

Table: Coefficients of Friction

| <i>Materials</i>                      | <i>Coefficient of Static Friction</i><br>$\mu_s$ | <i>Coefficient of Kinetic Friction</i><br>$\mu_k$ |
|---------------------------------------|--|---|
| <i>Steel on greased steel</i>         | <i>0.15</i>                                      | <i>0.09</i>                                       |
| <i>Steel on dry steel</i>             | <i>0.41</i>                                      | <i>0.38</i>                                       |
| <i>Oak on oak</i>                     | <i>0.50</i>                                      | <i>0.30</i>                                       |
| <i>Rubber on dry asphalt</i>          | <i>1.20</i>                                      | <i>0.80</i>                                       |
| <i>Rubber on wet asphalt</i>          | <i>0.60</i>                                      | <i>0.50</i>                                       |
| <i>Rubber on dry concrete</i>         | <i>1.00</i>                                      | <i>0.70</i>                                       |
| <i>Rubber on wet concrete</i>         | <i>0.70</i>                                      | <i>0.50</i>                                       |
| <i>Rubber on ice</i>                  | <i>0.006</i>                                     | <i>0.005</i>                                      |
| <i>Teflon on Teflon</i>               | <i>0.04</i>                                      | <i>0.04</i>                                       |
| <i>Waxed hickory skis on dry snow</i> | <i>0.06</i>                                      | <i>0.04</i>                                       |
| <i>Waxed hickory skis on wet snow</i> | <i>0.20</i>                                      | <i>0.14</i>                                       |

Assume  $g = 9.80 \text{ N/kg}$  for the following problems. Refer the table above for coefficient values.

**Friction Problems:**

1. A motorcycle and rider have a mass of 230 kg. Calculate the force of kinetic friction between the rubber tires of the motorcycle and dry concrete when the cycle skids with both wheels locked.
2. The total weight of a little girl and her sled is 545 N. Her older brother, pulling her to the tobogganing hill, finds that it takes a horizontal force of 88 N just to start the sled moving. Find the coefficient of static friction between the sled and the snow.
3. A force of 31 N pulls an 8.0 kg aluminum slider at a constant speed along a horizontal steel rail. What is the coefficient of kinetic friction between aluminum and steel?
4. Calculate the difference in the force of static friction for old-fashioned waxed hickory skis on wet and dry snow if the skis weigh 15.0 N.

Ans:

1.  $F_{fk} = 1.6 \times 10^3 \text{ N}$

2.  $\mu_s = 0.16$

3.  $\mu_k = 0.40$

4.  $2.1 \text{ N}$