of friction point towards the center of the circle in circular motion? Shouldn't the friction be opposing the direction of motion?
	Becoming a sleepless zombie makes it difficult to keep up with work, but I am persisting through because it will better my future supposedly.
	Question 1 on the pre-lecture. I also want to go over a question similar to the car rounding the corner, but with a car rounding a corner with an elevation.

Stuff you asked about:

It might be good to go into more detail about when to use static or kinetic friction for the example of the car going around the circle. It would be easy in future examples to mistakenly use kinetic friction when static friction is called for.

I would like to see how to solve a system with multiply pulleys hanging off a table with a mass in the middle, with and without friction.

Im getting confused when the forces are in the x and y direction. How do you compare them when finding the net force.

tension questions with things pulling on both ends are difficult for me, especially when trying to find out what the tension is or using some other net forces to find out what tension is

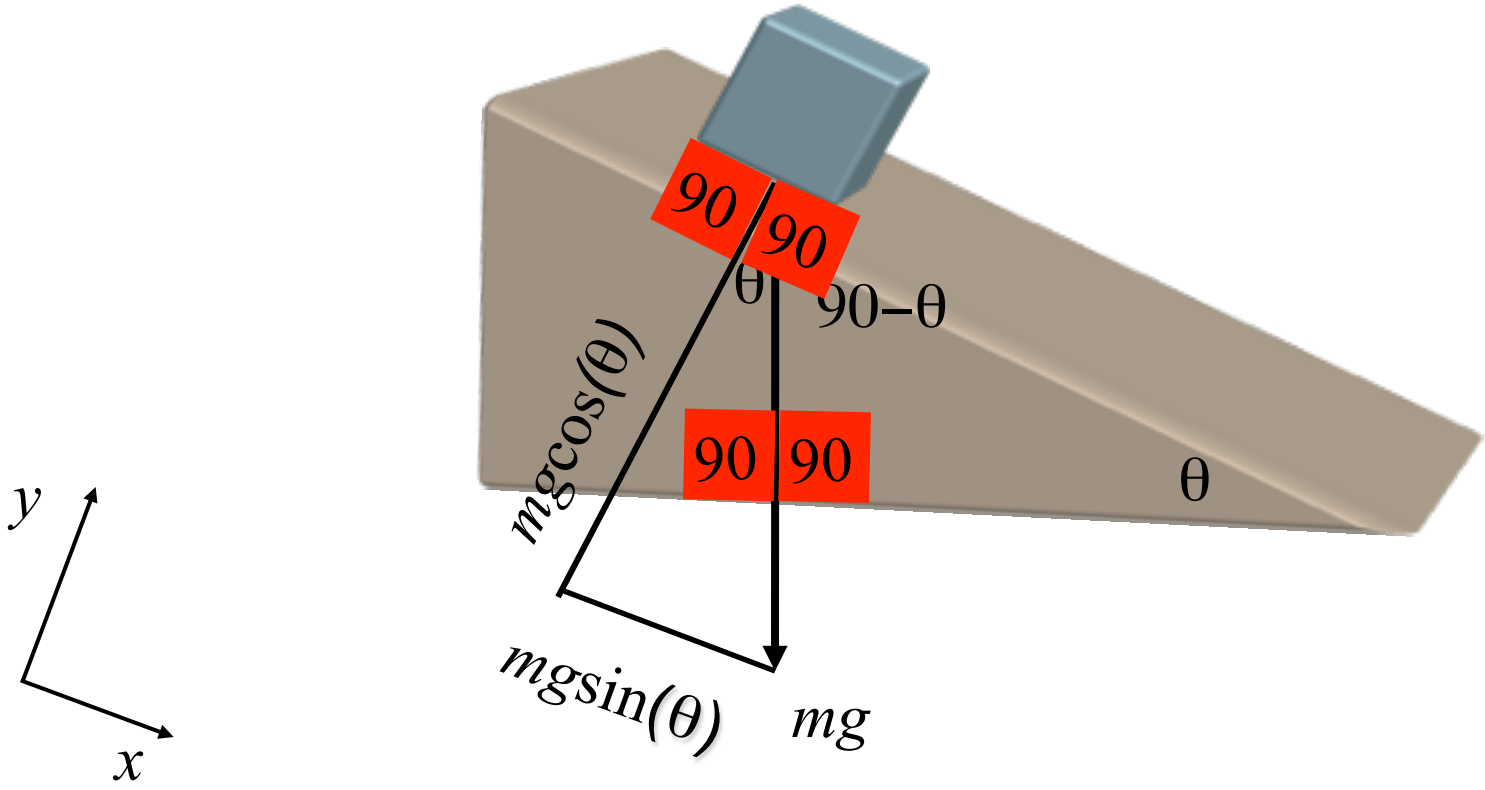
The most difficult concept was the static frictional force. I would like this discussed in lecture.

I got really confused about static frictional force. What's the difference? and why is it sometimes less then $\mu_s mg$.

