Lec07

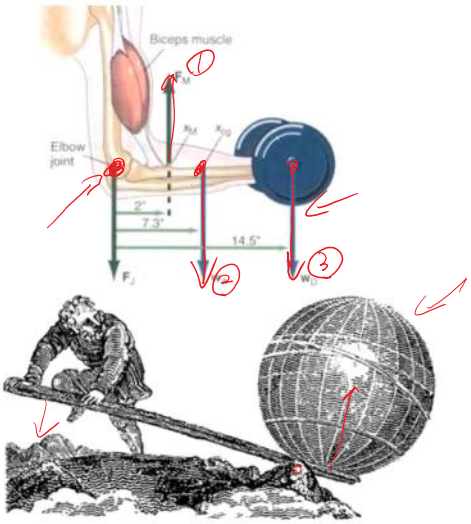
Sunday, September 27, 2020 10:02 AM

Lecture Objectives

Moment about a point

1

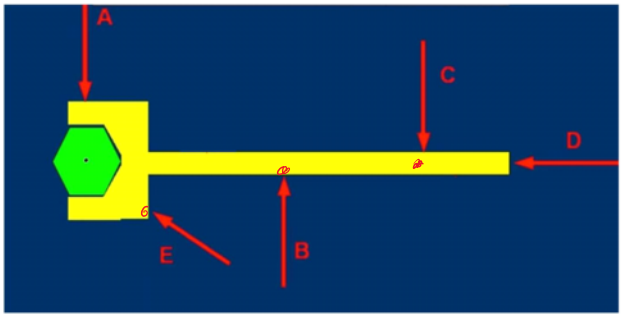
Applications



Moment - A turning effect produced by a force acting at a distance on an object.

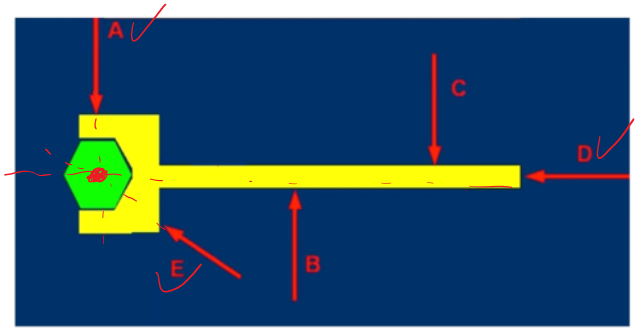
Give me a place to stand, and a lever long enough, and I will move the world.
-Archimedes

Moment of a Force



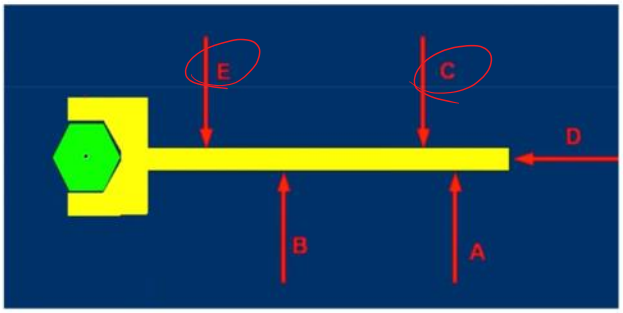
All five forces shown above have the same magnitude, do they have the same effects on the wrench??

Moment of a Force



Which force(s) have NO turning effect?

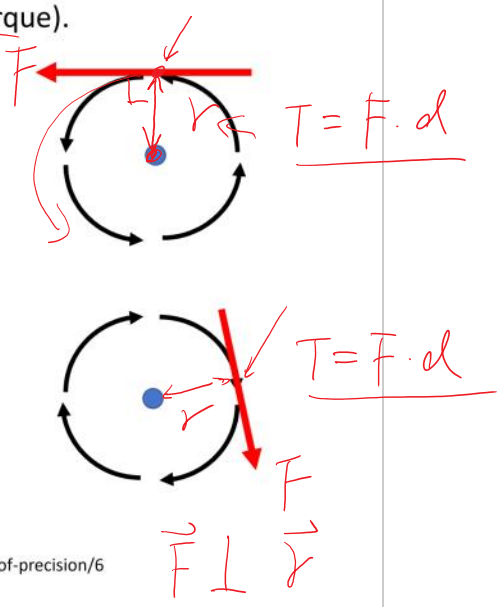
Moment of a Force



Which force(s) yields a "tighty" effect?

