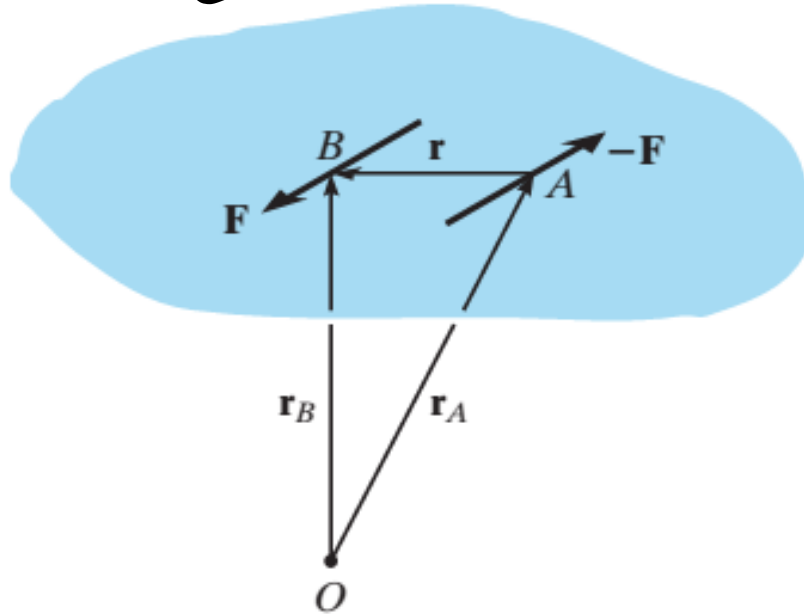


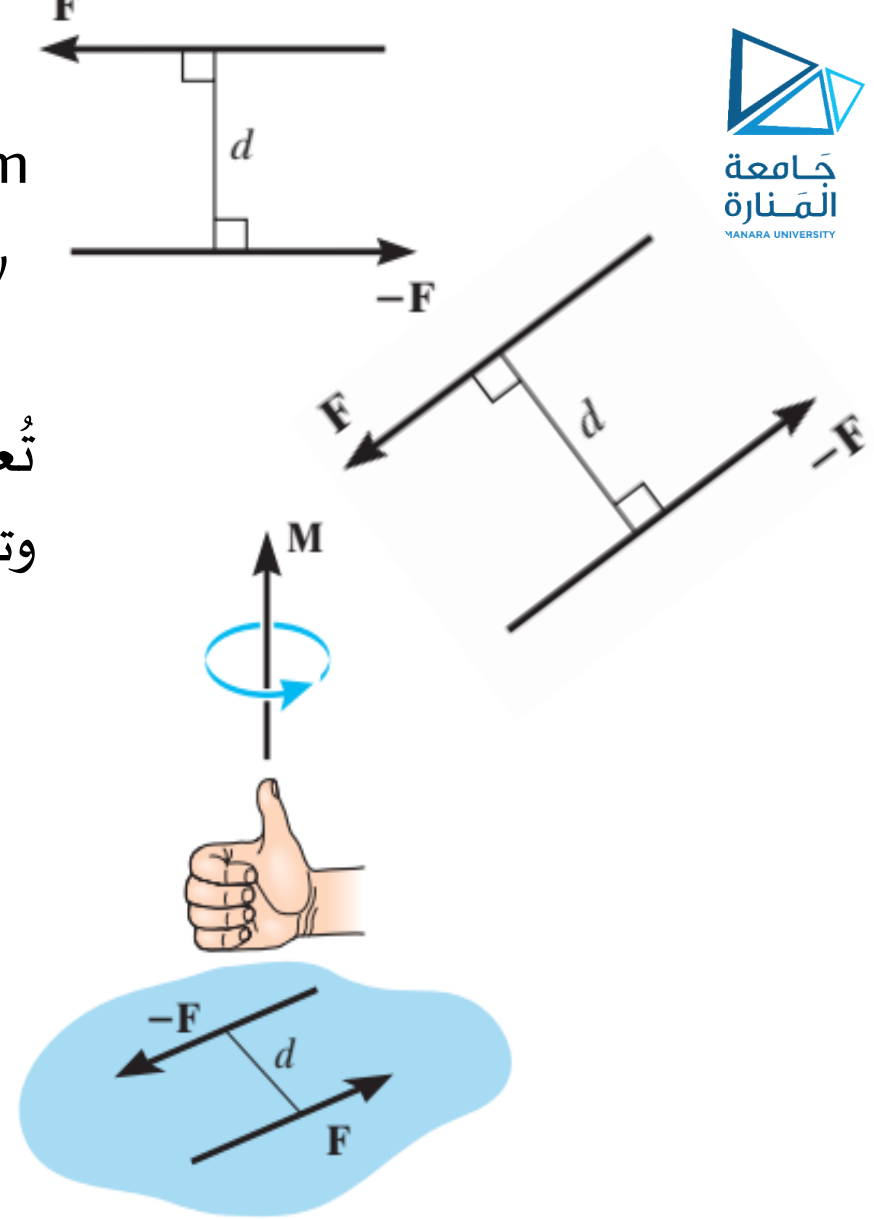
عزم المزدوجة Moment of a Couple

A *couple* is defined as two parallel forces that have the same magnitude, but opposite directions, and are separated by perpendicular distance d called arm of the couple.

تُعرف المزدوجة كقوتين متوازيتين لهما الشدة نفسها، لكن اتجاهيهما متعكسان وتفصل بينهما مسافة عمودية قدرها d ندعوها ذراع المزدوجة.