This is some cool stuff

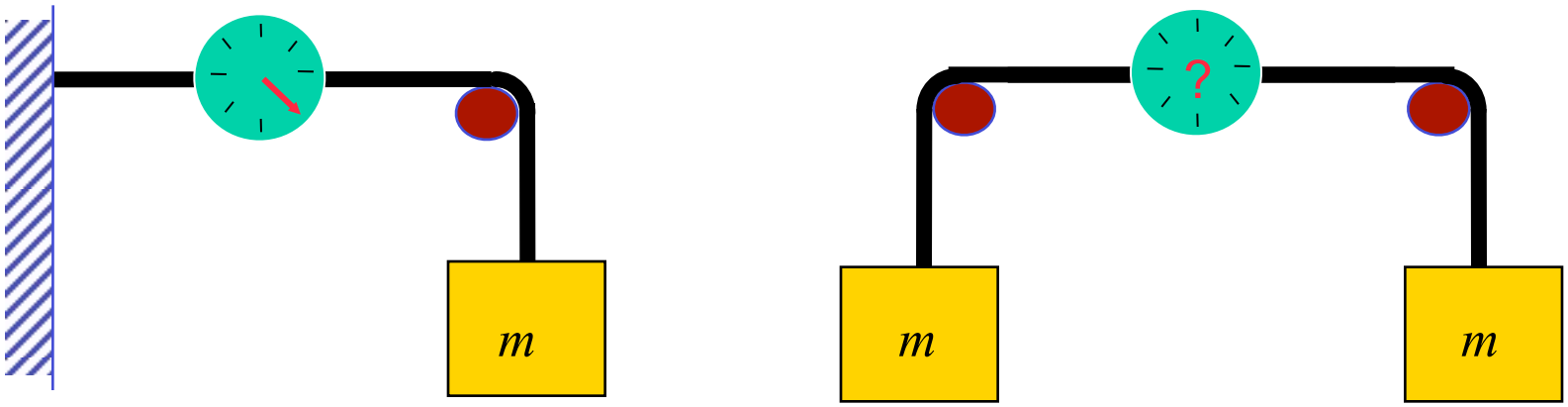
Stuff you asked about:

How is the angle of the y-component of the gravitational force equivalent to the angle of the ramp? I've learned this before but never quite understood geometrically why. I've been told that it "just is," but would like to know how.



Clicker Question

A block weighing 4 N is hung from a rope attached to a scale. The scale is then attached to a wall and reads 4 N. What will the scale read when it is instead attached to another block weighing 4 N?



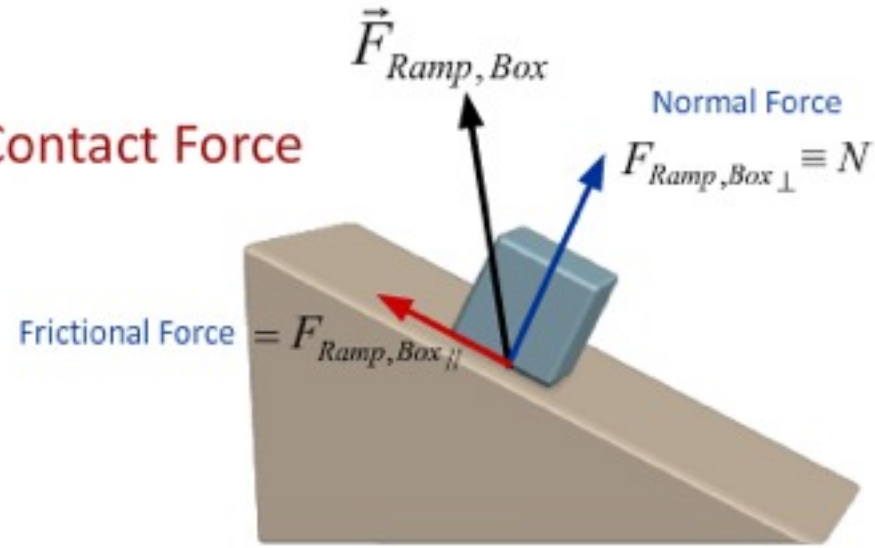
A) 0 N.

B) 4 N.

C) 8 N.

Friction

Components of a Contact Force



Kinetic Friction

$$f_k = \mu_k N$$

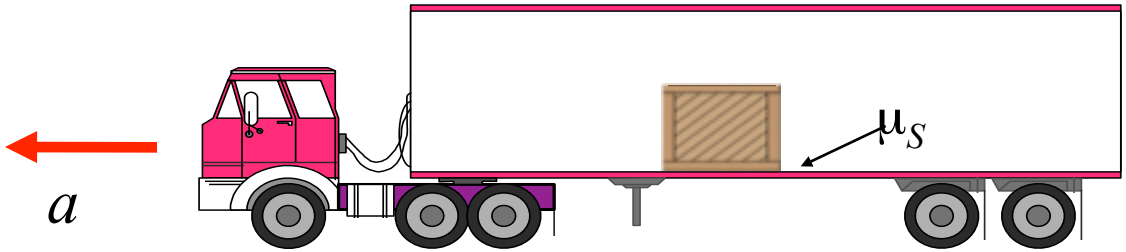
Static Friction

$$f_s \leq \mu_s N$$

Always opposes the relative motion of two surfaces

CheckPoint

A box sits on the horizontal bed of a moving truck. Static friction between the box and the truck keeps the box from sliding around as the truck drives.

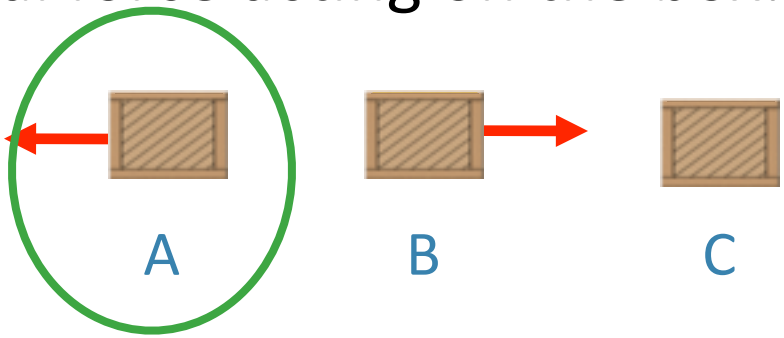


If the truck moves with constant acceleration to the left as shown, which of the following diagrams best describes the static frictional force acting on the box:

A B C

CheckPoint

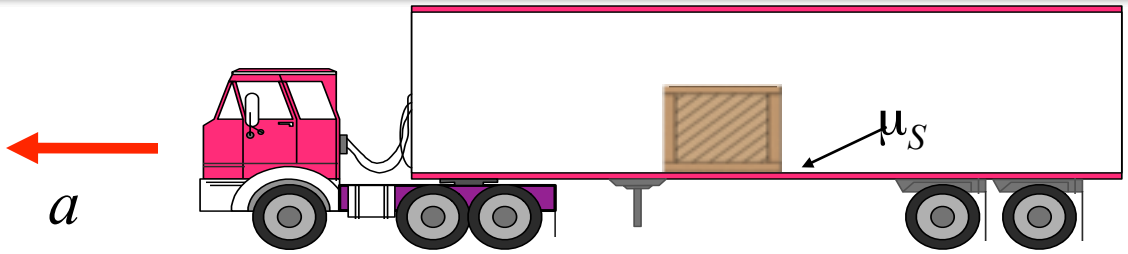
If the truck moves with constant accelerating to the left as shown, which of the following diagrams best describes the static frictional force acting on the box:



A) There must be a leftward static frictional force which imparts a leftward acceleration of the same magnitude as the truck's acceleration to the box, or the box will slide.

B) Friction always acts in the direction opposite to the applied force. Since the truck is accelerating to the left, the applied force is to the left. Therefore, friction acts towards the right.

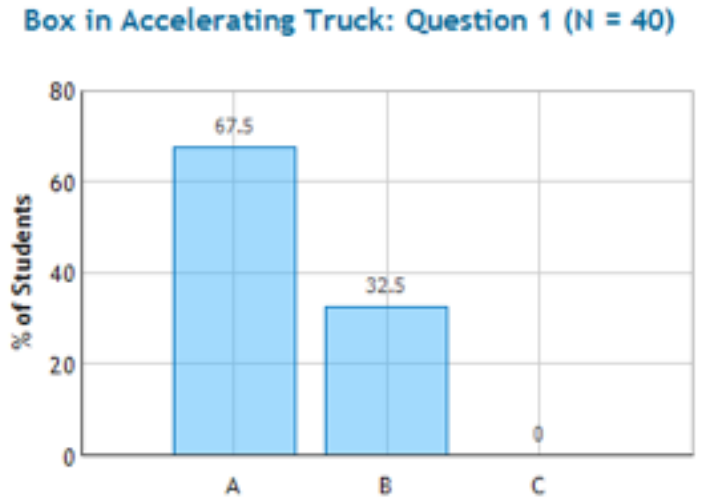
CheckPoint



If the truck moves with constant accelerating to the left as shown, which of the following diagrams best describes the static frictional force acting on the box:

A B C

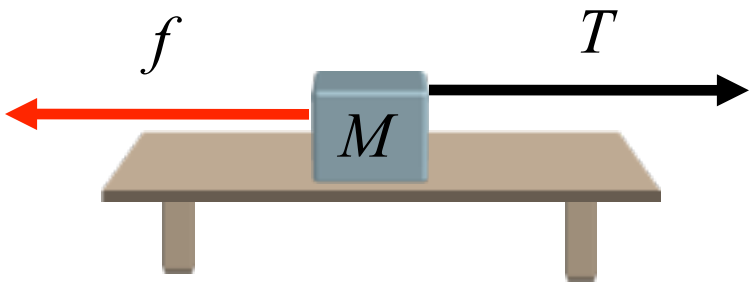
the force has to go in the same direction as the acceleration.



Clicker Question

A box of mass M sits on a horizontal table. A horizontal string having tension T applies a force on the box, but static friction between the box and the table keeps the box from moving.

What is the magnitude of the total force acting on the box?



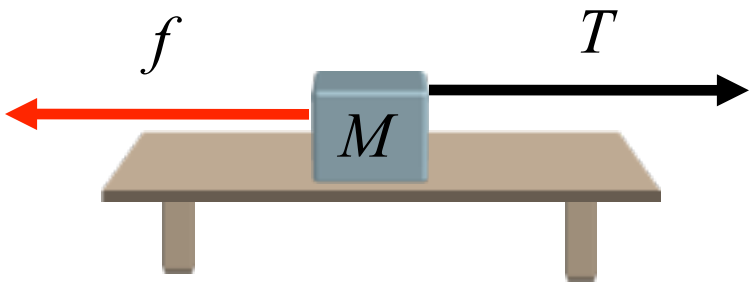
A) Mg
B) μMg
C) T
D) 0

Since acceleration is zero.

CheckPoint

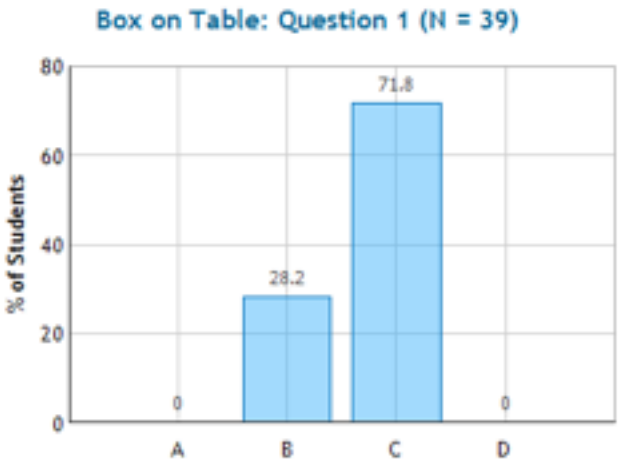
A box of mass M sits on a horizontal table. A horizontal string having tension T applies a force on the box, but static friction between the box and the table keeps the box from moving.

What is the magnitude of the static frictional force acting on the box?



