



In order to pull out the nail embedded at O , a force P is exerted downward at the handle of a crowbar. If a force of F is required to pull out the nail, what is the smallest force P that will remove the nail from the wall.

Identify the direction of the moments created by each force about A .

F : clockwise

P : counterclockwise

Determine the moment created by F about the point A .

$$M_{F_A} = d_1 F \sin \theta_2$$

Determine the minimum force P required to remove the nail.

$$M_{P_A} = d_3 \cdot P \cos \theta_1 + d_2 \cdot P \sin \theta_1$$

Since moments are in opposite directions:

$$M_{P_A} = M_{F_A}$$

$$P \cdot (d_3 \cos \theta_1 + d_2 \sin \theta_1) = d_1 F \sin \theta_2$$

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