$$\vec{M} = \vec{r}_B \times \vec{F} + \vec{r}_A \times (-\vec{F}) = (\vec{r}_B - \vec{r}_A) \times \vec{F} = \vec{r} \times \vec{F}$$



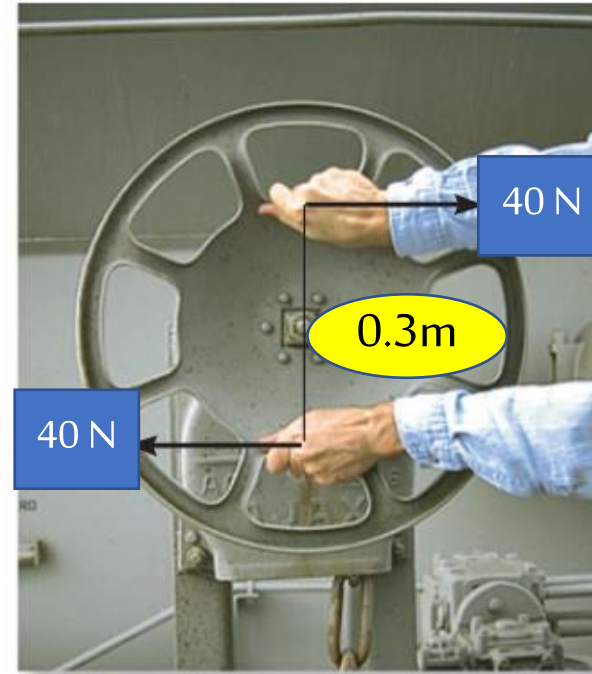
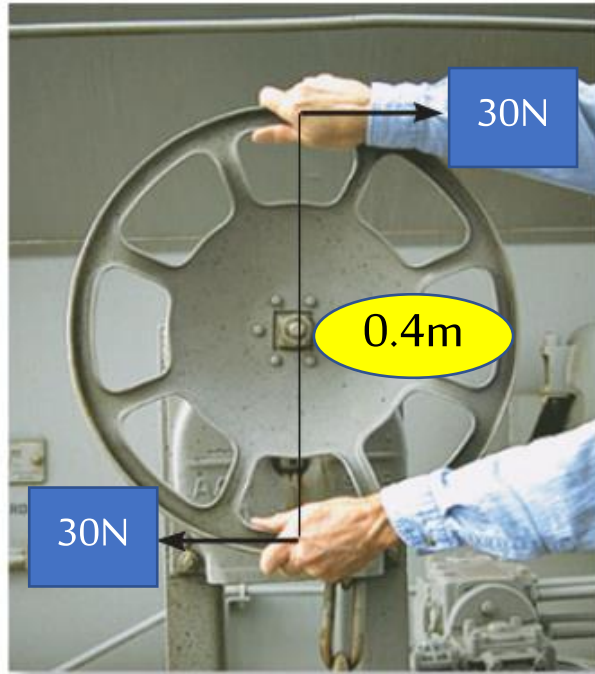
$$M = Fd$$

Equivalent Couples

Two couples are equivalent if they produce the same moment. Their forces lie on the same plane or planes parallel to one another.

المزدوجات المتكافئة

تتكافئ مزدوجتان إذا ولدتا شعاع العزم ذاته. تقع القوى الأربع لمزدوجتين متكافئتين في مستوى واحد أو في مستويين متوازيين.



