Friction Notes

Coefficients of friction between various surfaces

Maximum static friction: $F_s \leq \mu_s F_N$

Kinetic friction: $F_k = \mu_k F_N$

Material	μ_s	μ_k
Steel on ice	0.1	0.05
Steel on steel—dry	0.6	0.4
Steel on steel—greased	0.1	0.05
Rope on wood	0.5	0.3
Teflon on steel	0.04	0.04
Shoes on ice	0.1	0.05
Climbing boots on rock	1.0	0.8
Leather-soled shoes on carpet	0.6	0.5
Leather-soled shoes on wood	0.3	0.2
Rubber-soled shoes on wood	0.9	0.7
Auto tires on dry concrete	1.0	0.75
Auto tires on wet concrete	0.7	0.5
Auto tires on icy concrete	0.3	0.02
Rubber on asphalt	0.60	0.40
Teflon on Teflon	0.04	0.04
Wood on wood	0.5	0.3
Ice on ice	0.05–0.15	0.02
Glass on glass	0.9	0.4

Introduction to coefficient of friction

1. A 20-kg smooth wood box is at rest on a smooth wood floor. (a) How many newtons of force are needed to start the box moving? (b) Once the box is moving, how many newtons of force are needed to keep it moving?

2. A 50-kg smooth wood box is at rest on a smooth wood floor. (a) How many newtons of force are needed to start the box moving? (b) Once the box is moving, how many newtons of force are needed to keep it moving? (c) If the same force found in part (a) continues to be applied after the box has begun moving, what will the acceleration of the box be?

Police Investigation: Determining the speed of a vehicle.

In an actual auto accident, a Jaguar left skids marks 190 m long. Assume that the car was traveling on a dry concrete road and that the car had nearly stopped by the time it had collided. (Use the appropriate coefficient of friction from the preceding table.) We will want to determine the speed of the car when the brakes locked. The mass of the car is 1200 kg.

* Draw a motion diagram. Be sure to include the acceleration arrow.

* Draw a force diagram. Show the forces acting on the car.

* Find the force of friction acting on the car. Find the acceleration of the car. Find the initial velocity of the car in m/sec and in mph .