Video Lecture #1 – Introduction to Torque

Thank You, Puja Patel, for these notes.

Torque = τ (VECTOR!)

2 types of motion:

Translational: caused by force

Rotational: caused by torque

* mass is a measure of inertia (the ability to resist a change in motion)

Torque is the ability of a force to cause an angular acceleration (α).

$\boxed{\tau = fd\sin\theta}$ F = force

d = lever arm; distance from the force to the axis of rotation

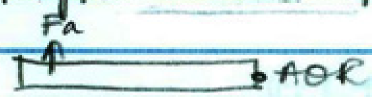
$\sin\theta = 90°$

θ = angle between the force & lever arm

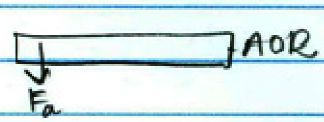
dimensions = N·m = Joule

Video Lecture #2 – Introduction to the Right Hand Rule for Torque

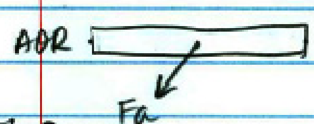
Right hand rule



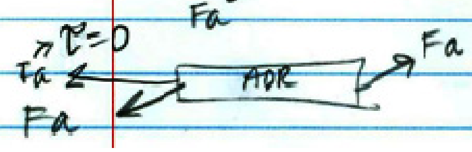
$-\tau$ (into the board)



$+\tau$ (out of the board)



$-\tau$ (into the board)



$+\tau$ (out of the board)

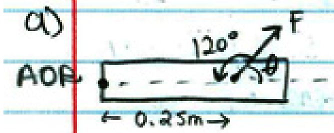
$+\tau$ (out of the board)

Video Lecture #3 – page 282 #1 An Introductory Torque Problem - The Torque by a Wrench

p.282 #1 $\tau = ??$ $F_a = 3.0N$ $\theta = 60.0°$ $d = 0.25m$

$\tau_{max} = ??$

a)



$\tau = fd\sin\theta$

$= (3)(0.25)(\sin 120)$

$= 0.6495190528$

$\boxed{\tau \approx 0.65 \text{ N}\cdot\text{m}}$

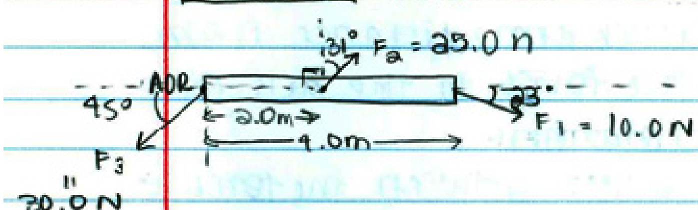
b) $\tau_{max} = Fd\sin\theta$

$= (3)(0.25)(\sin 90)$

$\boxed{\tau_{max} \approx 0.75 \text{ N}\cdot\text{m}}$

Video Lecture #4 – Page 282 Section Review #3 - The Net Torque on a Door

p.282 #3 $\tau_{net} = ??$



$\tau_3 = F_1 d_1 \sin\theta_1 \Rightarrow (10.0)(4.0)(\sin 23) = -15.36946$ N.m

$\tau_2 = F_2 d_2 \sin\theta_2 \Rightarrow (25.0)(2.0)(\sin 90+31) = +42.85836504$ n.m

$\tau_1 = F_3 d_3 \sin\theta_3 \Rightarrow (30.0)(0)(\sin\theta_1) = 0$ n.m

$\tau_{net} = \tau_1 + \tau_2 + \tau_3$

$= (-15.36946) + (42.85836504) + 0$

$= 27.229$

$\boxed{\tau_{net} \approx 27 \text{ N}\cdot\text{m}}$

Video Lecture #5 – Introduction to Rotational Equilibrium

Equilibrium

translational

$\Sigma\vec{F} = 0 = m\vec{a}$

$a = 0 \frac{m}{s^2}$ therefore the object is at rest or moving at a constant velocity

rotational

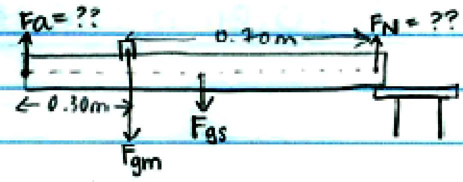
$\Sigma\vec{\tau} = 0 = I\alpha$ AOR

$\alpha = 0 \frac{m}{s^2}$ therefore the object is at rest or @ constant angular velocity

static: both translational & rotational

you can pick any AOR

ex| $m_m = 0.50$ kg $m_{stick} = 88.6$ g ≈ 0.0886 kg



$\Sigma F_y = +F_a - F_{gm} - F_{gs} + F_N = m a_y = 0$

$\Sigma \tau = \cancel{\tau_{Fa}} - \tau_{Fgm} - \tau_{Fgs} + \tau_{FN} = 0$
AOR@Fa

$- F_{gm} d_m \sin\theta_m - F_{gs} d_s \sin\theta_s + F_N d_N \sin\theta_N = 0$

$- m_m g\, d_m \sin\theta_m - m_s g\, d_s \sin\theta_s + F_N d_N \sin\theta = 0$

$-(0.50)(9.8)(0.30)(\sin 90) - (0.0886)(9.8)(0.5)\sin 90 + F_N(1)\sin 90 = 0$

$-1.47 - 0.43414 + F_n(1)\sin 90 = 0$

$F_N = 1.90414$

$\boxed{F_N \approx 1.9\text{N}}$

$\Sigma \tau = -\tau_{Fa} + \tau_{Fgm} + \tau_{Fgs} + \cancel{\tau_{FN}} = 0$
AOR@FN

$- F_a d_a \sin\theta_a + F_{gm} d_m \sin\theta_m - F_{gs} d \sin\theta_s = 0$

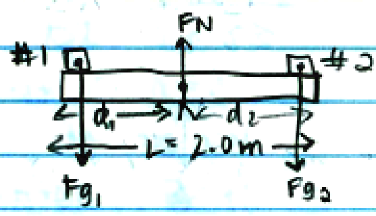
$- F_a d \sin\theta_a + m_m g\, d_m \sin\theta_m - m_s g\, d_s \sin\theta_s = 0$

$-F_a(1)\sin 90 + (0.50)(9.8)(0.70)\sin 90 - (0.0886)(9.8)(0.5)\sin 90 = 0$

$F_a = 3.86414$

$\boxed{F_a \approx 3.9\text{ N}}$

p.288 #2A| $F_{g1} = 400$N $L = 2.0$ m
$F_{g2} = 300$ N $m_{seesaw} = 0$ kg



$\Sigma \tau = +\tau_{Fg1}\ \ \tau_{FN} - \tau_{Fg2} = 0$

$F_{g1} d_1 \sin\theta_1 - F_g d_2 \sin\theta_2 = 0$

$(400)(d_1)\sin 90 - (300)(d_2)\sin 90 = 0$

$400 d_1 - 300 d_2 = 0$

$L = d_1 + d_2$

$d_2 = L - d_1$

$400 d_1 - 300(2 - d_1) = 0$

$400 d_1 - 600 + 300 d_1 = 0$

$700 d_1 = 600$

$d_1 = 0.857142857$

$\boxed{d_1 \approx 0.86 \text{ m from 400m child}}$