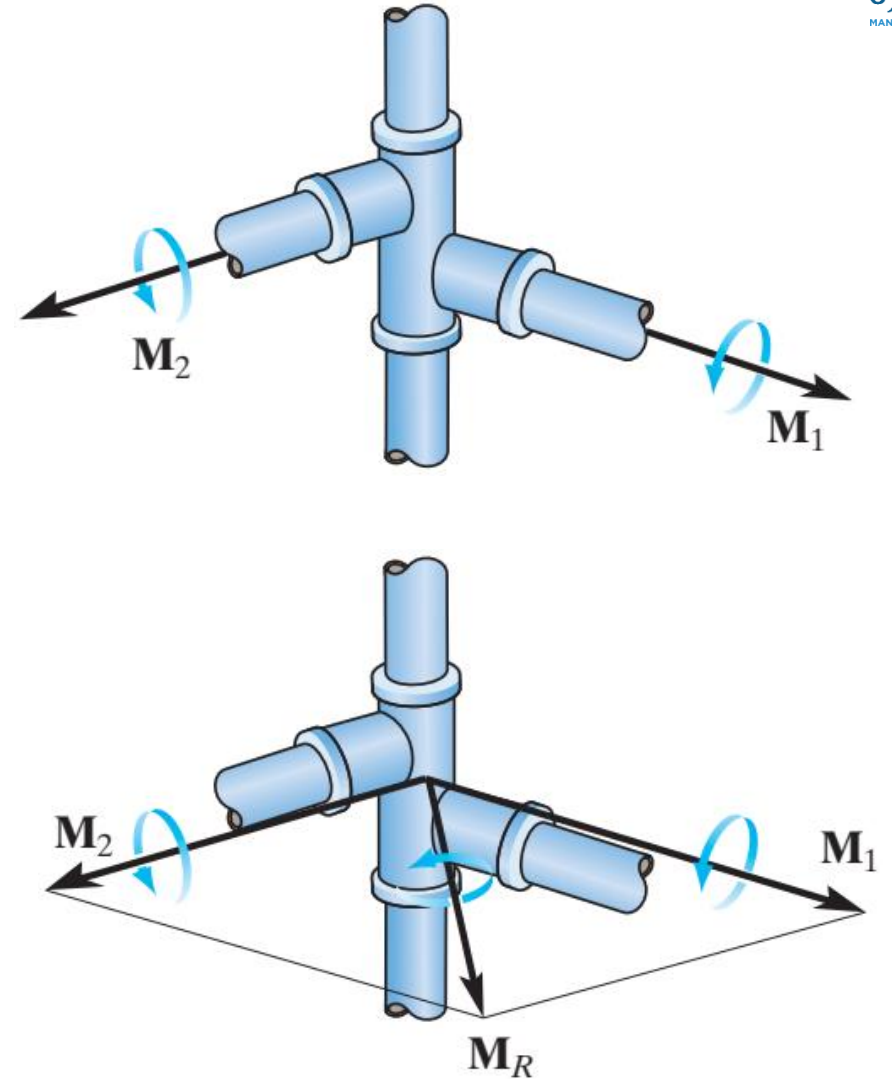
$$M = -30 \text{ [N]}(0.4 \text{ [m]}) = -40 \text{ [N]}(0.3 \text{ [m]}) = -12 \text{ N.m}$$

تجمع عزوم المزدوجات الواقعة في مستوي واحد أو في مستويات متوازية جبرياً. لكن..

Resultant Couple Moment.

