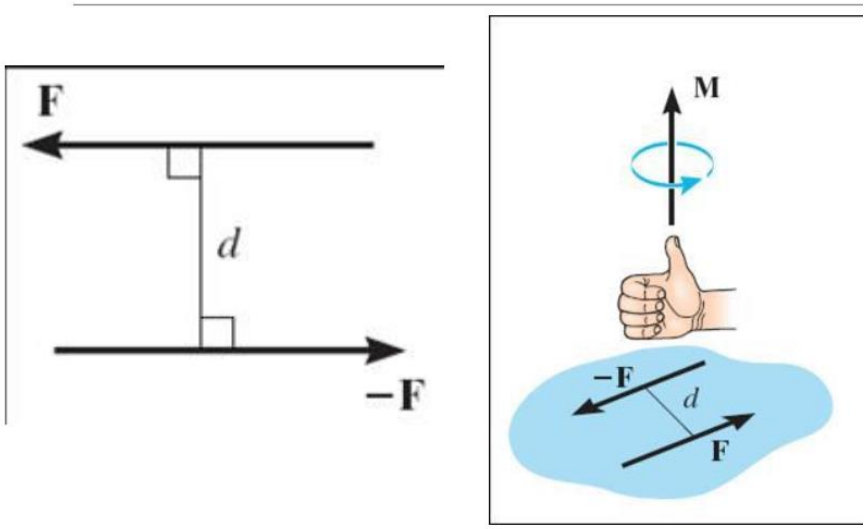
The Moment of Couple

A couple: is defined as two parallel forces with the same magnitude but opposite in direction separated by a perpendicular distance d.



The moment of a couple is defined as

$M_O = F * d$ (using a scalar analysis)

Important Note:

Moment of a couple depends solely on the magnitude and the perpendicular distance between the forces, it is "free vector"!

Email (mariam.ghassan.ghaffar@uomus.edu.iq)

*Classification of couples

The couples may be, broadly, classified into the following two categories, depending upon their direction, in which the couple tends to rotate the body, on which it acts :

1. Clockwise couple,
2. Anticlockwise couple.

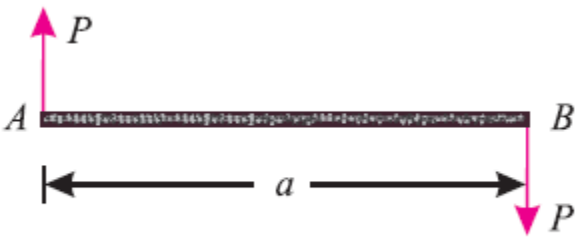
1. CLOCKWISE COUPLE

A couple, whose tendency is to rotate the body, on which it acts, in a clockwise direction, is known as a clockwise couple as shown in (a). Such a couple is also called positive couple.

2. ANTICLOCKWISE COUPLE

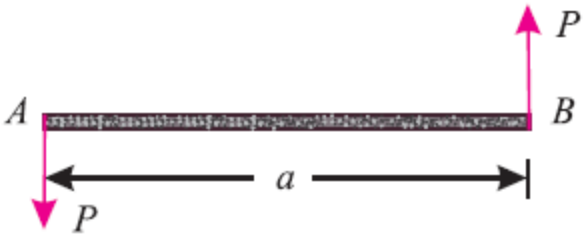
A couple, whose tendency is to rotate the body, on which it acts, in an anticlockwise direction, is known as an anticlockwise couple as shown in(b). Such a couple is also called a negative couple.

The Moment of Couple



(a) Clockwise couple

Email (mariam.ghassan.ghaffar@uomus.edu.iq)



(*b*) Anticlockwise couple

The Moment of Couple

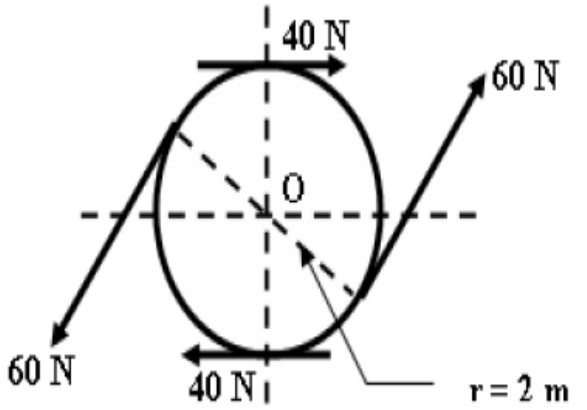
Email (mariam.ghassan.ghaffar@uomus.edu.iq)

Ex1: Compute the magnitude and direction of the resultant couples action on the body shown.

Solution:

Mc = 60 * 4 – 40 * 4

= 240 – 160 = 80 N.m

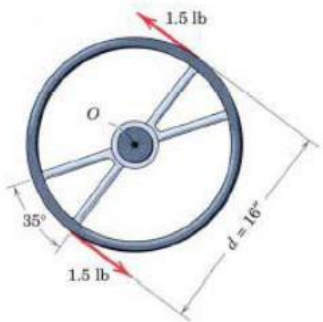


Ex2: Determine the moment associated with the forces shown in fig.

