# Physics 121 – September 28, 2017

## Announcements:

**Office hours change: Thur 2-3, Fri 1-3 pm**

## Assignments:

**This week:**

- Finish reading Chapter 6 of textbook
- Complete ETA Problem Set #6 and Chapter 6 written problems 26, 34, 42, 64, 71, and 84, due by Oct 2 at 4 PM
- No quiz in recitation this week, but we'll do practice problems from Chapter 6 of textbook: 35, 37, 61, 77, and 81
- Start reading Chapter 7 (Work and Kinetic Energy)

# Examples of Newton's Laws for today:

- Spring and mass; Hooke's law
- More on tension
- Drag force

# Just a few more things about friction

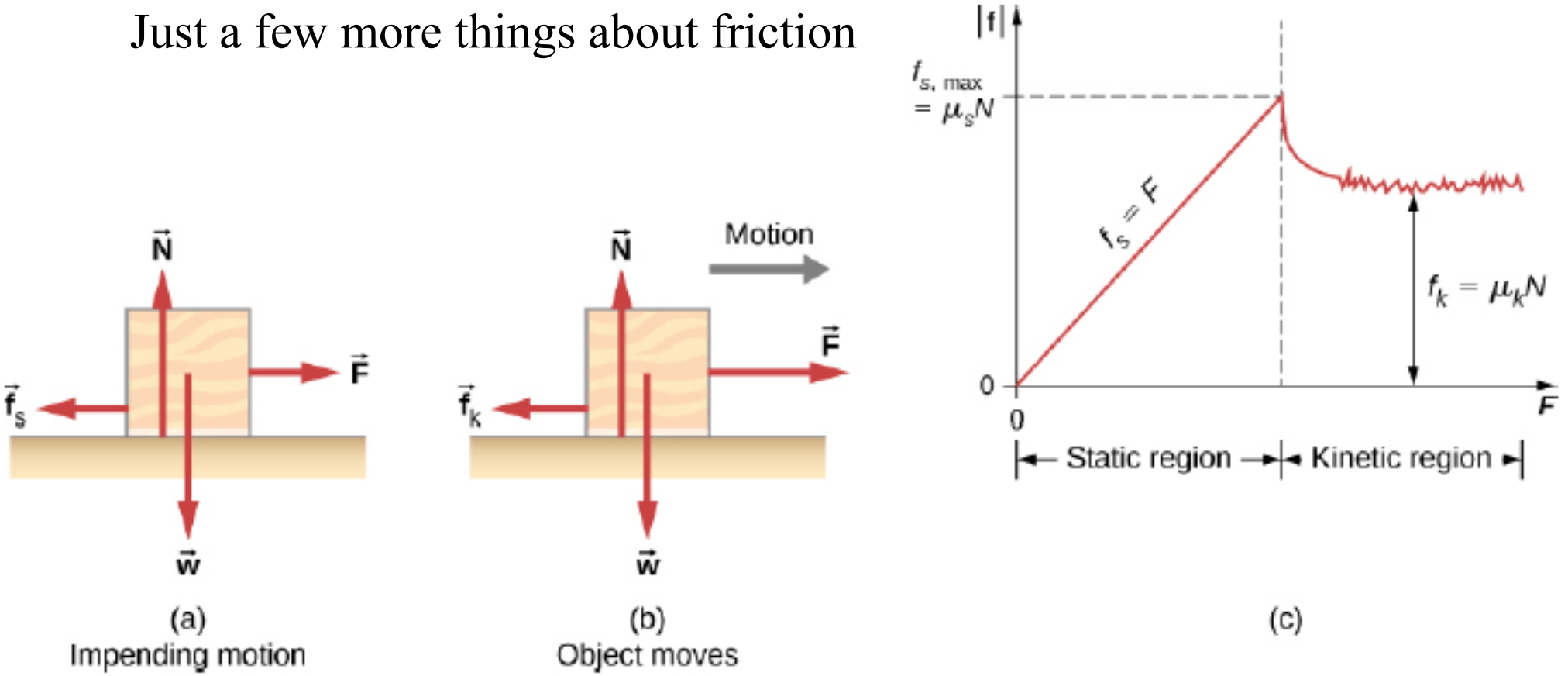


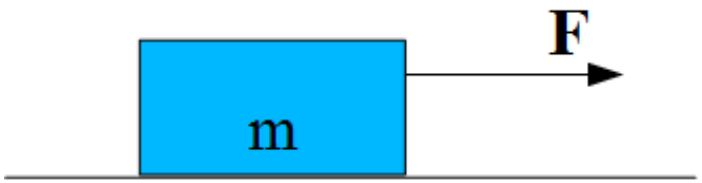

**Figure 6.11** (a) The force of friction $\vec{f}$ between the block and the rough surface opposes the direction of the applied force $\vec{F}$. The magnitude of the static friction balances that of the applied force. This is shown in the left side of the graph in (c). (b) At some point, the magnitude of the applied force is greater than the force of kinetic friction, and the block moves to the right. This is shown in the right side of the graph. (c) The graph of the frictional force versus the applied force; note that $f_s(\max) > f_k$. This means that $\mu_s > \mu_k$.

| System | Static Friction $\mu_s$ | Kinetic Friction $\mu_k$ |
|---|---|---|
| Rubber on dry concrete | 1.0 | 0.7 |
| Rubber on wet concrete | 0.5-0.7 | 0.3-0.5 |
| Wood on wood | 0.5 | 0.3 |
| Waxed wood on wet snow | 0.14 | 0.1 |
| Metal on wood | 0.5 | 0.3 |
| Steel on steel (dry) | 0.6 | 0.3 |
| Steel on steel (oiled) | 0.05 | 0.03 |
| Teflon on steel | 0.04 | 0.04 |
| Bone lubricated by synovial fluid | 0.016 | 0.015 |
| Shoes on wood | 0.9 | 0.7 |
| Shoes on ice | 0.1 | 0.05 |
| Ice on ice | 0.1 | 0.03 |
| Steel on ice | 0.4 | 0.02 |

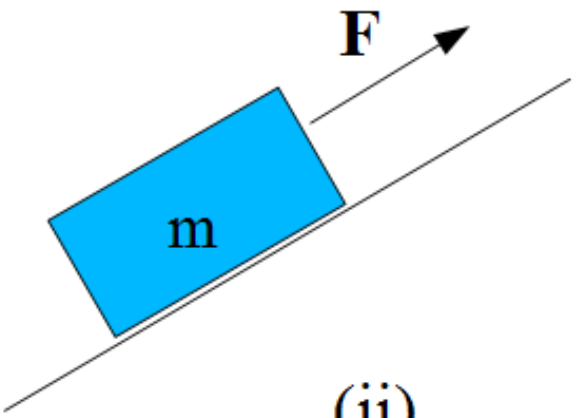
**Table 6.1 Approximate Coefficients of Static and Kinetic Friction**

**Equation 6.1** and **Equation 6.2** include the dependence of friction on materials and the normal force. The direction of friction is always opposite that of motion, parallel to the surface between objects, and perpendicular to the normal force. For example, if the crate you try to push (with a force parallel to the floor) has a mass of 100 kg, then the normal force is equal to its weight,

A heavy wooden block is dragged by a force **F** along a rough surface, as shown below for two possible situations. The magnitude of **F** is the same. The frictional force in (i), as compared with that in (ii), is:




(i)




(ii)

A. the same
B. greater
C. less
D. less for some angles, and greater for others
E. can be less or greater, depending on the magnitude of **F**