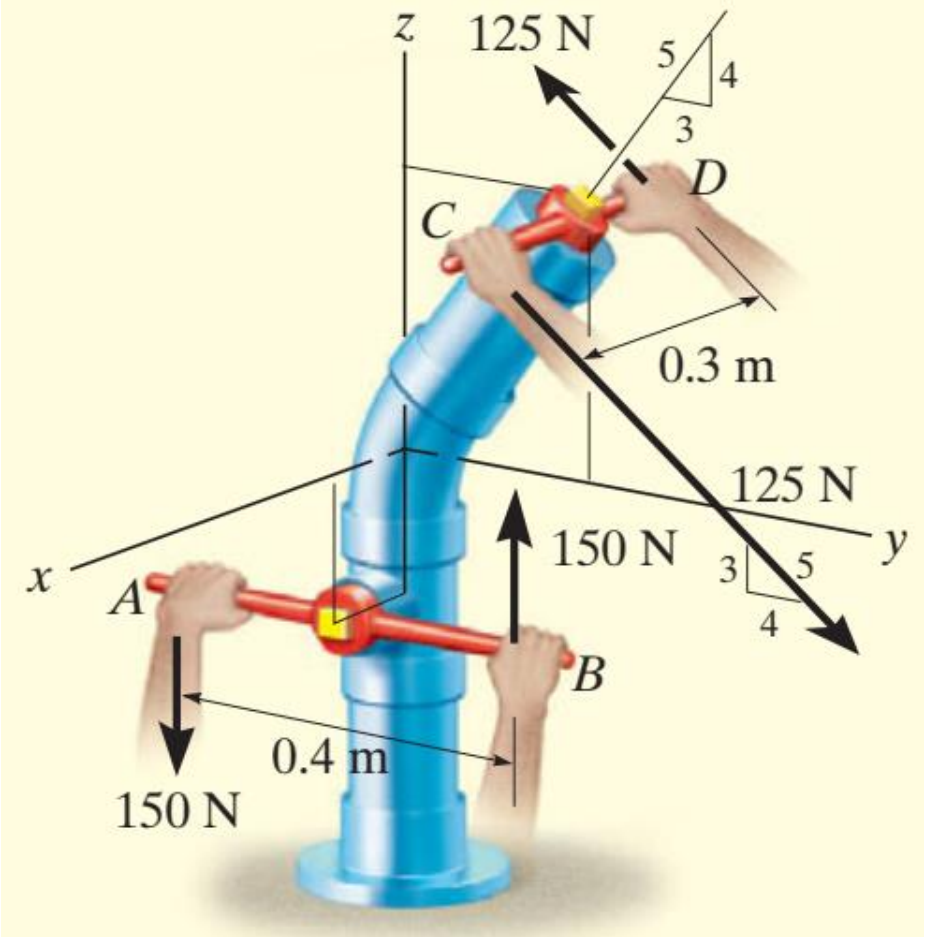
Since couple moments are vectors, their resultant can be determined by vector addition.

$$\vec{M}_R = \vec{M}_1 + \vec{M}_2$$



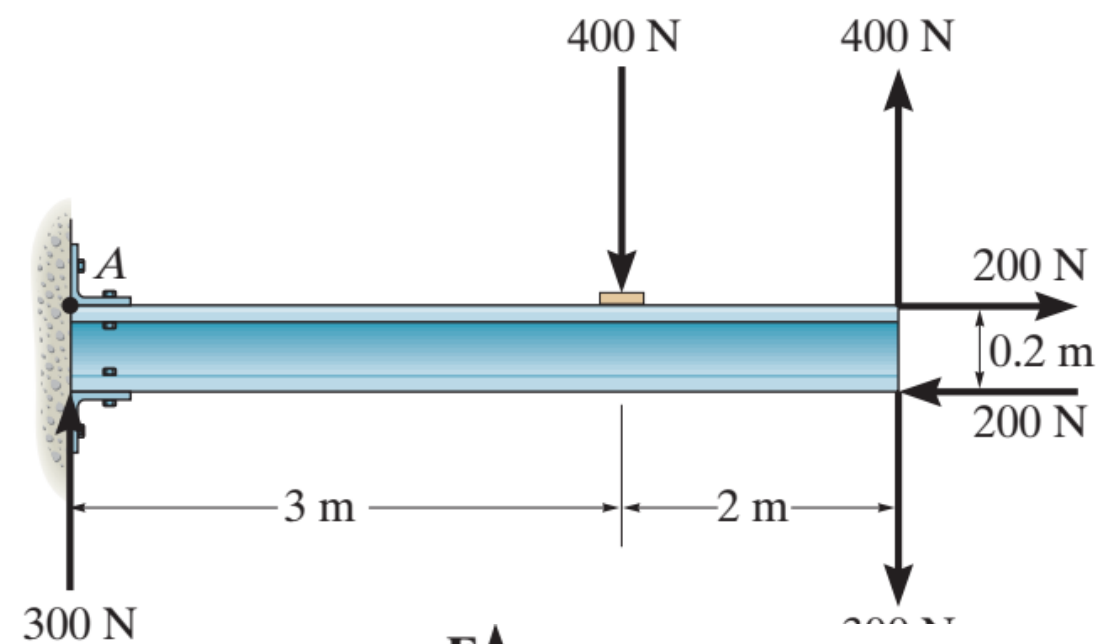
EXAMPLE 1.

Replace the two couples acting on the pipe column in Fig. by a resultant couple moment.



