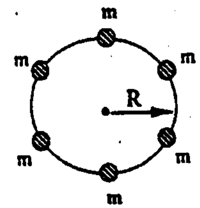
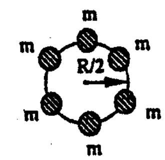
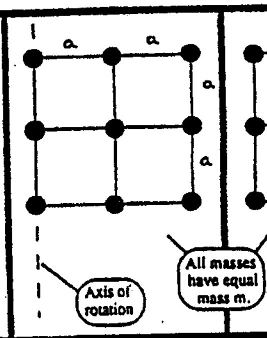
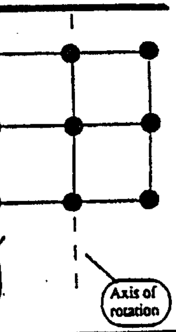
for point masses

$I = \sum m_i r_i^2$ ← radius from axis of rotation

ROTATIONAL INERTIA

Write an expression for the rotational inertia of each group of masses shown below.

 About the axis through the center and perpendicular to the page.	 About the axis through the center and perpendicular to the page.		
$6[mR^2]$ $6mR^2$	$6\left[m\left(\frac{R}{2}\right)^2\right]$ $\frac{6}{4}mR^2$	$I = 3[ma^2] + 3[ma^2] + 3[m(2a)^2]$ $I = 15ma^2$	$I = 3[ma^2]$ left $+ 3[ma^2]$ middle $+ 3[ma^2]$ right $I = 6ma^2$

Which ring is easiest to start (or stop) rotating? Explain.

the one with the smallest moment of Inertia b/c get larger α

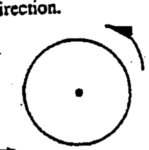
About which axis is it easiest to (start or stop) the rotation of the above masses? Explain.

the one with the smallest moment of Inertia b/c get larger α

ROTATIONAL KINEMATICS

For each situation below, indicate the direction of the angular velocity $\vec{\omega}$ and of the angular acceleration $\vec{\alpha}$. [Note: in = into paper, out = out-of-papter, and 0 = zero.]

Disc turning at constant angular velocity in ccw direction.



$\vec{\omega}$: ⊙ out

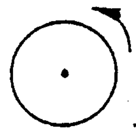
$\vec{\alpha}$: 0

Increasing ω in ccw direction.

$\vec{\omega}$: ⊙ out

$\vec{\alpha}$: ⊙ out — the $\vec{\omega}$ vector is getting longer

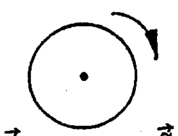
Decreasing ω in ccw direction.



$\vec{\omega}$: ⊙ out

$\vec{\alpha}$: ⊗ in — the $\vec{\omega}$ vector is getting shorter

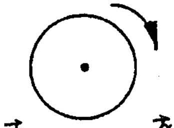
Constant ω in the cw direction.



$\vec{\omega}$: ⊗ in

$\vec{\alpha}$: 0

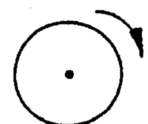
Increasing ω in the cw direction.



$\vec{\omega}$: ⊗ in

$\vec{\alpha}$: ⊗ in — the $\vec{\omega}$ vector is getting longer

Decreasing ω in the cw direction.



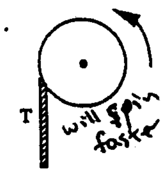
$\vec{\omega}$: ⊗ in

$\vec{\alpha}$: ⊙ out — the $\vec{\omega}$ vector is getting shorter

ROTATIONAL FORM OF NEWTON'S SECOND LAW

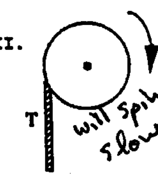
For each situation shown below, determine the direction of the angular velocity, the direction of the angular acceleration, and the directions of the resultant torque. Place these directions (in = into the paper, out = out of the paper, or 0 = zero) in the table.

I. Initially rotating ccw



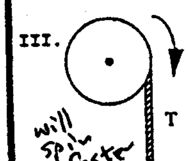
$\vec{\omega}_0$: ⊙ out $\vec{\alpha}$: ⊙ out $\Sigma\vec{\tau}$: ⊙ out

II. Initially rotating cw



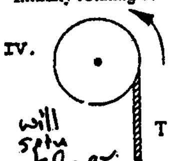
$\vec{\omega}_0$: ⊗ in $\vec{\alpha}$: ⊙ out $\Sigma\vec{\tau}$: ⊙ out

III. Initially rotating cw



$\vec{\omega}_0$: ⊗ in $\vec{\alpha}$: ⊗ in $\Sigma\vec{\tau}$: ⊗ in

IV. Initially rotating ccw



$\vec{\omega}_0$: ⊙ out $\vec{\alpha}$: ⊗ in $\Sigma\vec{\tau}$: ⊗ in

(b.) Describe in words how the angular velocity changes.

I. will spin faster ∴ $\vec{\alpha}$ in same direction as $\vec{\omega}$

II. will spin slower

III. will spin faster ∴ $\vec{\alpha}$ in same direction as $\vec{\omega}$

IV. will spin slower

(c.) Complete the table.

	$\vec{\omega}$	Direction $\vec{\alpha}$	$\Sigma\vec{\tau}$
I.	out	out	out
II.	in	out	out
III.	in	in	in
IV.	OUT	in	in

(d.) Bases on the information in the table, is $\Sigma\vec{\tau}$ proportional to $\vec{\omega}$? Explain.

No obvious correlation

(e.) Is $\Sigma\vec{\tau}$ proportional to $\vec{\alpha}$?

Well, they certainly point in the same direction

Reading Quiz for Lesson 17

Ch6: 3-4

1. The figure shows four different methods for applying a torque to a nut. Assume | **r** | and | **F** | have the same values in each of the pictures.
List the pictures in terms of increasing | τ |.

i) a,b,c,d

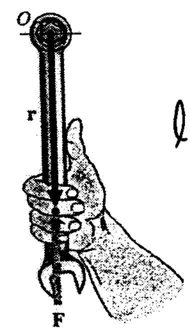
ii) d,c,b,a

iii) a,b,d,c

iv) c,d,b,a

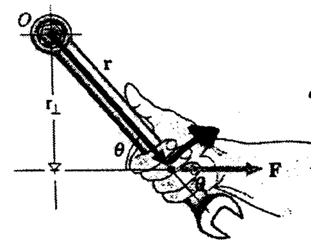
v) all of the above

vi) none of the above



(a)

least Torque - No rotation at all.

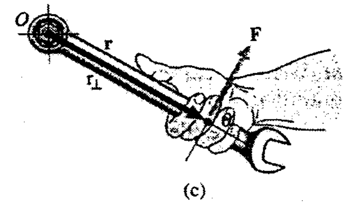


(b)

smaller

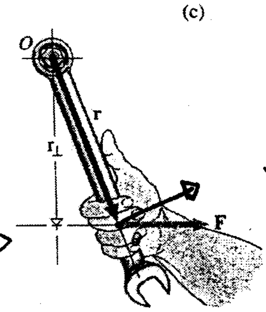
Basic description of the pictures:
The vector **r** goes from the center of the nut to the center of the hand. In figure a, the force pulls straight down. In figures b & d, the force is directed toward the right. In figure c, the force is directed perpendicular to the wrench body.

d) has a bigger perpendicular component of force, which will be more effective in causing an angular acceleration



(c)

greatest by far



(d)

bigger