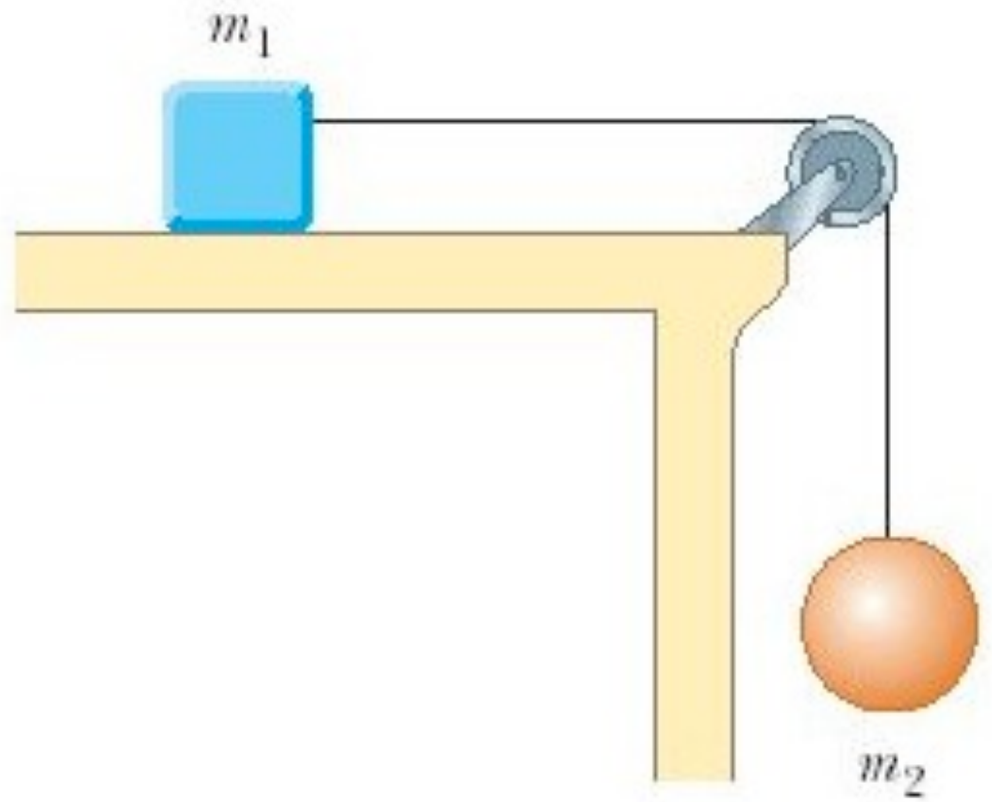
Good Morning

- Please put your homework in the box in the front of the room.



- Draw the FBD for m1 & m2. Assume that the objects are stationary.

This Week

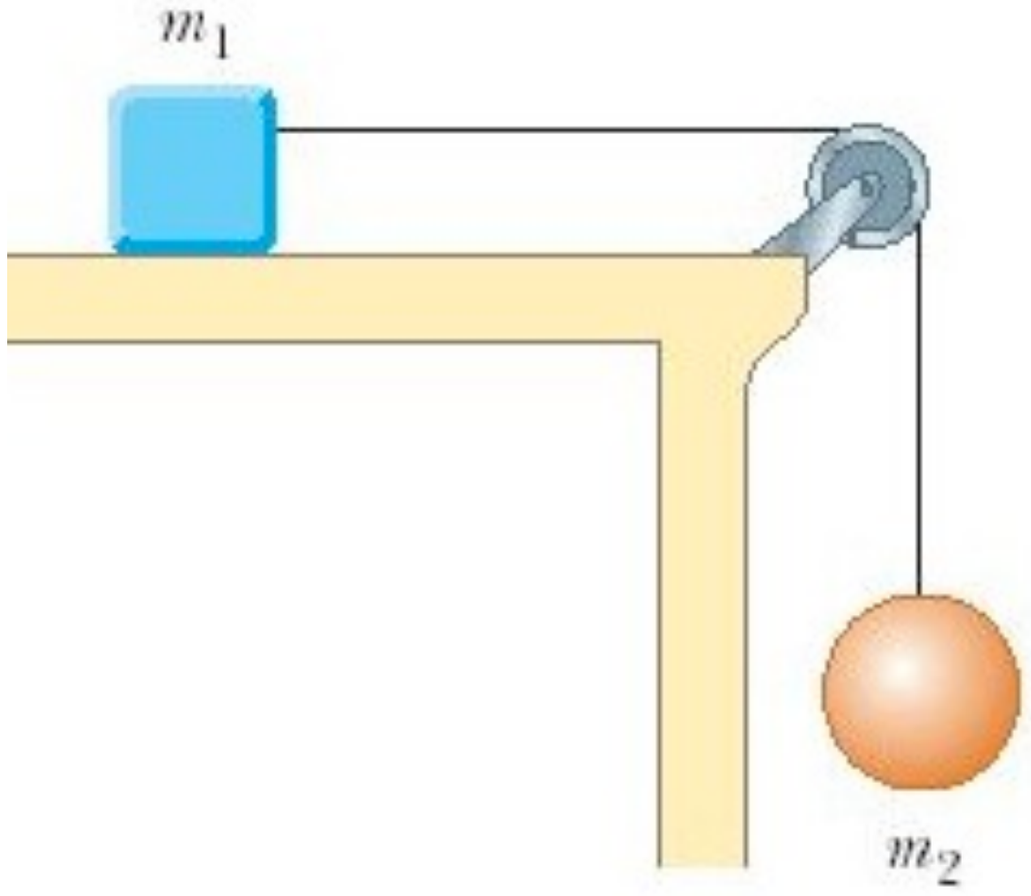
- Monday: Finish Newton's First Law
- Tuesday: Cover Newton's Third Lab
- Wednesday: Terminal Velocity Lab
- Thursday: Review for quiz
- Friday: Quiz and Begin Newton's 2nd.

