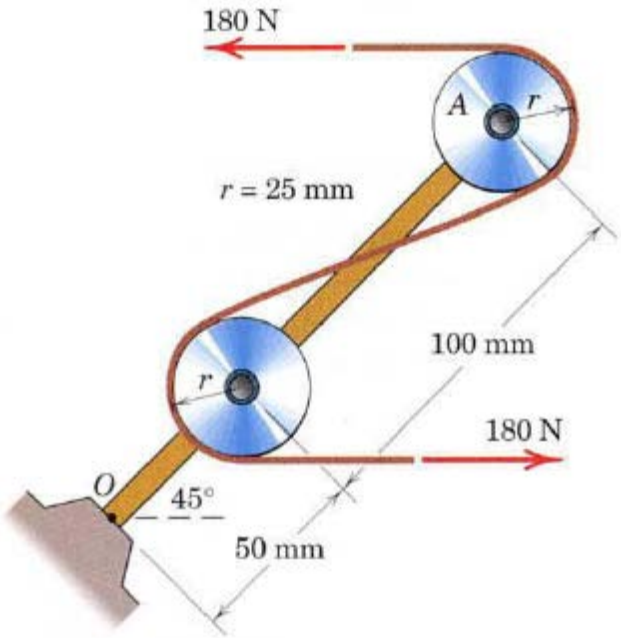
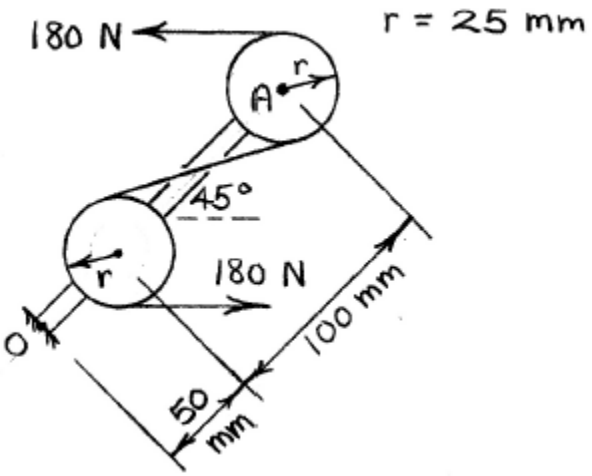
Problem 5

The system consisting of the bar GA, two identical pulleys, an d a section of thin tape is subjected to the two 180-N tensile forces shown in the figure. Determine the equivalent force-couple system at point O.



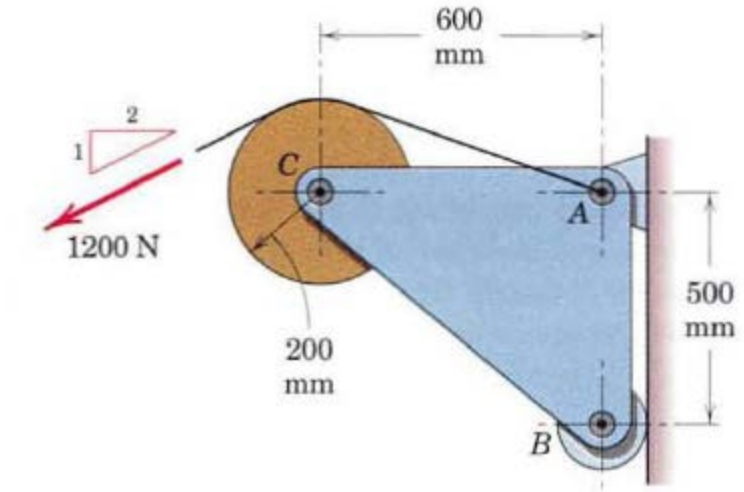
Solution



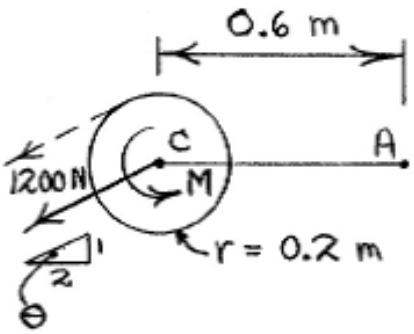
$$\curvearrowleft M = Fd = 180\,(100 \sin 45^\circ + 25 + 25)$$
$$= 21\,700 \text{ N·mm or } \underline{21.7 \text{ N·m CCW}}$$

Problem 6

Calculate the moment of the 1200-N force about pin A of the bracket. Begin by replacing the 1200-N force by a force - couple system at point C.



