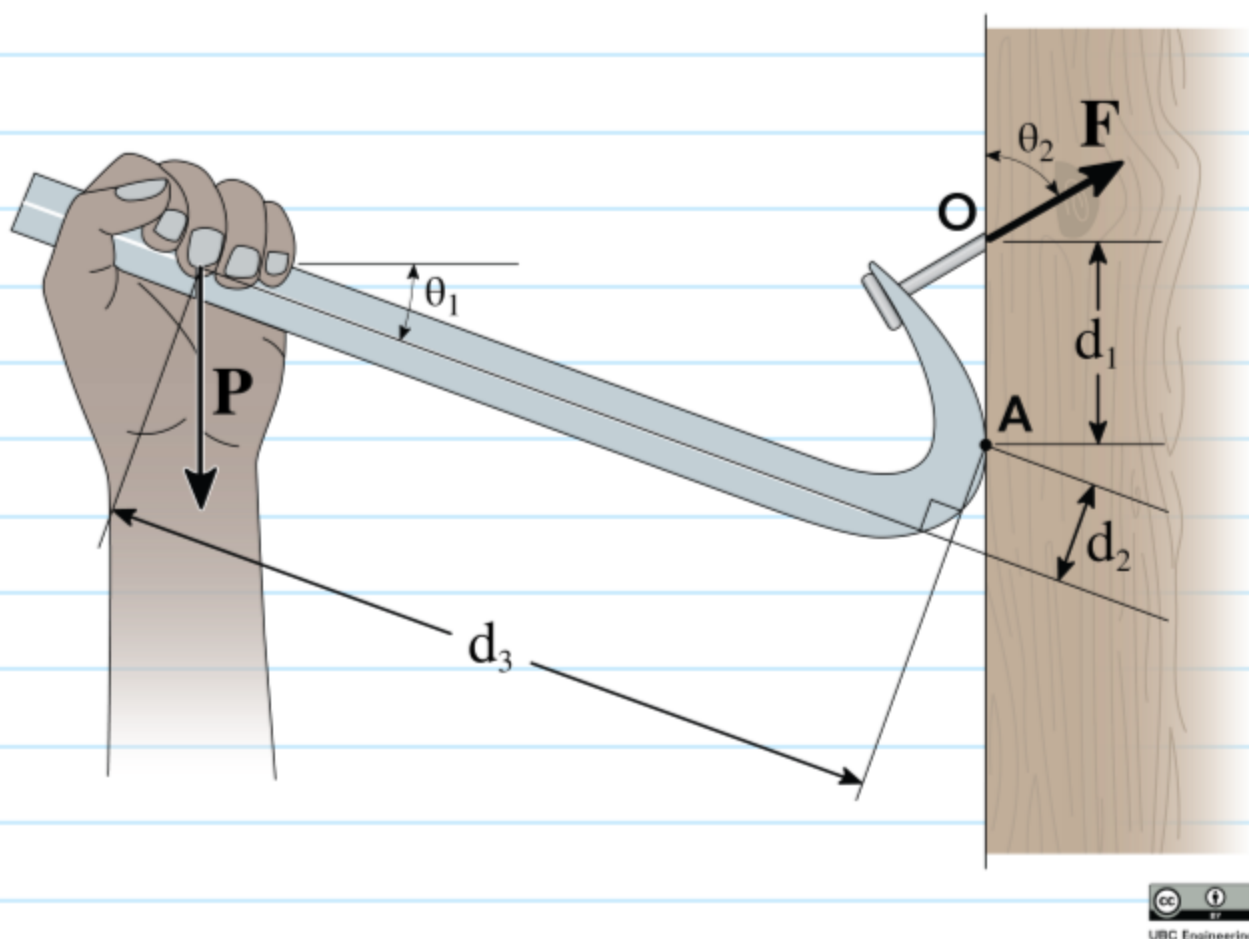A contractor is renovating a home and they are removing old nails from a stud. An especially stubborn nail begins to come out, just as the contractor pulls down with P N. If the crowbar was in equilibrium just before moving, what is the magnitude of the nail's force F?
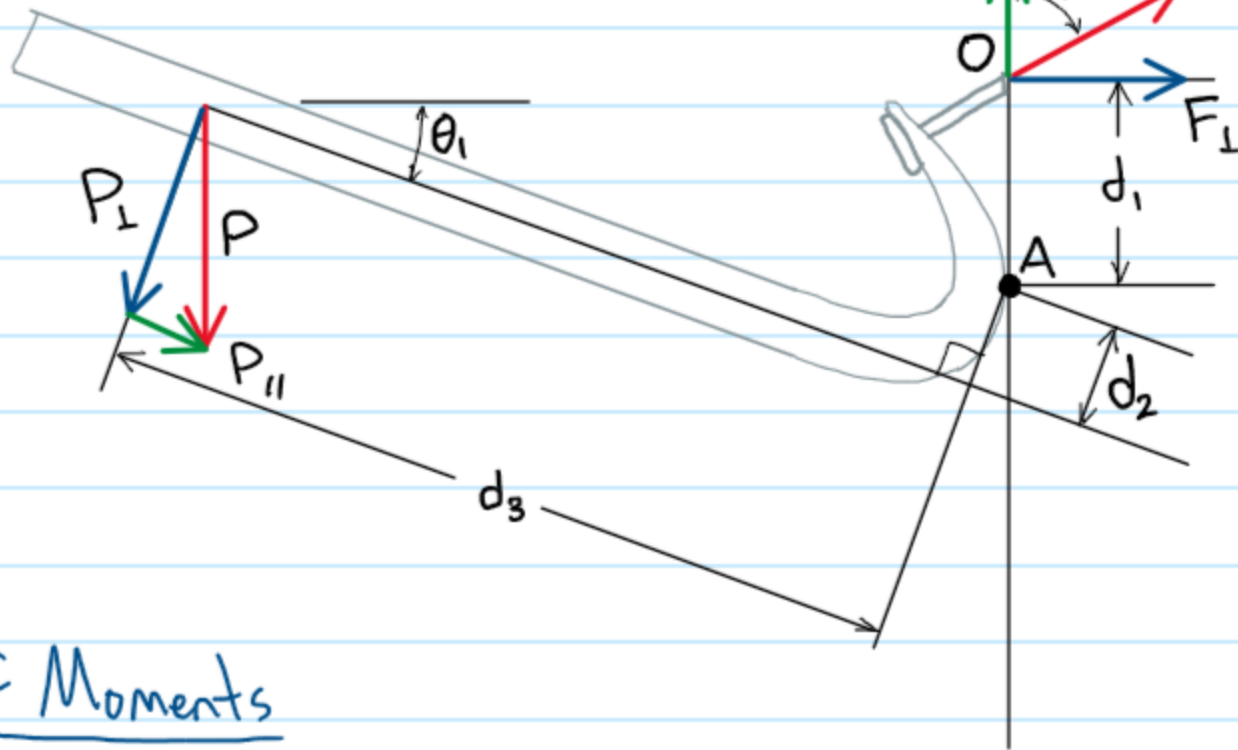
($\theta_1 = \theta_1$ degrees, $\theta_2 = \theta_2$ degrees, $d_1 = d_1$ m, $d_2 = d_2$ m and $d_3 = d_3$ m. Take the moment about A)

given
P, θ_1, θ_2

find
F

$P_\perp = P\cos\theta_1$
$P_{||} = P\sin\theta_1$
$F_\perp = F\sin\theta_2$

FBD

forces with line of action through A apply no moment

$F_{||}$ θ_2 F

O

$F_\perp$

θ_1

$P_\perp$

P

$P_{||}$

d_1

A

d_2

d_3

Sum of Moments

$\circlearrowright \quad \sum M_A = 0 = P\cos\theta_1(d_3) + P\sin\theta_1(d_2) - F\sin\theta_2(d_1)$

$$F = \frac{P\cos\theta_1(d_3) + P\sin\theta_1(d_2)}{\sin\theta_2(d_1)}$$