4-9 Problem Solving – A General Approach

1. **Read** the problem carefully; then read it again.
2. **Draw** a sketch, and then a free-body diagram.
3. Choose a convenient **coordinate system**.
4. List the **known** and **unknown** quantities; find **relationships** between the knowns and the unknowns.
5. **Estimate** the answer.
6. Solve the problem without putting in any numbers (**algebraically**); once you are satisfied, put the **numbers** in.
7. Keep track of **dimensions**.
8. Make sure your answer is **reasonable**.

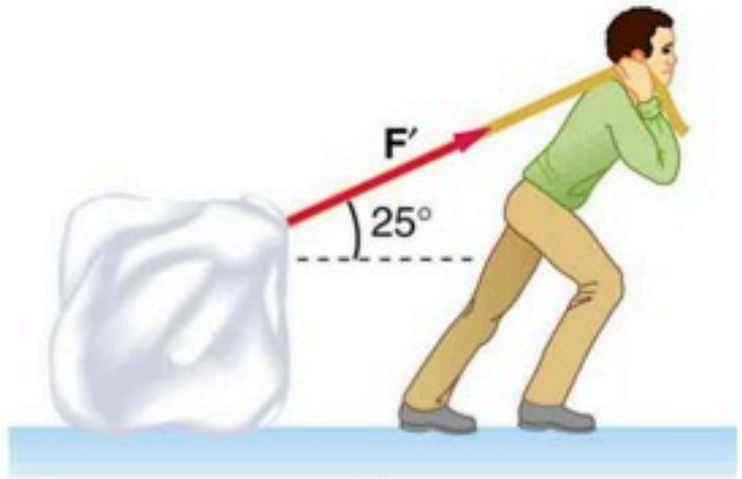
Solve for F_f

- m1: 12kg
- m2: 14kg



Use your words. Write down what requires more force: pushing the object at an angle or pulling it. Why?

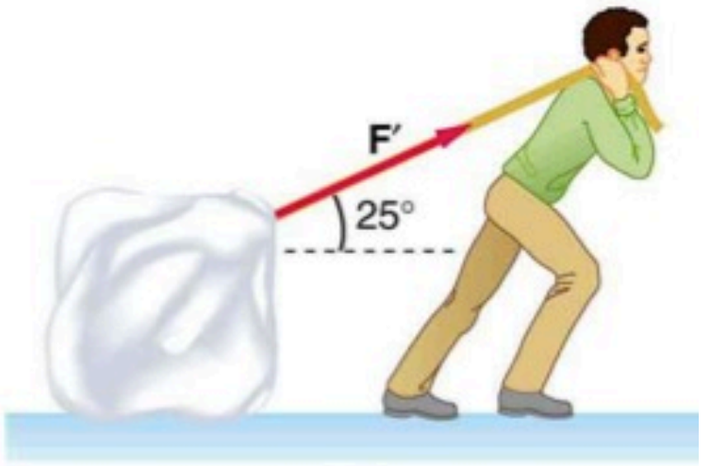
(a)



(b)

a) The man pushes a 50kg ice block with a force of 100N at an angle of 25 degrees below horizontal. What is the force of friction?

