Rotational Motion

Rotational motion and Translational motion

Table 10.1 Rotational and Translational Quantities

Rotational	Translational	Relationship
θ	x	$\theta = \frac{x}{r}$
ω	v	$\omega = \frac{v}{r}$
α	a	$\alpha = \frac{a_t}{r}$

Kinematic equations for rotation – some of them

Table 10.2 Rotational Kinematic Equations

Rotational	Translational	
$\theta = \bar{\omega} t$	$x = \bar{v} t$	
$\omega = \omega_0 + \alpha t$	$v = v_0 + at$	(constant α , a)
$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$	$x = v_0 t + \frac{1}{2}at^2$	(constant α , a)
$\omega^2 = \omega_0{}^2 + 2\alpha\theta$	$v^2 = v_0{}^2 + 2ax$	(constant α , a)

With the aid of a string, a gyroscope is accelerated from rest to 32 rad/s in 0.40 s.
(a) What is its angular acceleration in rad/s^2?
(b) How many revolutions does it go through in the process?

- Variables (knowns and unknowns) and Equations

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- Solution

- Reasonability Check

During a very quick stop, a car decelerates at 7.00 m/s^2.

(a) What is the angular acceleration of its 0.280-m-radius tires, assuming they do not slip on the pavement?
(b) How many revolutions do the tires make before coming to rest, given their initial angular velocity is 95.0 rad/s ?
(c) How long does the car take to stop completely?
(d) What distance does the car travel in this time?
(e) What was the car's initial velocity?

- Qualitative Representation

- Variables (knowns and unknowns) and Equations

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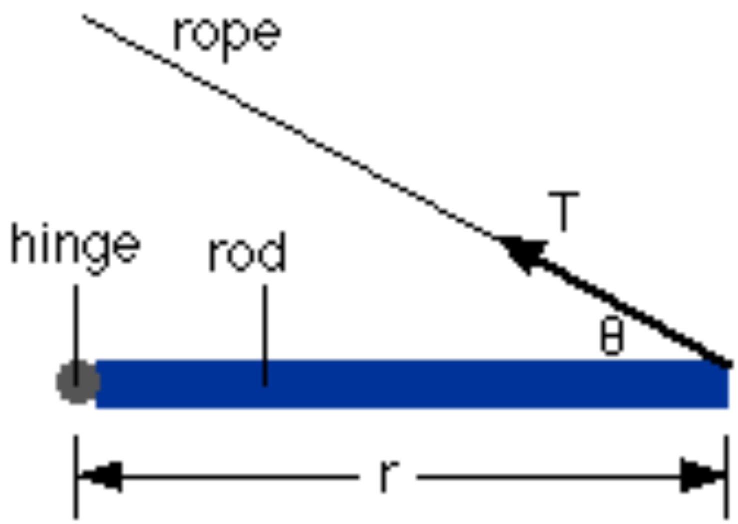
- Solutions

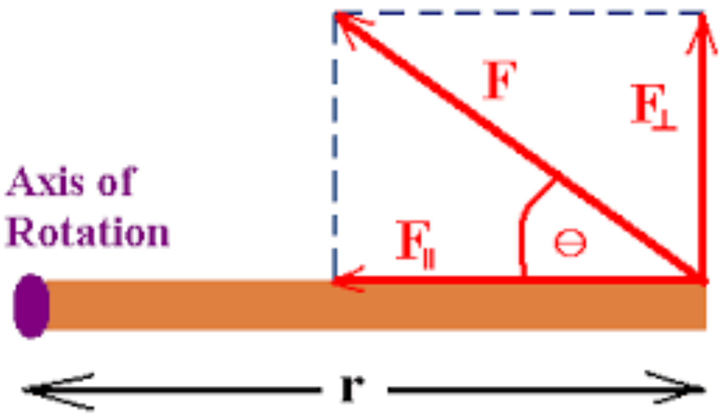
How does force affect rotational motion?

- Torque is our analogous concept to force

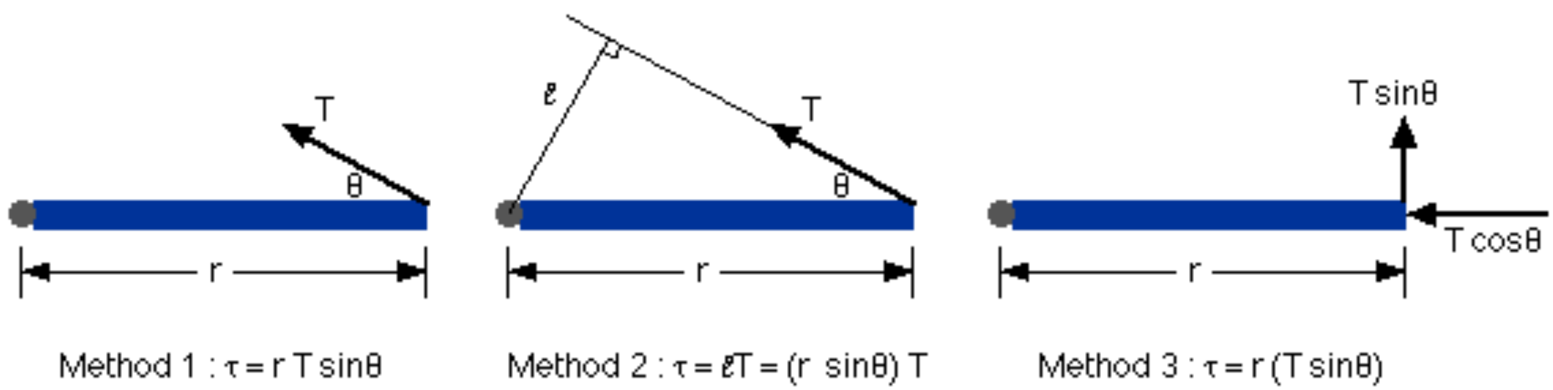
$$\vec{\tau} = \vec{r} \times \vec{F}$$

Magnitude of torque can be thought of as $\tau = rF \sin \theta$





Alternative ways of thinking about this math…



If I am exerting a 15 N force on a wrench, but I direct the force at a 45 degree angle from the wrench, what will the torque be?