A) Mg
B) μMg
C) T
D) 0

Since the box is not moving the forces must be equal, otherwise there would be an acceleration.



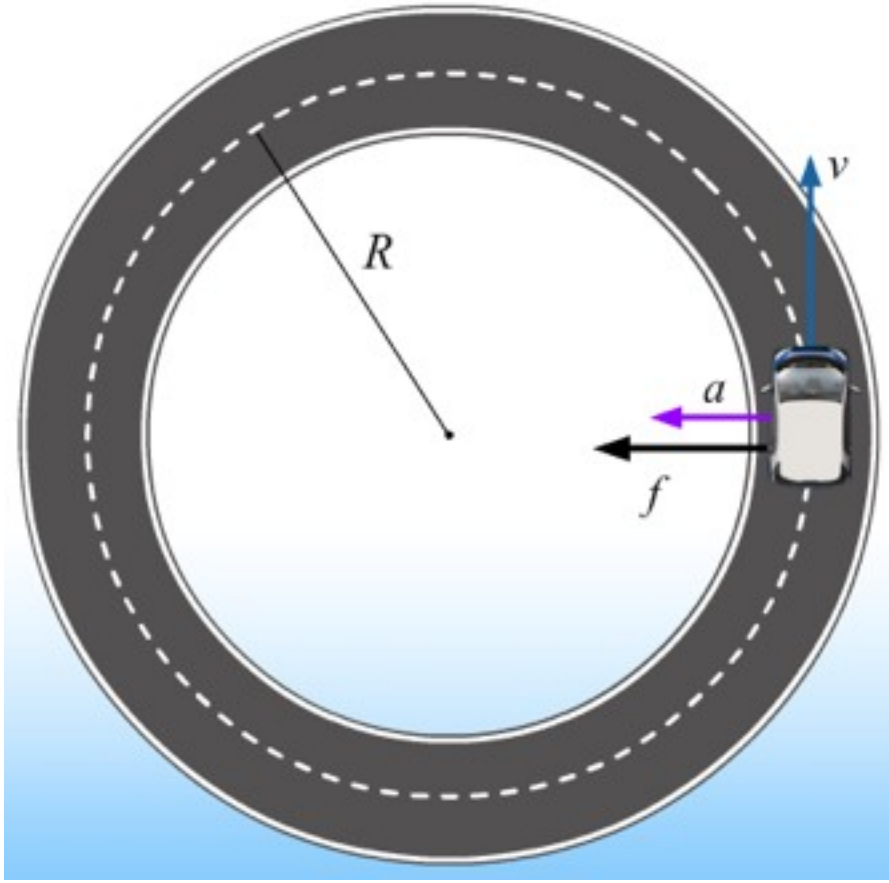
Question: How fast can the car go without skidding off the road?

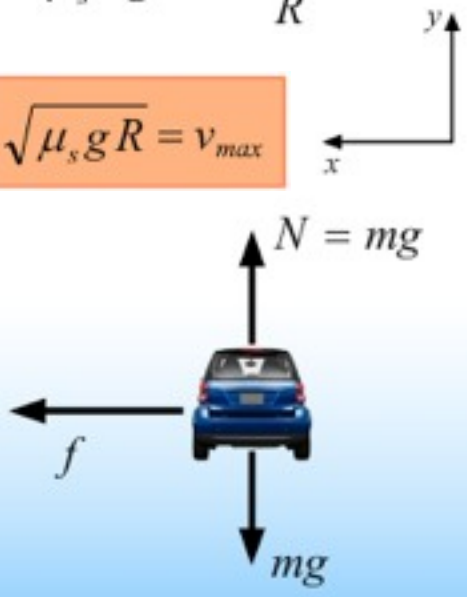
$$f = m\frac{v^2}{R}$$

$$\mu_s N = m\frac{v_{max}^2}{R}$$

$$\mu_s mg = m\frac{v_{max}^2}{R}$$

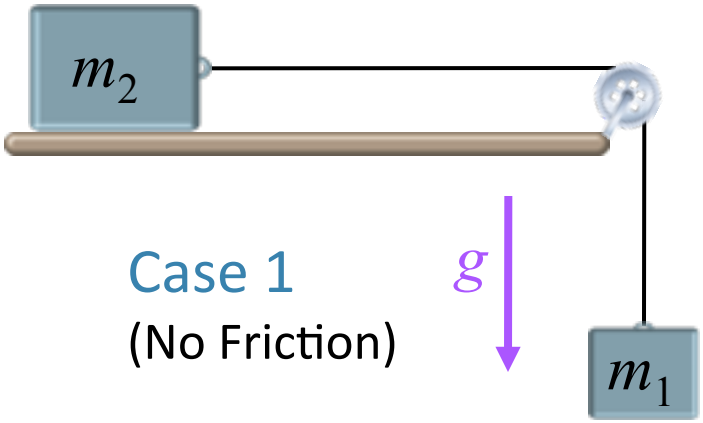
$$\sqrt{\mu_s g R} = v_{max}$$

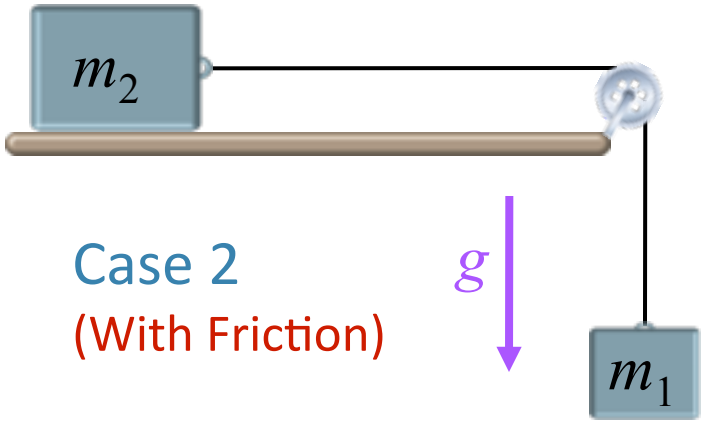




CheckPoint

A block slides on a table pulled by a string attached to a hanging weight. In Case 1 the block slides without friction and in Case 2 there is kinetic friction between the sliding block and the table.





In which case is the tension in the string biggest?

A) Case 1 B) Case 2 C) Same

~75% got this right

Clicker Question

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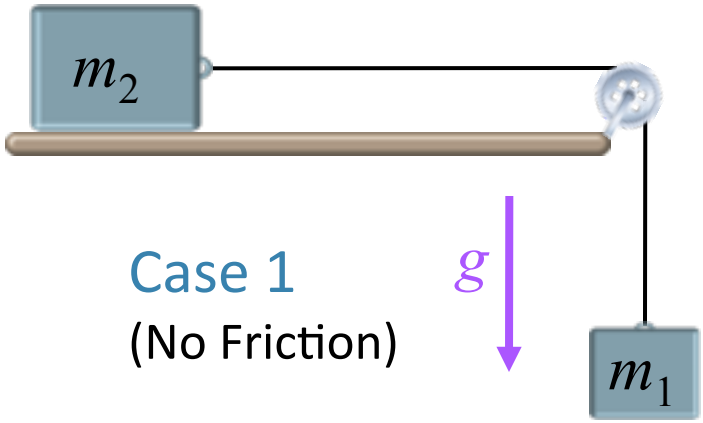
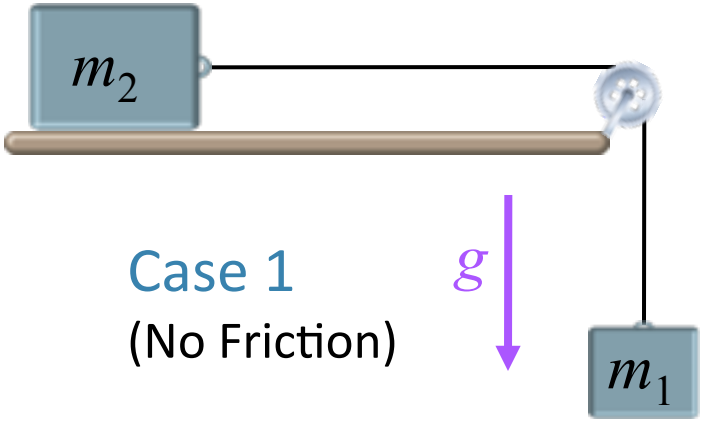
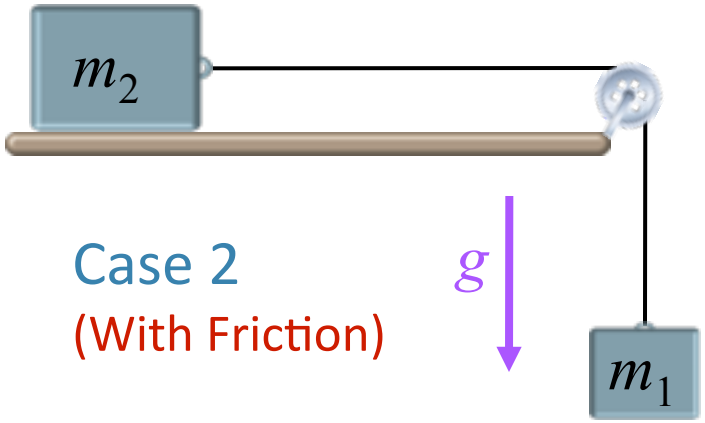


What is the tension in the string in Case 1?

A) $T = 0$ B) $T = mg$ C) T is between 0 and mg



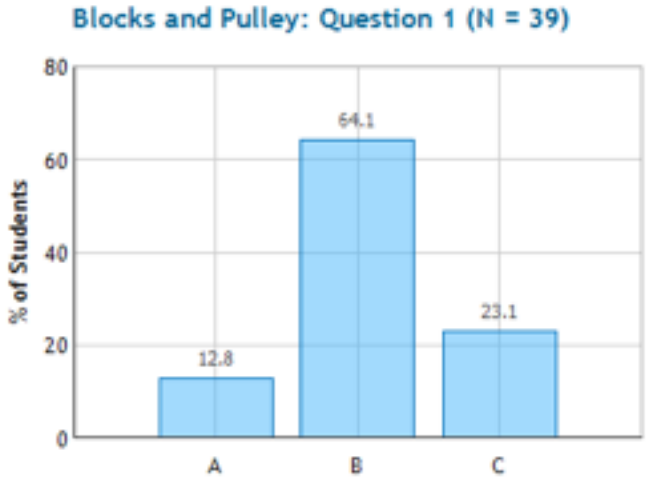


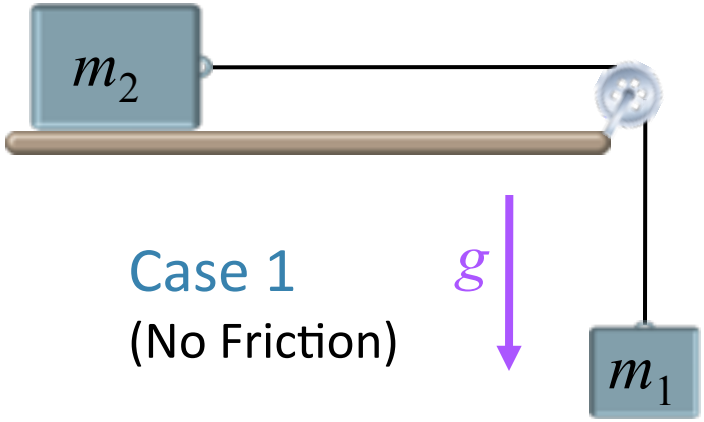
In which case is the tension in the string biggest?

