Frictional Forces

What affects frictional forces?

- The material of the surfaces
- The normal force exerted on one surface by another

Coefficient of Friction

- Ratio of the magnitude of the force of friction to the normal force between two surfaces
- Varies depending on the surfaces
- Represented by the Greek letter μ

Coefficient of Static Friction

$$\mu_s = \frac{F_{s,max}}{F_N} \longrightarrow F_{s,max} = \mu_s F_N$$

Coefficient of Kinetic Friction

$$\mu_k = \frac{F_k}{F_N} \longrightarrow F_k = \mu_k F_N$$

Coefficients of friction of some common materials

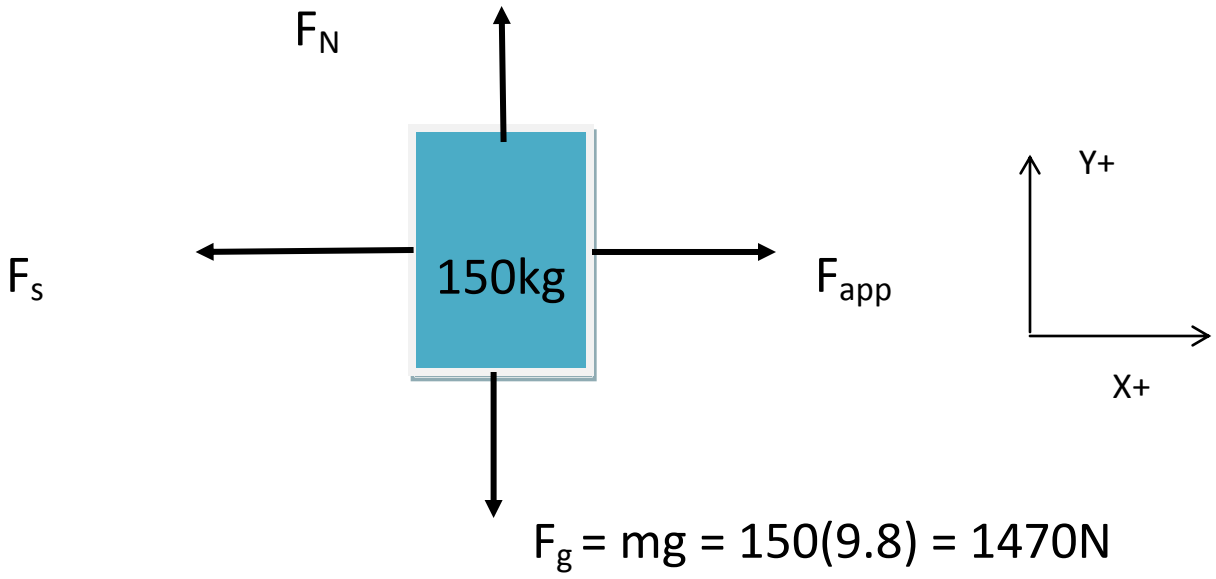
Materials	μ_s	μ_k
Rubber on concrete (dry)	1.1	1.0
Rubber on asphalt (dry)	1.1	1.0
Steel on steel(dry)	0.6	0.4
Steel on steel (greasy)	0.12	0.05
Ice on ice	0.1	0.03
Wood on dry snow	0.22	0.18
Wood on wet snow	0.14	0.1

Example :

Iggy is trying to push his new fridge into place across his kitchen floor. The fridge has a mass of 150kg and the coefficient of static friction between the fridge and the floor is 0.65.

a. With what horizontal force must Iggy push the fridge to get it to start moving?
b. Once Iggy gets its started he pushes with a constant force of 800 N causing it to accelerate at 0.2m/s^2. What is the value of the coefficient of kinetic friction between the fridge and the floor?

a.