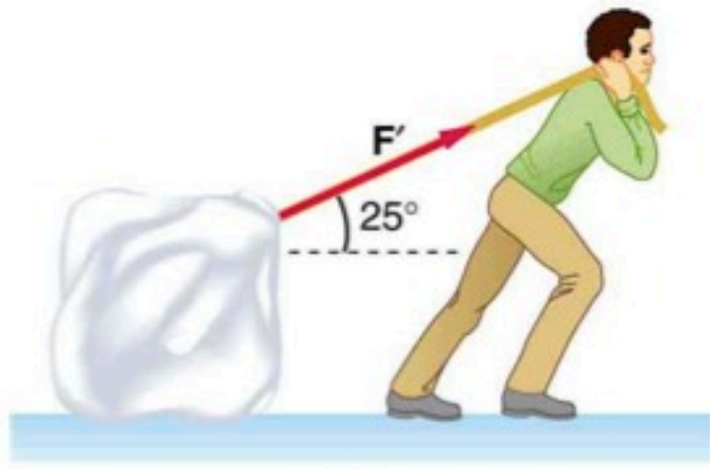
(a)



(b)

b) The man pulls a 50kg ice block with a force of 100N at an angle of 25 degrees above the horizontal. What is the force of friction?

(a)



(b)

Comparisons

- The force applied in both situations was the same.
- The force of friction was higher when the applied force came from above the horizon.
- What other force was higher in this situation?

Friction and the Normal Force

- The force of friction is directly proportional to the normal force.
- There is a ratio of the force of friction and the normal force. Fn/Ff.
- This is the coefficient of friction.

μ: the coefficient of friction.

Kinetic and Static Friction

- Both are ratios to the normal force.
- μs: coefficient of static friction.
- μk: coefficient of kinetic friction.
- Static friction > kinetic friction.

TABLE 4–2 Coefficients of Friction[†]

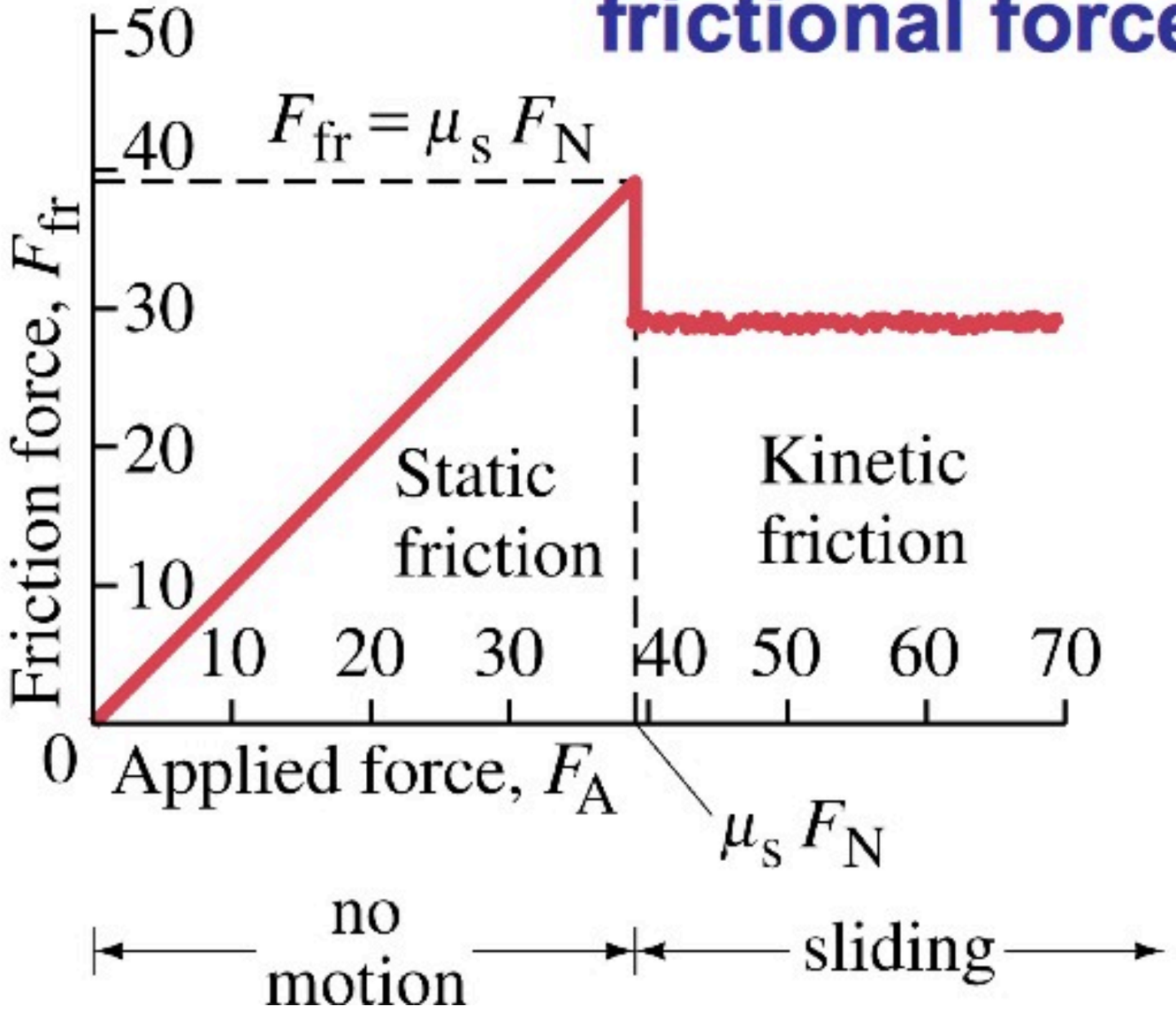
Surfaces	Coefficient of Static Friction, μ_s	Coefficient of Kinetic Friction, μ_k
Wood on wood	0.4	0.2
Ice on ice	0.1	0.03
Metal on metal (lubricated)	0.15	0.07
Steel on steel (unlubricated)	0.7	0.6
Rubber on dry concrete	1.0	0.8
Rubber on wet concrete	0.7	0.5
Rubber on other solid surfaces	1–4	1
Teflon® on Teflon in air	0.04	0.04
Teflon on steel in air	0.04	0.04
Lubricated ball bearings	<0.01	<0.01
Synovial joints (in human limbs)	0.01	0.01

