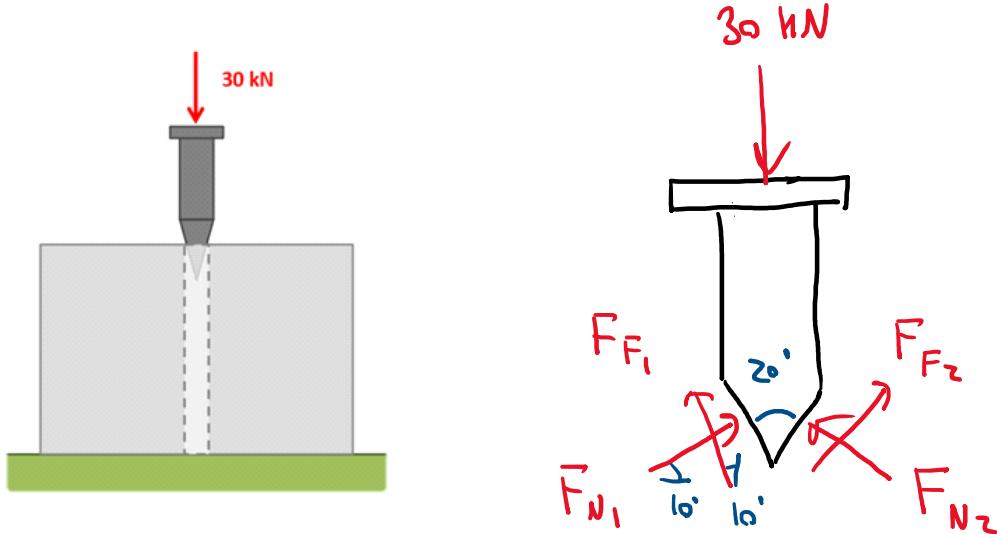


Problem 1

A geologist drills a hole through a rock and is trying to split the rock using a rock chisel as shown below. Assume the tip of the chisel has a 20-degree angle and that the coefficient of friction between the chisel and rock is 0.3. If the geologist exerts a 30kN force by striking the chisel with a hammer, what are the expected normal forces on the rock?



Assume Symmetry

Assume negligible mass
for chisel

Impending motion

$$F_{F_1} = 0.3 F_{N_1} \quad F_{F_2} = 0.3 F_{N_2}$$

$$\begin{aligned} \sum F_x &= F_{N_1} \cos(10) - 0.3 F_{N_1} \sin(10) \\ &\quad - F_{N_2} \cos(10) + 0.3 F_{N_2} \sin(10) = 0 \end{aligned}$$

$$F_{N_1} (\cos(10) - 0.3 \sin(10)) = F_{N_2} (\cos(10) - 0.3 \sin(10))$$

$$F_{N_1} = F_{N_2}$$

$$\begin{aligned} \sum F_y &= F_{N_1} \sin(10) + F_{N_2} \sin(10) + 0.3 F_{N_1} \cos(10) \\ &\quad + 0.3 F_{N_2} \cos(10) - 30 \text{ kN} = 0 \end{aligned}$$

$F_{N_1} = F_{N_2} = 31.98 \text{ kN}$