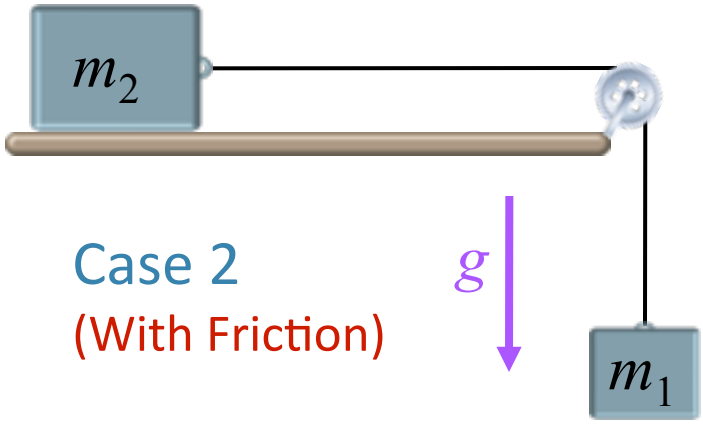
A) Case 1 B) Case 2 C) Same

B) M1 will not be accelerating as fast in case two than in case one because there is the extra force of friction acting against mass 1. Since the acceleration is smaller in case two, there has to be more of a force acting against gravity, the only other possible force is Tension.

C) The tension on the string is m1*g regardless of what is happening on top of the table; the force is equal.







In which case is the tension in the string biggest?

A) Case 1 B) Case 2 C) Same

Some wrong explanations for picking B) :

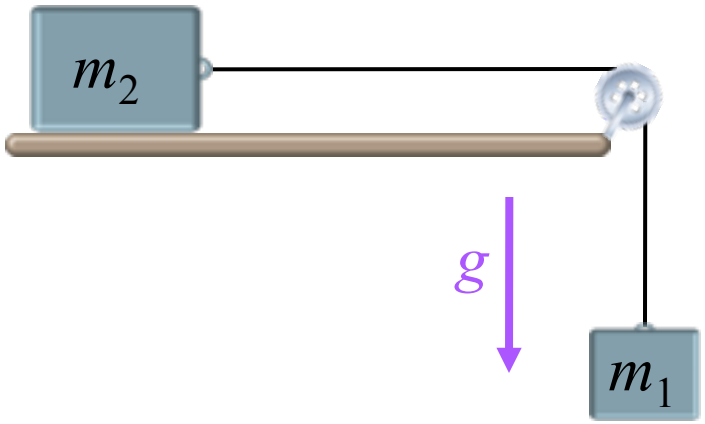
In case one the tension in the string is just equal to mg, but in case 2 the tension is equal to mg + friction.

In case 1, m_1 is like free fall, so there is no tension in the string. In case 2, the tension of the string is equal to the kinetic friction.

Lets work it out

A block (m_2) slides on a table pulled by a string attached to a mass (m_1) hanging over the side. The coefficient of kinetic friction between the sliding block and the table is μ_k. What is the tension in the string?

(pulley is massless)



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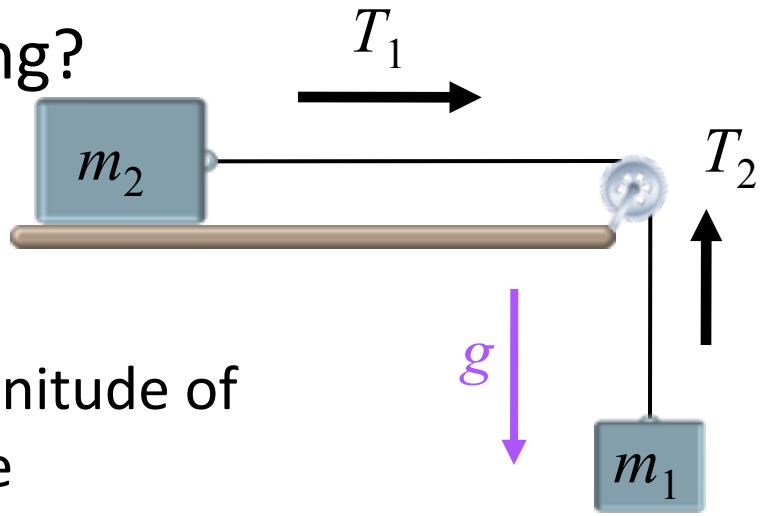

What is the relationship between the magnitude of the tension of the string at block 2 and the magnitude of the tension in the string at block 1?