Moment of a force – scalar formulation

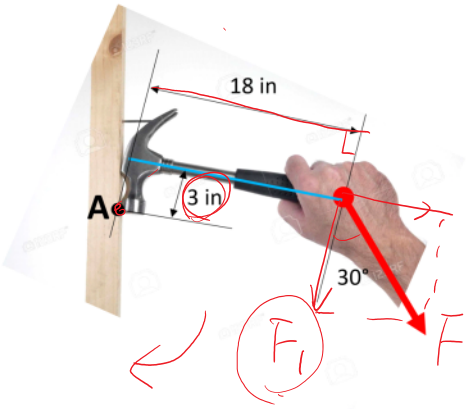
The **moment of a force about a point** provides a measure of the **tendency for rotation** (sometimes called a torque).



https://www.dyess.af.mil/News/Features/Display/Article/813403/masters-of-precision/6

Example – Scalar Formulation

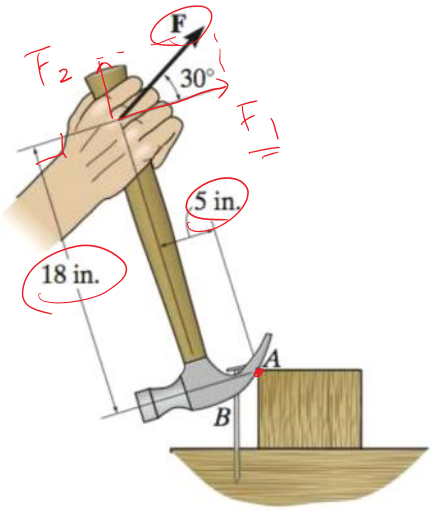
Determine the moment of this force about the point *A* as a function of **F**.



https://www.123rf.com/photo_34798185

Example – Scalar Formulation

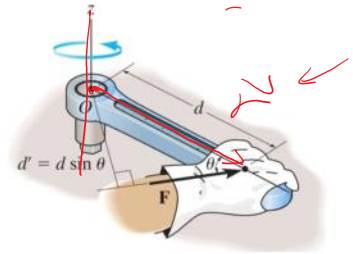
Determine the moment of this force about the point *A* as a function of **F**.



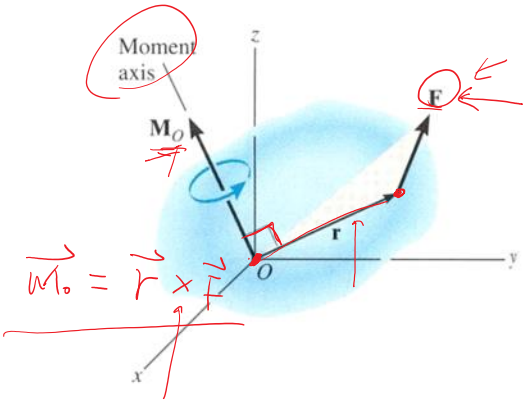
https://www.123rf.com/photo_34798185

Moment of a force – vector formulation

The moment of a force **F** about point **O**, or actually about the moment axis passing through O and perpendicular to the plane containing **O** and **F**, can be expressed using the cross (vector)



$\vec{M} = \vec{r} \times \vec{F}$



$\vec{M}_O = \vec{r} \times \vec{F}$

i-Clicker Time

If $\vec{\mathbf{M}} = \vec{\mathbf{r}} \times \vec{\mathbf{F}}$, then what will be the value of $\vec{M} \cdot \vec{r}$?