[†] Values are approximate and intended only as a guide.

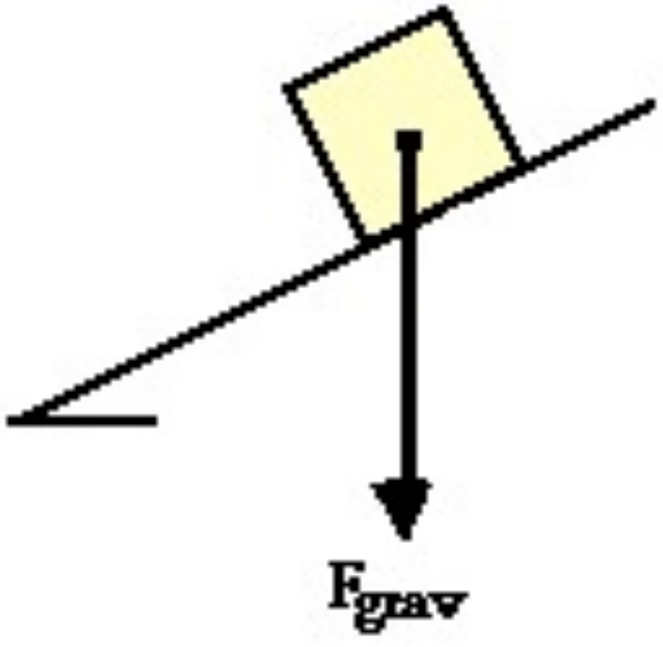
Variable Forces

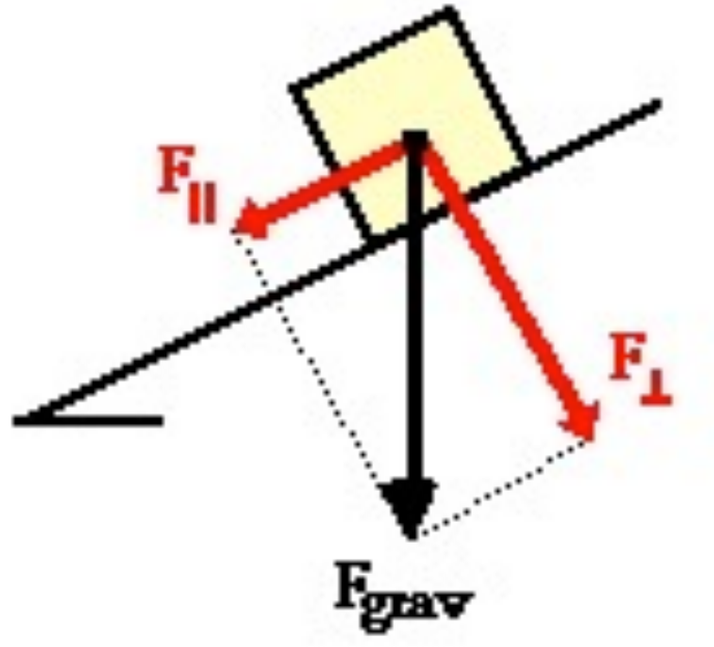
- μs is determined by the maximum force applied until an objects begins to move.
- μk is constant.

