

Part F: Dragging a Block with *kinetic friction*

Realistically, all real surfaces experience some amount of *friction*.

If a block is being dragged on such a surface, the friction it experiences is **kinetic** friction, or the friction that affects moving objects.

If the applied force is stronger than kinetic friction, the object will accelerate.

Typically, however, people will pull blocks at a *constant velocity*. Moving something at a constant speed is more efficient than having it constantly speed up or slow down, and the human mind seems to adapt naturally and make this happen.

Friction can also cause a block to *slow down* if there is *no applied force* or an *applied force weaker than friction*.

Force 4: Kinetic Friction (note that forces 1, 2, and 3 are described in part D)

Kinetic Friction

Acts on any object that is sliding on a surface.

It *only* prevents motion, it never creates motion. Once an object is stopped, the force of kinetic friction disappears.

The direction of kinetic friction is always opposite the motion of the object.

The magnitude of kinetic friction is given by the formula:

$$F_{fr} = \mu_k F_N$$

Symbol	Quantity	SI Unit	Notes
F_{fr}	Magnitude of force of friction	Newtons (N)	
μ_k	Coefficient of kinetic friction	Unitless	A property of the two materials sliding against each other.
F_N	Magnitude of normal force	Newtons (N)	Represents the strength of the connection between two objects.

Situation F.1: A 2.00 kg object is being dragged on a surface *with friction* at a **constant velocity** by a force of 16.0 Newtons.

What is the *acceleration* and the *net force* acting on this object? How do you know?

Free-Body Diagram		
Force	Magnitude	How do you determine the magnitude?

What is the *coefficient of kinetic friction*?

Situation F.2: A 12.0 kg object is being dragged on a surface *with friction* at a constant velocity by a force of 44.0 Newtons.

What is the *acceleration* and the *net force* acting on this object? How do you know?

Free-Body Diagram		
Force	Magnitude	How do you determine the magnitude?

What is the coefficient of kinetic friction?

Situation F.3: A 6.00 kg object is being dragged on a surface *with friction* by a force of 44.0 Newtons. The object is NOT moving at a constant velocity. It is accelerating! The coefficient of kinetic friction between the object and the surface is 0.400.

Free-Body Diagram		
Force	Magnitude	How do you determine the magnitude?

What is the net force? [The two vertical forces cancel out, and we need to deal only with two horizontal forces to find net force.]

What is the acceleration? [Use Newton's Second Law, from page 5!]

Situation F.4: A 8.00 kg object is being dragged on a surface *with friction* by a force of 48.0 Newtons. The object is NOT moving at a constant velocity. It is accelerating! The coefficient of kinetic friction between the object and the surface is 0.380.

Free-Body Diagram		
Force	Magnitude	How do you determine the magnitude?

What is the net force? [The two vertical forces cancel out, and we need to deal only with two horizontal forces to find net force.]

What is the acceleration? [Use Newton's Second Law, from page 5!]