A) $T_1 > T_2$ B) $T_1 = T_2$ C) $T_1 < T_2$

Clicker Question

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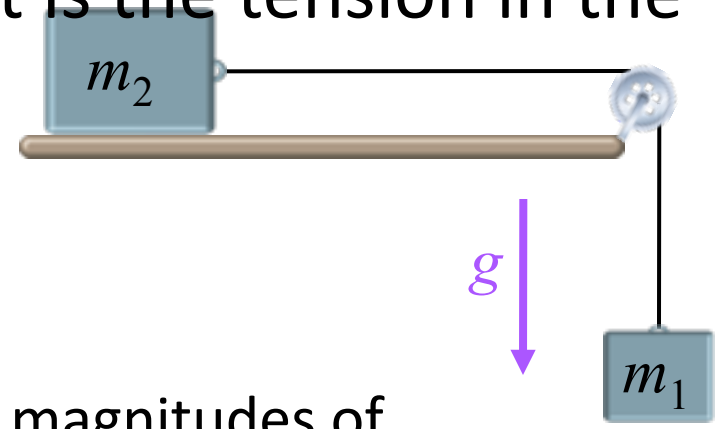
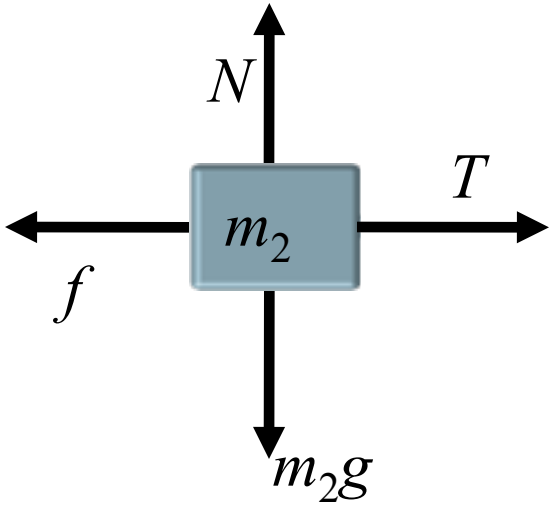
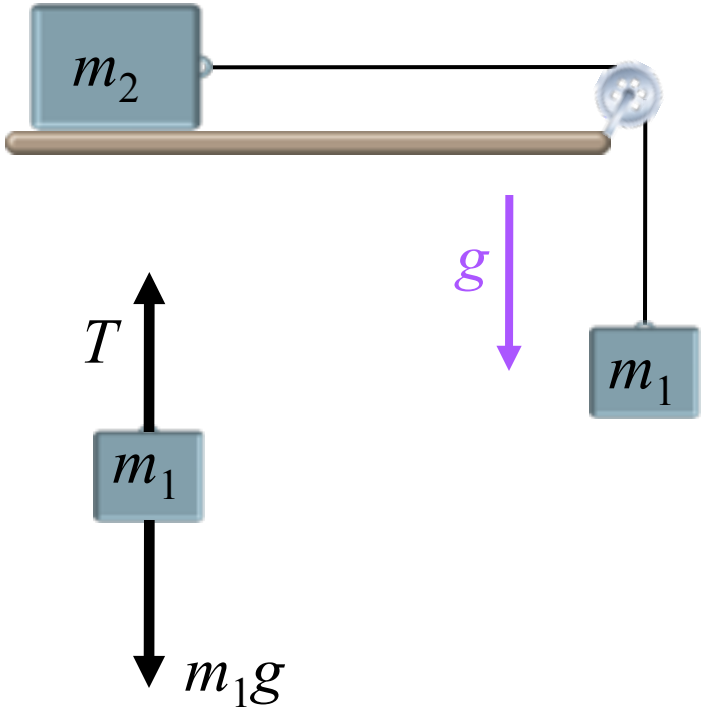


What is the relationship between the magnitudes of the acceleration of the two blocks?

A) $a_1 = a_2$ B) $a_1 < a_2$ C) $a_1 > a_2$

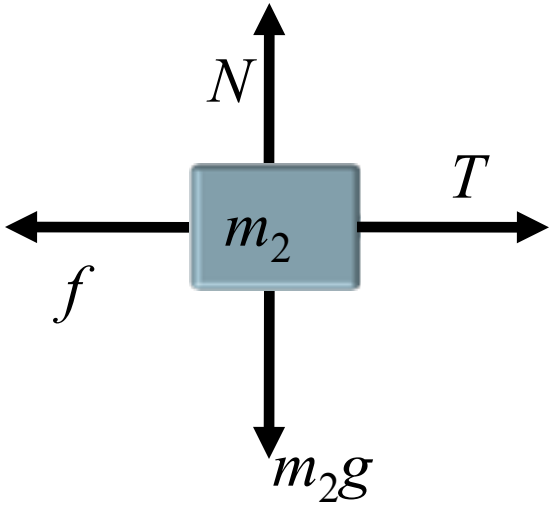
1) FBD

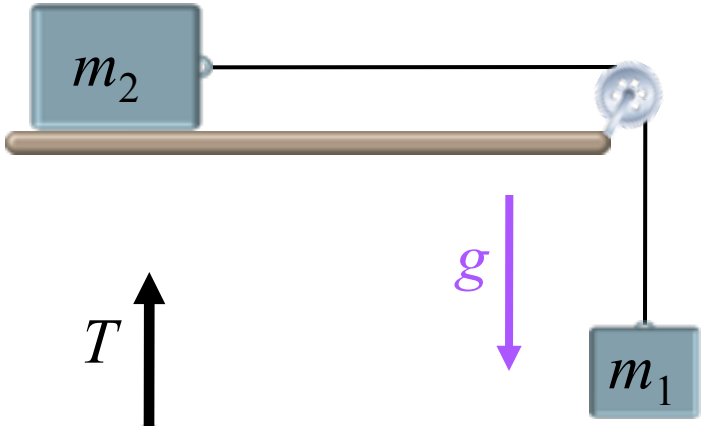


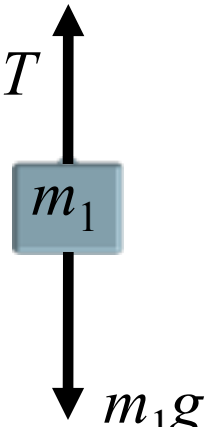


1) FBD

2) $\Sigma F = ma$







$$N = m_2 g$$

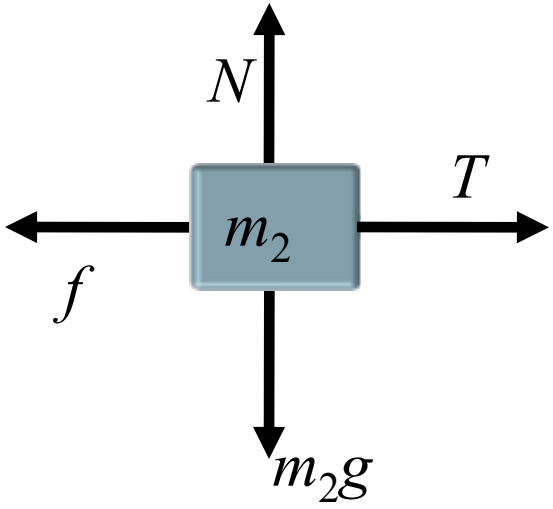
$$T - \mu m_2 g = m_2 a \qquad m_1 g - T = m_1 a$$