$\sum F_y = 0 \rightarrow F_N - F_g = 0$

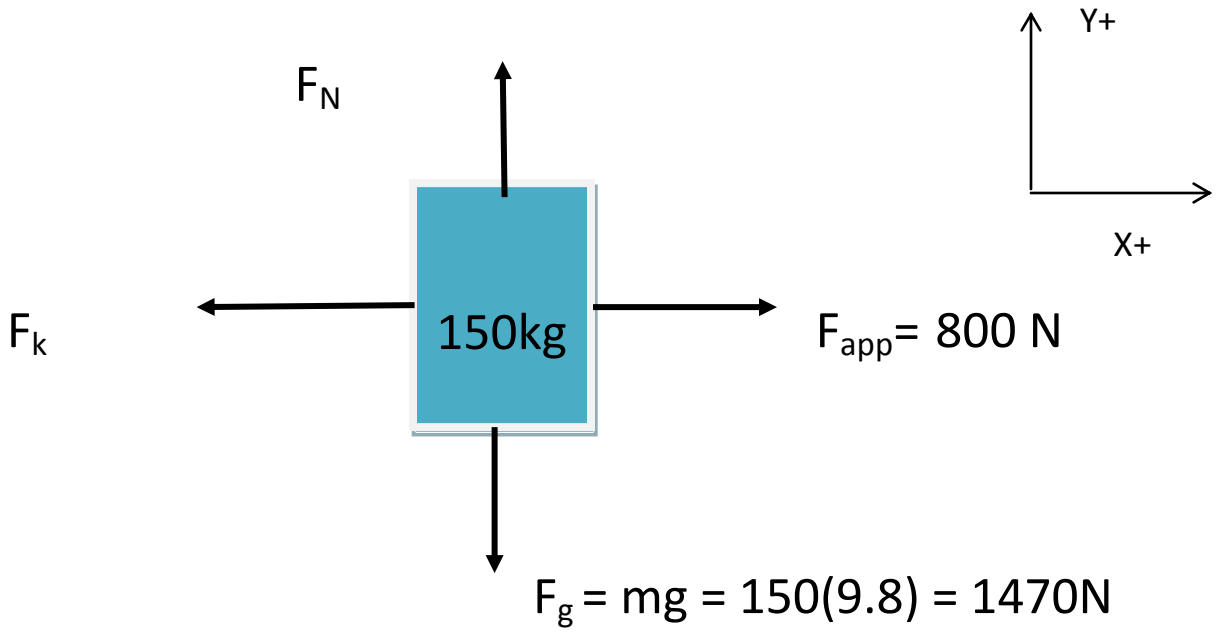
$F_N = 1470$ N

$$\mu_s = \frac{F_{s,max}}{F_N} \rightarrow F_{s,max} = F_N \mu_s$$

$$F_{s,max} = 1470(0.65) = 955.5 \text{ N}$$

Therefore Iggy must push with a horizontal force of more than 955.5 N in order to move his fridge.

b.



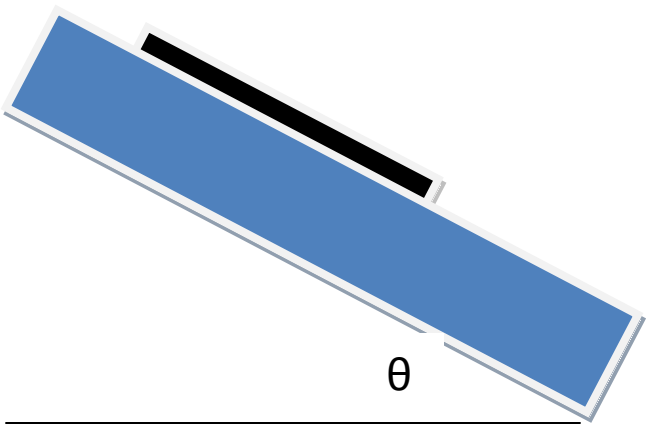
$\sum F_x = ma_x$ ➔ $F_{app} - F_k = ma_x$

$$800 - F_N \mu_k = 150(0.2)$$

$$\mu_k = 0.52$$

Activity:

Try to find the coefficient of static friction between your calculator and your textbook.



Once you know the angle at which your calculator starts to slide off the textbook should be able to calculate the coefficient of static friction.

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