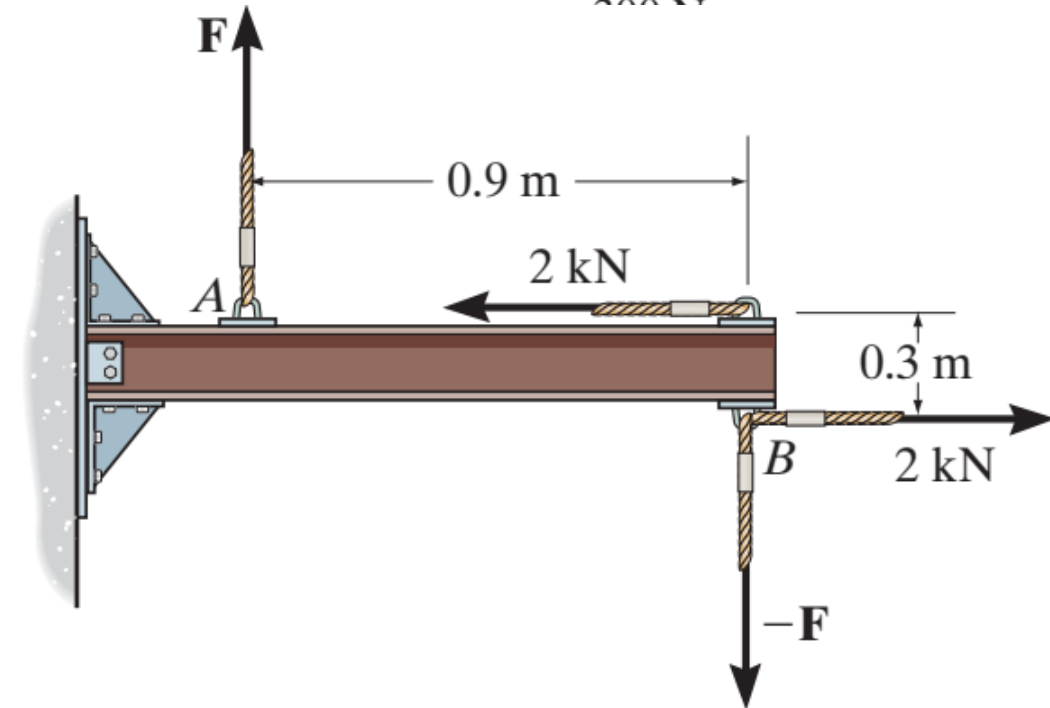
EXAMPLE 2.

Determine the resultant couple moment acting on the beam.



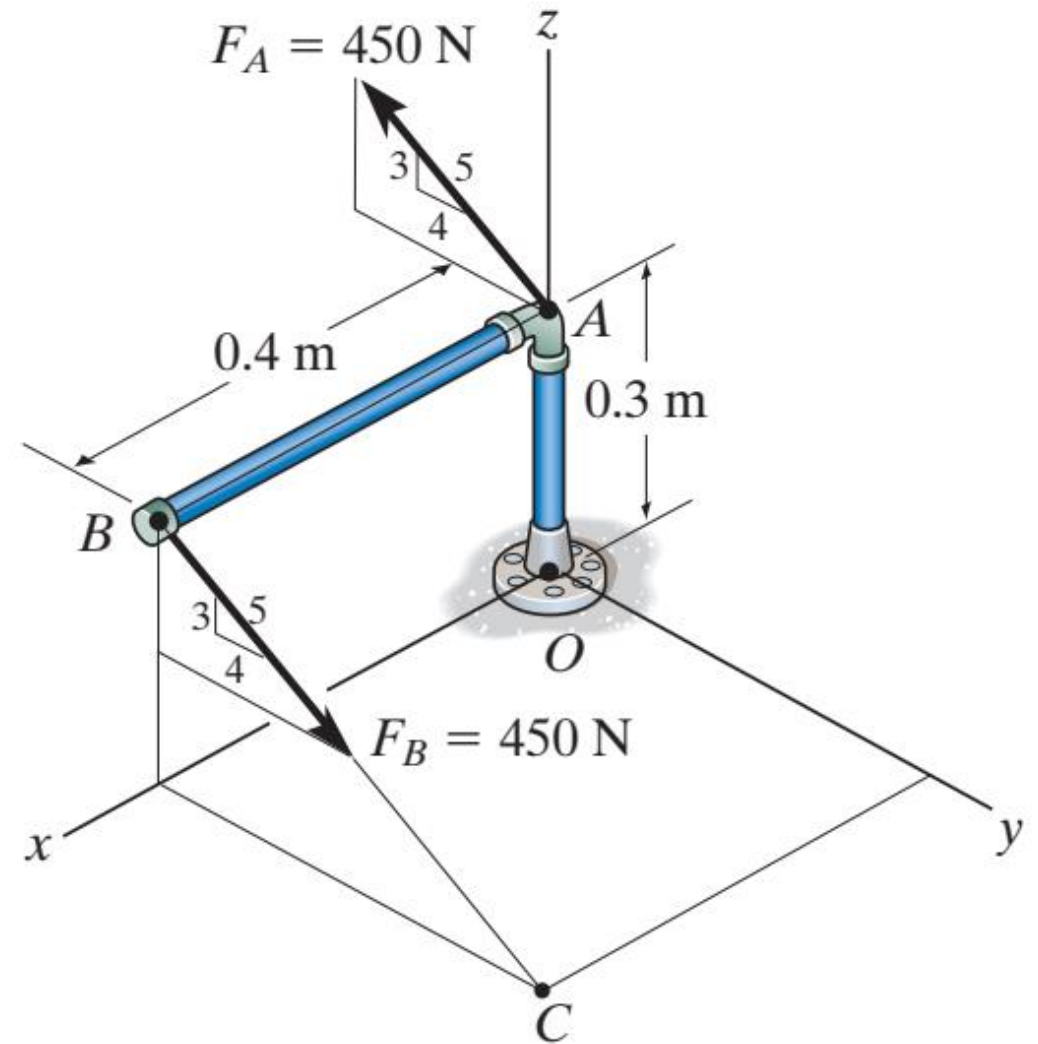
EXAMPLE 3.

