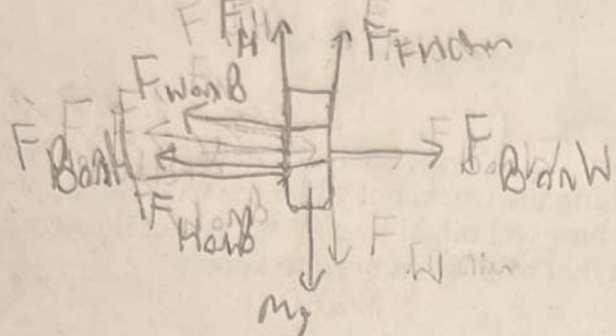
PHY121 (Jacobs) Recitation 4

1. Suppose you successfully press a book (B) against a wall (W) with your hand (H).

   a. Identify all the forces acting on the book and draw a clear extended free-body diagram (FBD) showing each force with their correct directions and approximately correct magnitudes.



   b. Suppose that you now decrease size of your pushing force, but not enough for the book to slip. What happens to each of the two normal force components and to each of the two frictional force components in your FBD; do they increase in magnitude, decrease, or not change? Explain, using Newton's 1st or 3rd Law where appropriate.

As our pushing force decreases, both normal forces would decrease (push is weaker), and the friction forces would also decrease. These 3rd law pairs fall in magnitude together.

frictional forces

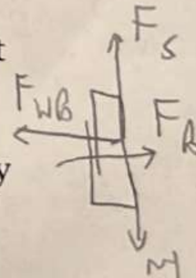
$\leq \mu_s F_N$

   c. For the situation in **b.**, what happens to the maximum force of static friction on each side of the book? Explain.

$\mu_s F_N$

The maximum force of static friction will get closer and closer to 0 as magnitude of normal force approaches 0. Decreasing pushing forces weakens the equal and opposite normal force, so $F_s \to 0$.

   d. Now suppose the side of the book on which you are pushing is very slick so that the only frictional force is between the wall and the book. If the coefficient of static friction (μ_s) between wall and book is known, as well as the book's mass m_B, then at least how hard must you push to keep the book at rest? Is this likely to be more or less than the weight of the book?



F on B

By the 2nd law, $\vec{F} = F_s - mg = m\vec{a}$ $\quad F_s = mg$

$\mu_s F_N$

We must push at least equal to the force of gravity on the book. If we push less, the book will fall.

$= \frac{F_s}{\mu_s} = \frac{mg}{\mu_s}$