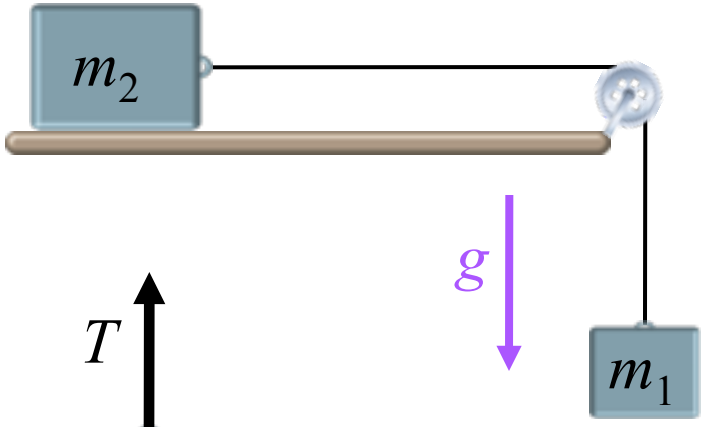
add

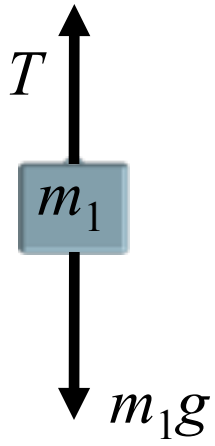
$$m_1 g - \mu m_2 g = m_1 a + m_2 a$$

$$a = \frac{m_1 g - \mu m_2 g}{m_1 + m_2}$$

1) FBD
2) $\Sigma F = ma$







$$m_1 g - T = m_1 a$$

$$a = \frac{m_1 g - \mu m_2 g}{m_1 + m_2}$$

$$T = m_1 g - m_1 a$$

T is smaller when a is bigger

Which Job entails the least Work?

jobs to rival companies. All three jobs pay the same amount of money. Which one would you choose for your crew?

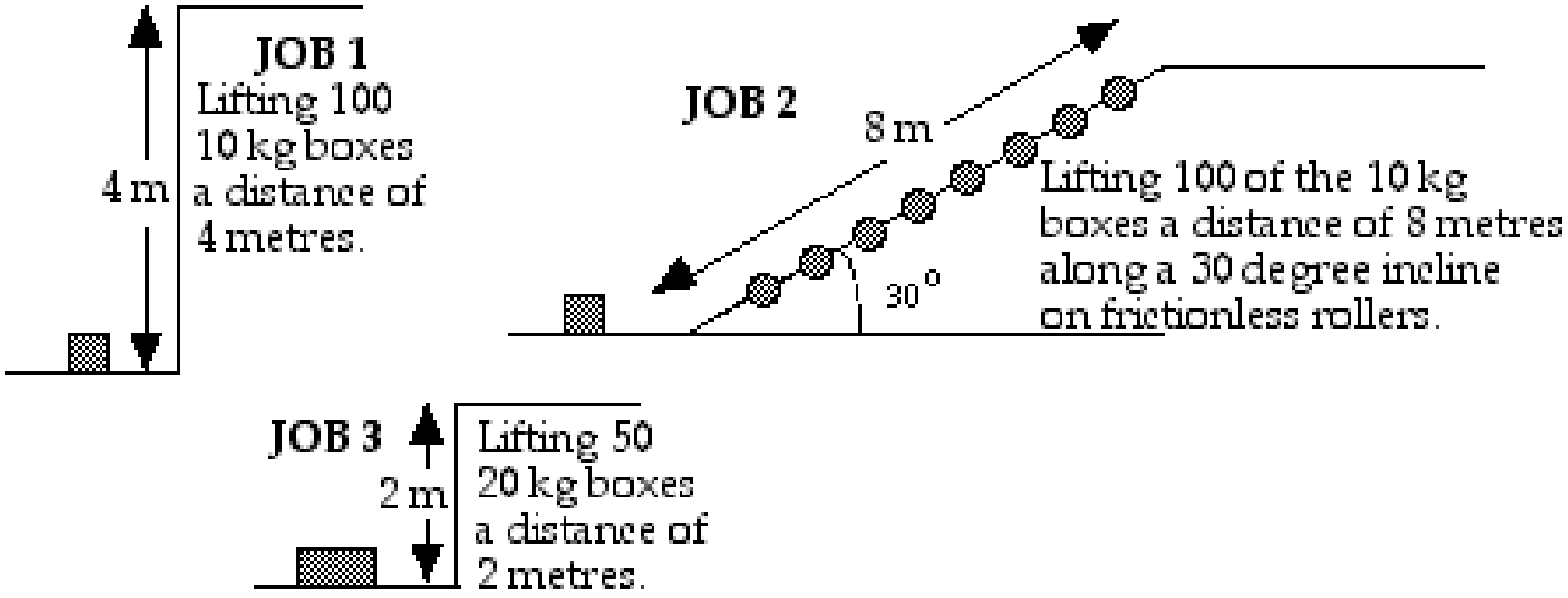


Figure 10-1: A description of jobs to bid on