Determine the magnitude of F so that the resultant couple moment acting on the beam is $-1.5 \text{ kN}\cdot\text{m}$ (clockwise).



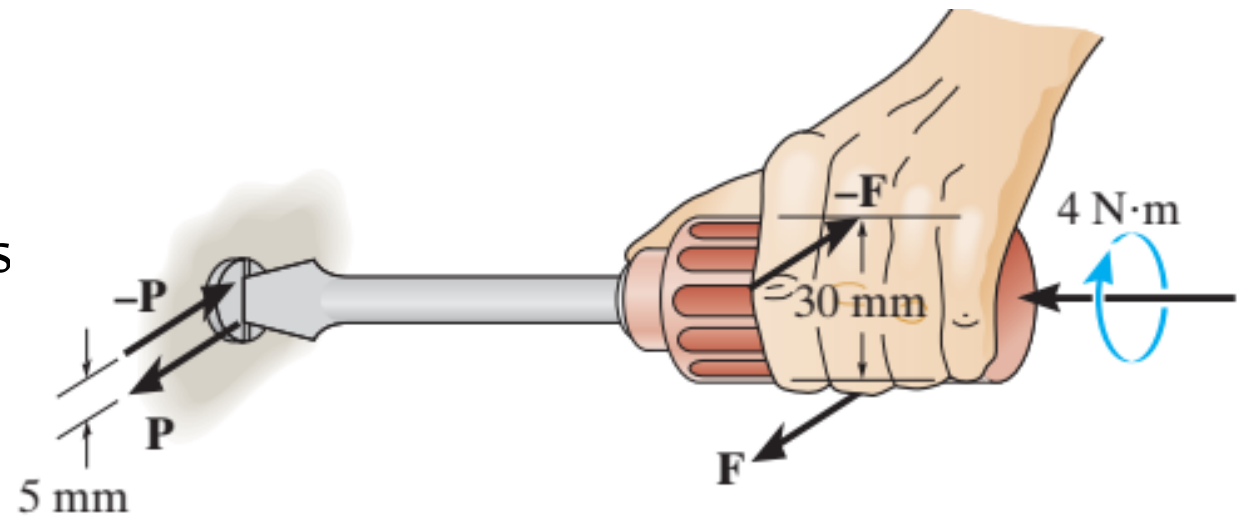
EXAMPLE 4.

Determine the couple moment acting on the pipe assembly and express the result as a Cartesian vector .



EXAMPLE 5.

A torque of $4 \text{ N}\cdot\text{m}$ is applied to the handle of the screwdriver. Resolve this couple moment into a pair of couple forces F exerted on the handle and P exerted on the blade.



EXAMPLE 6.

The ends of the triangular plate are subjected to three couples. Determine the plate dimension d , so that the resultant couple is 350 N.m clockwise.