Solution:

Mc = F * d

= 1.5 * 16= 24 Ib.In



Email (mariam.ghassan.ghaffar@uomus.edu.iq)

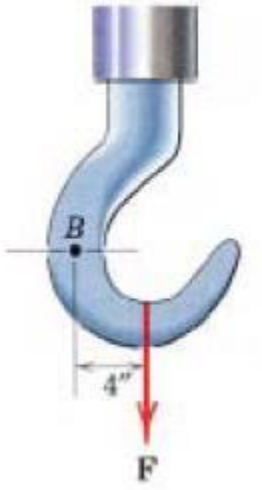
Ex3:In the design of lifting hook , the action of the applied force (F) at theoretical section of the hook is a direct pull at (B) and a couple . if the magnitude of the couple is (4000 N.m) , Determine the magnitude of the force (F).

Solution:

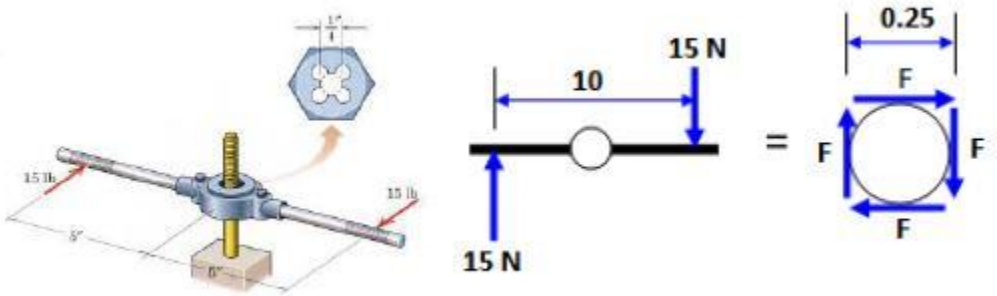
MB = F * d

4000 = F * 4

F = 1000 N



Ex4:A die is being used to cut thread son a rod . if the (150 N) forces are applied as shown , Determine the magnitude of (F) of the equal forces exerted on the (1/4 ") rod by each of the four cutting surfaces so that their external effect on the rod is equivalent to that of the two (15 N) forces .



Email (mariam.ghassan.ghaffar@uomus.edu.iq)

Solution:

M = F × d

M=15× 10 =150 N.in

M = F ×0.25

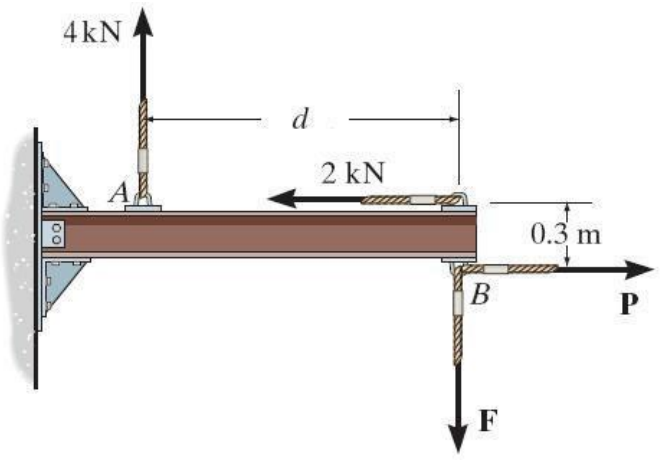
M_{total} = 2(F × 0.25) = 0.5F

0.5F=150

F= 300N

Ex5: Two couples act on the beam. The resultant couple is zero. Find the magnitudes of the forces P and F and the distance d.

1) Use definition of a scalar couple to find P and F.
2) Determine the net moment (couple).
3) Equate the net moment to zero to find d.



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From the definition of a couple:

P = 2 kN

F = 4 kN

Determine the net moment

ΣM = (2)(0.3) – (4)(d)

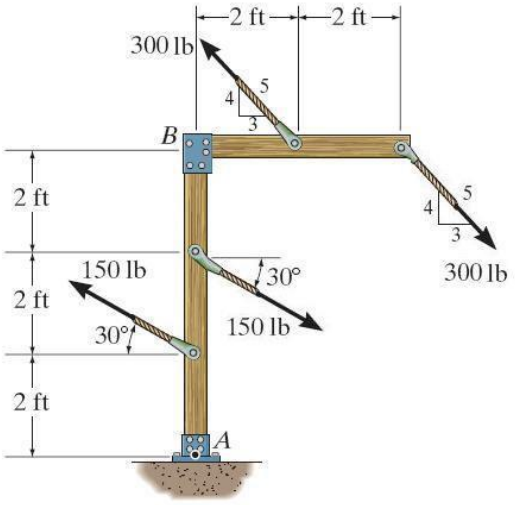
It was given that the net moment equals zero. So

ΣM = (2)(0.3) – (4)(d) = 0

Now solve this equation for d.

d = (0.6) N·m / (4) N = 0.15 m

HW: Two couples act on the beam with the geometry shown. Find the resultant couple



Email (mariam.ghassan.ghaffar@uomus.edu.iq)