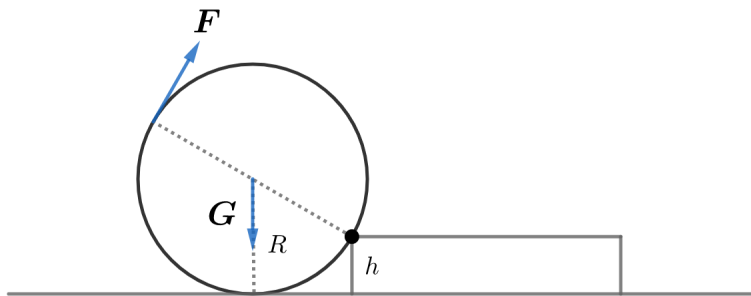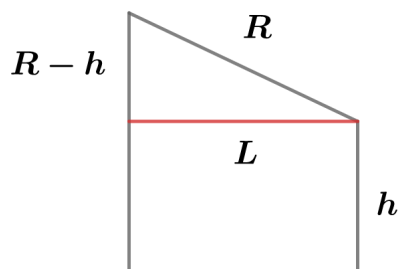# 2019A F=ma Exam: Problem 5

Kevin S. Huang

To roll the cylinder over the step, we need to balance the torque from gravity. To minimize the applied force, we maximize its moment arm:

$$F(2R) = GL$$

where L is the moment arm of the cylinder's weight.

We have

$$L = \sqrt{R^2 - (R-h)^2} = \sqrt{2Rh - h^2}$$

so

$$F = \frac{\sqrt{2Rh - h^2}}{2R}G$$

Note that as the cylinder rotates about the pivot, the torque from gravity decreases (since its moment arm shortens) so F is indeed the minimum force required. Thus, the answer is $\boxed{C}$.