WEDGES

Learning Objectives

1). To determine the *force* required to insert and/or remove a wedge.

2). To determine whether a wedge is *self-locking*.

3). To determine the *minimum coefficient of friction* necessary for a wedge to be self-locking.

4). To determine the minimum force necessary to hold a *non-self-locking* wedge in place.

Definitions

Wedge: a simple machine designed to affect a small change in the position of a system. Wedges often experience large normal and friction forces.

Self-Locking Wedge: a wedge in which the friction forces large enough to prevent it from being **squeezed** out.

Remarks

1). Friction forces always **opposes** the direction of impending motion.

2). Evaluating the condition of impending motion **out** is the only way to determine if a wedge is self-locking.

3). $F = F_s = \mu_s N$ for impending motion.

4). The weight of the wedge is often neglected because of the large normal and frictional forces acting on the wedge.

5). Wedges typically have half angles (β) of about 6°, so that μ between the wood and wedge need be only about 0.1 to be self-locking.

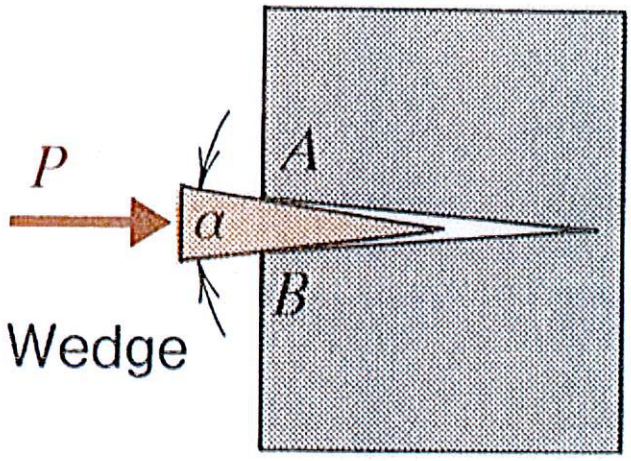


FIGURE 8a

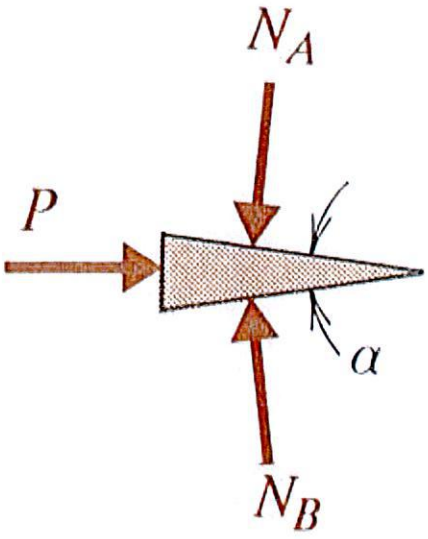


FIGURE 8b

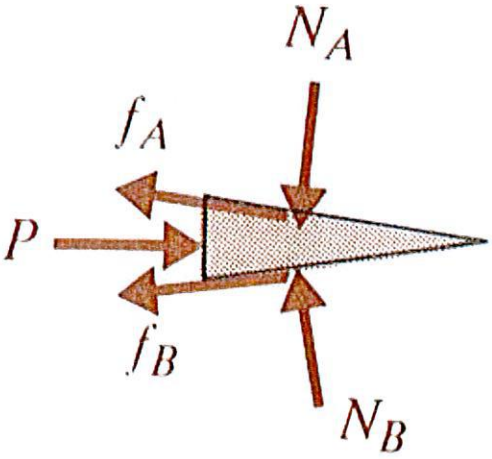


FIGURE 9a

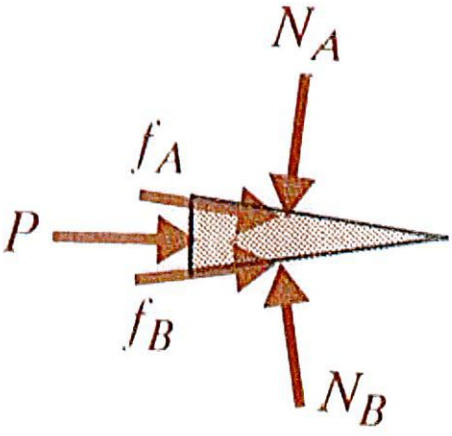


FIGURE 9b

Wedges

Example 1

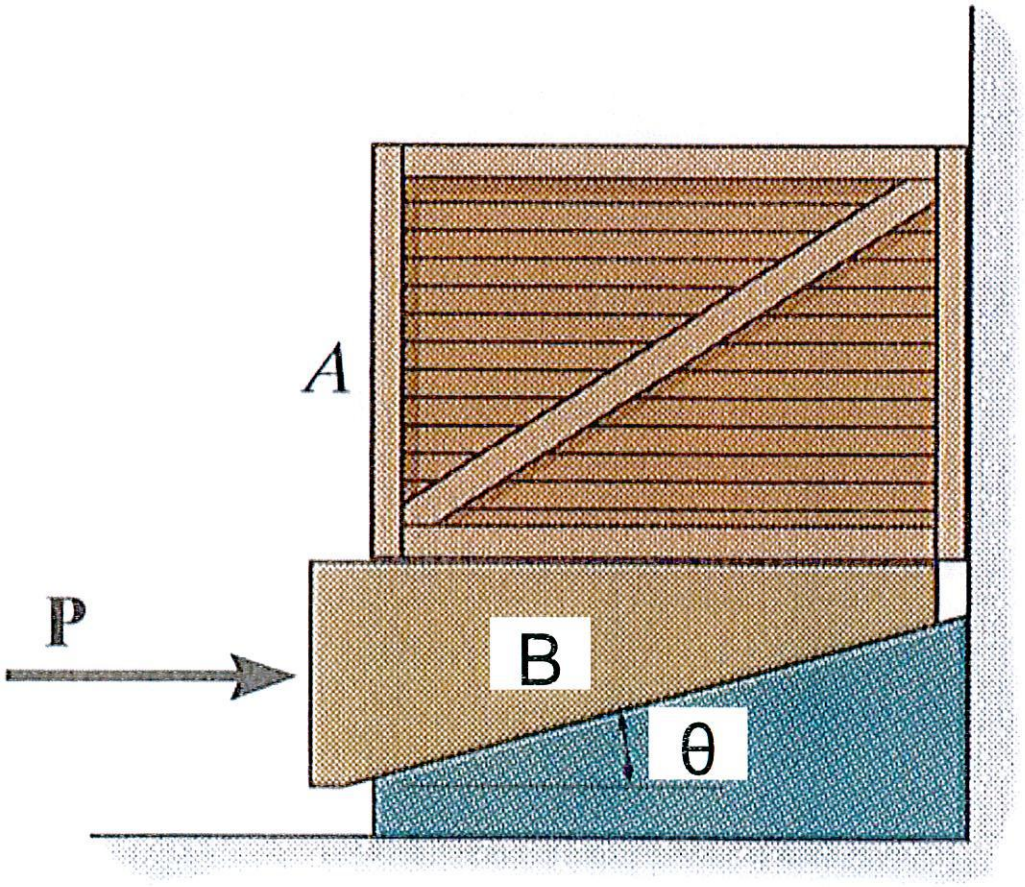
Given: A 2400N crate (A) is to be moved using wedge as shown ($\theta = 20°$). The coefficient of friction between the wedge and the crate between the wedge and the base (C) is $\mu_S = 0.3$.