A) 0

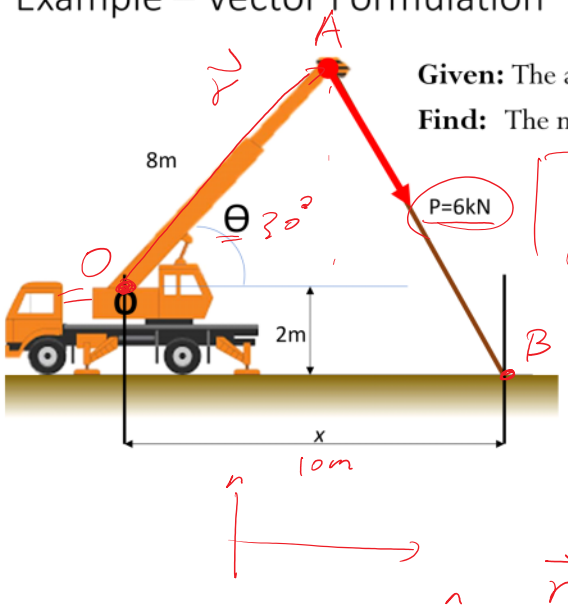
B) 1

C) $r^2 F$

D) None of the above

E) Depends

Example – Vector Formulation



Given: The angle $\theta = 30°$ and $x = 10$ m.

Find: The moment by **P** about point O.

$\vec{M}_O = \vec{r} \times \vec{P}$

$\vec{r}$

$\vec{r}_{OA} = (8\cos 30°,\ 8\sin 30°,\ 0)$

$A = (8\cos 30°,\ 8\sin 30°,\ 0)$

$\vec{P} = |P|\,\hat{u}$

$\hat{u} = \dfrac{\vec{r}_{AB}}{|\vec{r}_{AB}|}$

$B(10, -2, 0)$

Example – Vector Formulation

Given: The angle $\theta = 30°$ and $x = 10$ m.

Find: The moment by **P** about point O.

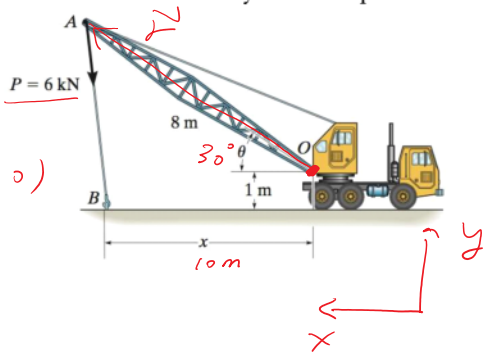
$\vec{M}_O = \vec{r} \times \vec{P}$

$\vec{r} = \vec{r}_{OA}$

$A(8\cos 30°,\ 8\sin 30°,\ 0)$

$\vec{P} = |P| \cdot \hat{u}$

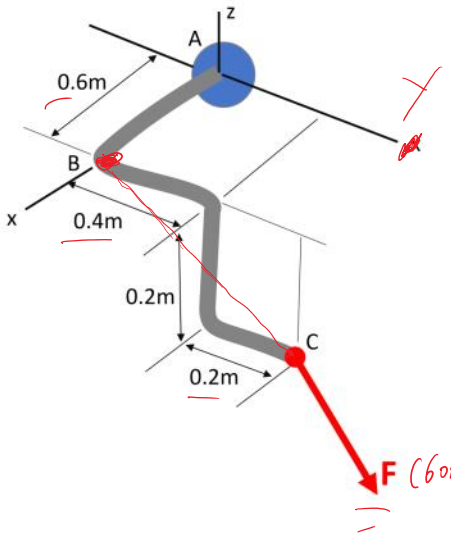
$\hat{u} = \dfrac{\vec{r}_{AB}}{|\vec{r}_{AB}|}$



Example – Vector Formulation

Given: $\mathbf{F} = \{600\mathbf{i} + 800\mathbf{j} - 500\mathbf{k}\}$ N

Find: Moment of the force about point *B*.



$\vec{r} = \vec{BC} = (0, 0.6, -0.2)$

$\vec{M} = \vec{r} \times \vec{F} =$

$B(0.6, 0, 0)$

$C(0.6, 0.6, -0.2)$

$F\ (600, 800, -500)\ N$