The static frictional force increases as the applied force increases, until it reaches its maximum. Then the object starts to move, and the kinetic frictional force takes over.



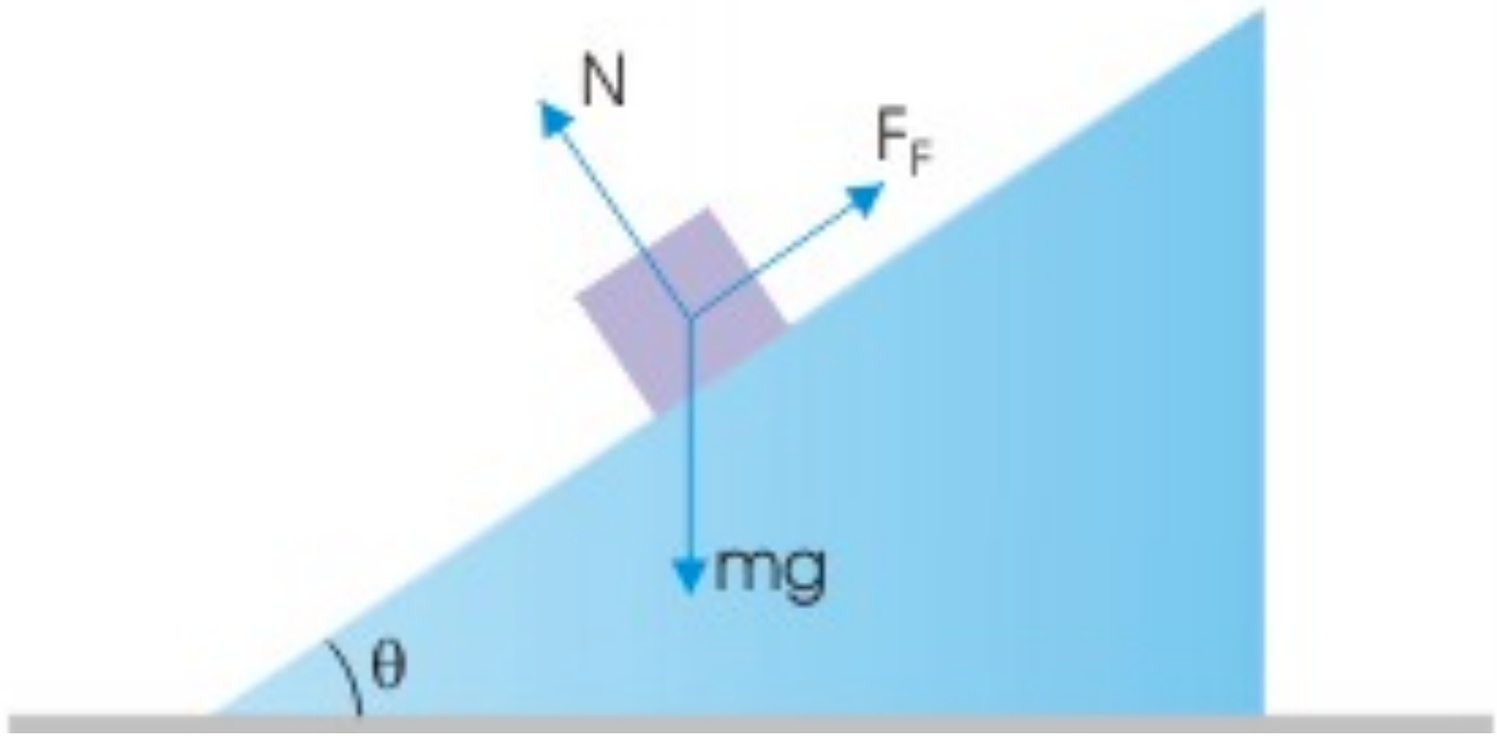
We Need Friction





The force of gravity can be resolved into two components. Together, these two components replace the affect of the force of gravity.

Forces on an inclined plane



Creating new axis

A chicken stands on the ramp to it's coop. If the chicken weighs 1.7kg and the angle of the ramp is 20°, what is the force of friction?

A 75kg skier moves at a constant velocity down a 30° slope. What is the force of friction? What is the coefficient of kinetic friction?

55kg Luke Fox feeble grinds a 40° handrail. If Luke is moving at a constant velocity what is the coefficient of friction between the trucks and the handrail?