Solution



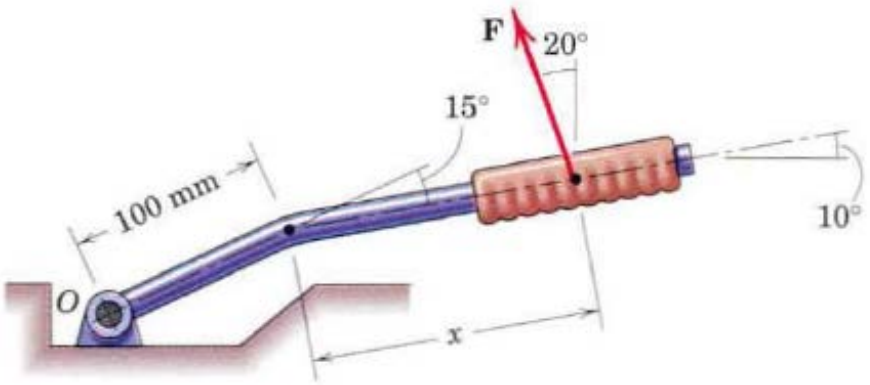
$$\circlearrowleft M = 1200(0.2) = 240 \text{ N·m}$$

$$\theta = \tan^{-1}\left(\frac{1}{2}\right) = 26.6^\circ$$

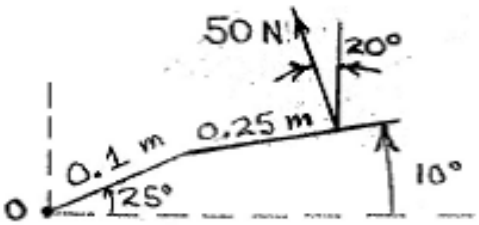
$$\circlearrowleft M_A = 1200 \sin 26.6\,(0.6) + 240 = \underline{562 \text{ N·m}}$$

Problem 7

A force F of magnitude 50 N is exerted on the automobile parking-brake lever at the posit ion x = 250 mm. Replace the force by a n equivalent force-couple system at the pivot point O.



Solution



$$\circlearrowleft \Sigma M_O = 50 \cos 20^\circ [0.1 \cos 25^\circ + 0.25 \cos 10^\circ] + 50 \sin 20^\circ [0.1 \sin 25^\circ + 0.25 \sin 10^\circ]$$

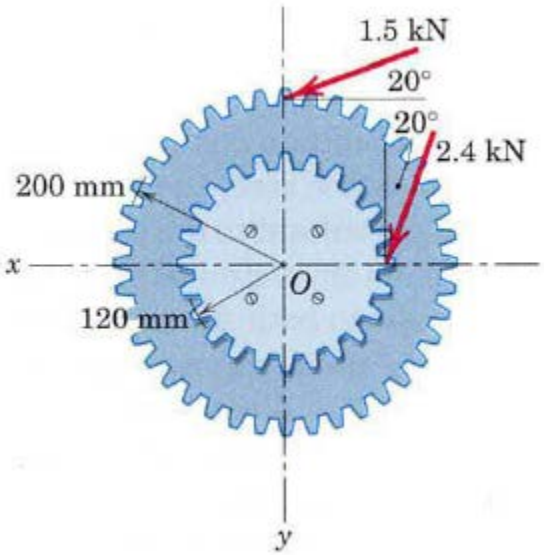
$$= 17.29 \ \text{N·m}$$

Force - Couple System at O:

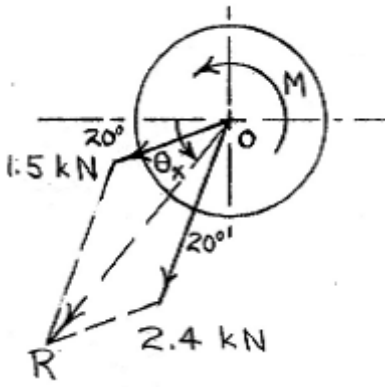
$$\begin{cases} R = 50 \ \text{N} \ \angle 110^\circ \\ M_O = 17.29 \ \text{N·m} \ \circlearrowleft \end{cases}$$

Problem 8

The figure represents two integral gears subjected to the tooth-contact forces shown. Replace the two forces by an equivalent single force R at the rotation axis O and a corresponding couple M. Specify the magnitudes of R and M. If the gears were to star t from rest under the action of the tooth loads shown, in what direction would rotation take place?



Solution



$$R_x = \Sigma F_x = 1.5 \cos 20^\circ + 2.4 \sin 20^\circ$$

$$= 2.23 \text{ kN}$$

$$R_y = \Sigma F_y = 1.5 \sin 20^\circ + 2.4 \cos 20^\circ$$

$$= 2.77 \text{ kN}$$

$$R = \sqrt{R_x^2 + R_y^2} = \sqrt{2.23^2 + 2.77^2}$$

$$= \underline{3.56 \text{ kN}}$$

$$\theta_x = \tan^{-1}\left(\frac{2.77}{2.23}\right) = \underline{51.1^\circ}$$

$$M = 1.5\,(200)\cos 20^\circ - 2.4\,(120)\cos 20^\circ$$

$$= 11.28 \text{ N·m} \quad \underline{\text{CCW}}$$