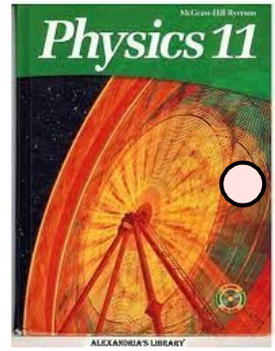
Whole Class Experiment

Going to need a protractor for the following.

What is the coefficient of static friction between the cover of your physics' text and a coin when the cover is inclined at theta max?



Step 1: Get a coin from Mr. Hennessey (I want them back!)

Step 2: Lay textbook flat on table and place coin on top near outer edge

Step 3: Very gradually open the front cover (so as to raise the coin)

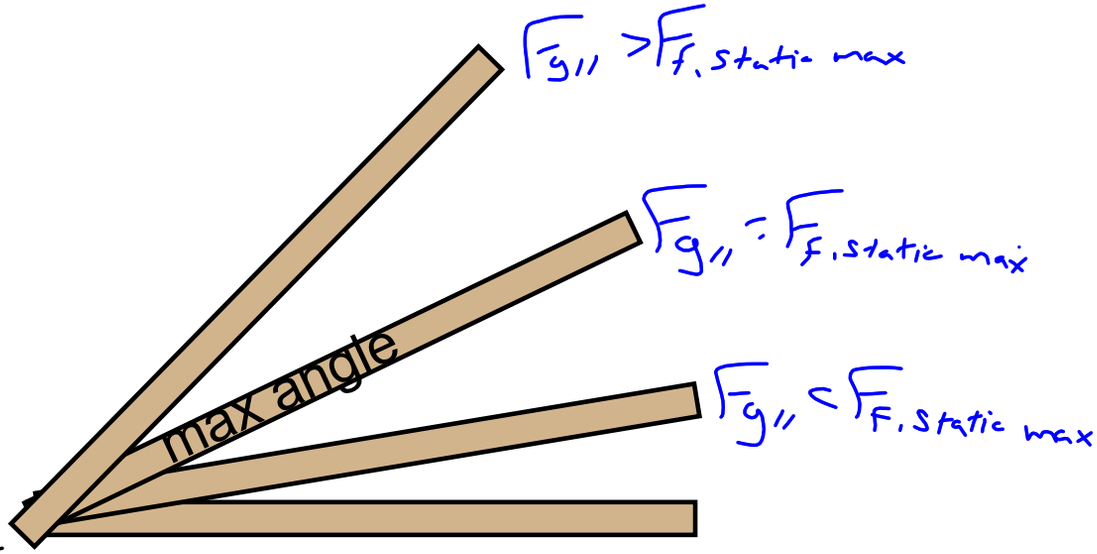
Step 4: Once the coin starts moving, stop moving to cover and hold it very still

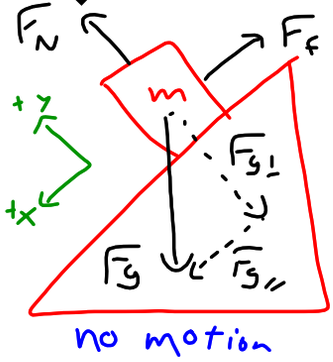
Step 5: Doing your best to keep cover in the same position, measure the angle the cover is making with the horizontal - record this value down and write it on the board

What factors can be affecting the result for this angle? What factors could be making your measured coefficient off from others, or even off of the true value?

- cover condition
- position of coin
- size of coin
- table level (shaky)
- consistency of movement
- timing
- use of protractor
- rate of movement
- condition of coin
- cover cleanliness

Summary Analysis





$F_{Net,x} = F_{g//} - F_f = 0N$ (no motion)

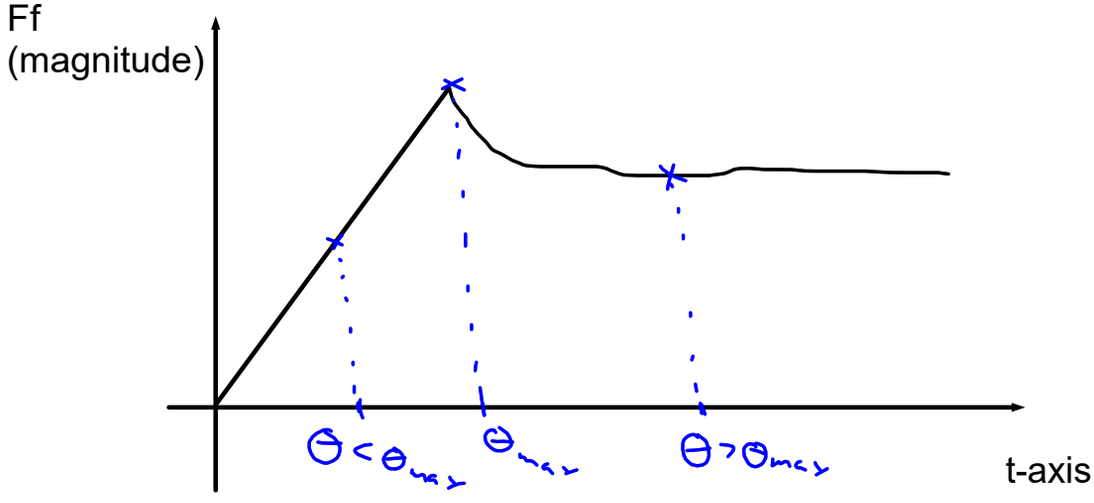
$F_{Net,y} = F_N - F_{g\perp} = 0N$

$F_N = F_{g\perp}$

$F_{g//} = mg\sin\theta$

$F_f = \mu F_N = \mu F_{g\perp} = \mu mg\cos\theta$

as $\theta \uparrow$
$F_{g//} \uparrow$
$F_f \downarrow$



Serious Thoughts About Static Friction

1. Calculate both the max force of static friction and the parallel component of gravity for a 10 kg object on surfaces inclined at the following angles. Note that the surface materials are the same and the coefficient of static friction is 0.200. (Keep 2 s.f.)

a) $\theta_1 = 4^\circ$

$F_{g//} = mg\sin\theta$ $F_f = \mu mg\cos\theta$

$= 6.8\ N$ $= 20\ N$

$F_{g//} < F_f \longrightarrow$ no motion

b) $\theta_2 = 8^\circ$

$F_{g//} = 14\ N$ $F_f = 19\ N$

$F_{g//} < F_f \longrightarrow$ no motion

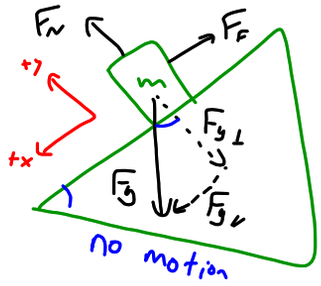
$\theta_3 = 12^\circ$

$F_{g//} = 20\ N$ $F_f = 19\ N$

$F_{g//} > F_f \longrightarrow$ moving

Serious Thoughts About Static Friction

2. What is the maximum angle at which an object of mass 10 kg will remain at rest on an inclined plane given the coefficient of static friction between the object and the plane is 0.200? (3 s.f.)



$m = 10\ kg$ $\quad \vec{a}_x = 0\ m/s^2$

$\mu_s = 0.200$ $\quad \vec{a}_y = 0\ m/s^2$

$\vec{g} = 9.81\ m/s^2$ $\quad \theta_{max} = ?$

$$F_{Net,x} = F_{g//} - F_f = 0\ N \longrightarrow F_f = F_{g//}$$

$$F_{Net,y} = F_N - F_{g\perp} = 0\ N \longrightarrow F_N = F_{g\perp}$$

$$F_f = \mu_s F_N$$

$$F_{g//} = \mu_s F_{g\perp}$$

$$\frac{mg \sin\theta_m}{\cos\theta_m} = \frac{\mu_s\, mg \cos\theta_m}{\cos\theta_m}$$

$$\boxed{\tan(\theta_{max}) = \mu_s}$$

$$\theta_{max} = \tan^{-1}(\mu_s)$$

$$= \tan^{-1}(0.200) = \boxed{11^\circ}$$