Find:

a) Determine the **minimum** force P_{MIN} required to raise the crate.

b) Determine the **maximum** force P_{MAX} required to lower the crate.

c) Is the wedge self-locking? Justify your answer using your results from parts (a) and (b).



Wedges
Example 2

Given: A 1m diameter circular pipe is raised by a wedge with a 10° slope using force P. The pipe has a weight of 981N, and the coefficient of static friction at surface A is $\mu_s = 0.6$, at surface B it is $\mu_s = 0.2$, and at surface C it is $\mu_s = 0.3$.

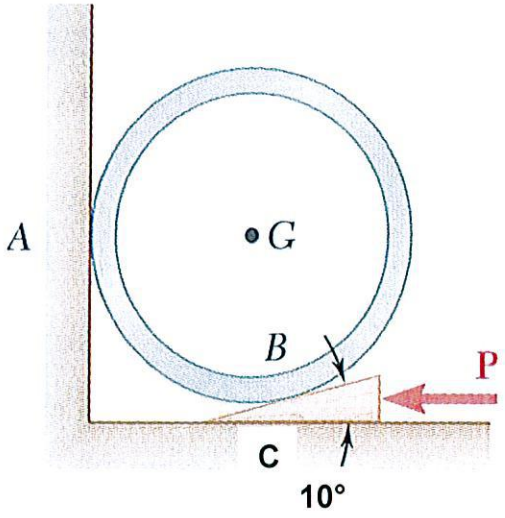
Find:

a) Qualitatively determine the possible motions that could occur.

b) Using the proper assumptions, determine the minimum value of Force P required to initiate motion.

c) Describe the nature of the impending motion.

d) Can you tell if the wedge self-locking?



Friction: Wedges
Group Quiz 1

Group #: _____

Group Members: 1) _____
(Present Only)

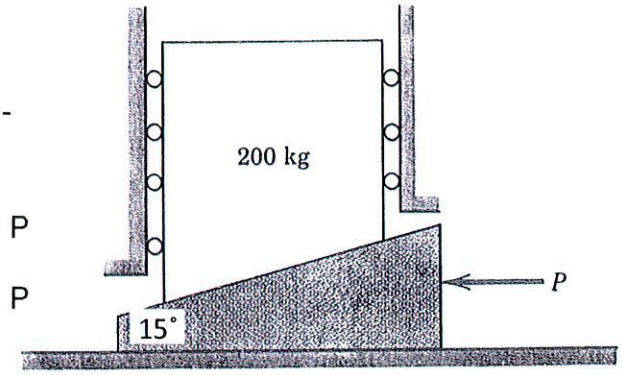
Date: _____ Period: _____

2) _____

3) _____

4) _____

Given: A 200 kg load is positioned on a 15° wedge. The coefficient of friction is $\mu = 0.1$ for all contacting surfaces. Assume the mass of the wedge is negligible.



Find:

a) Determine the magnitude and direction of force P necessary to raise the load.
b) Determine the magnitude and direction of force P necessary to lower the load.
c) Is the wedge self-locking?

Solution: