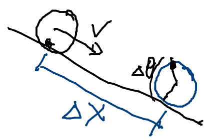
$v = r\omega$

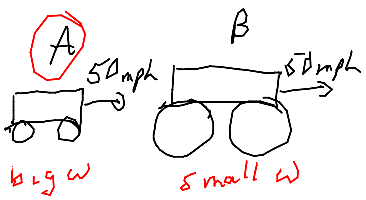
$v = r\omega$
if no slipping

rolling wheel



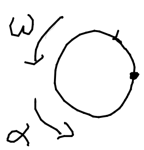
$$\frac{\Delta x}{\Delta t} = r\frac{\Delta \theta}{\Delta t}$$

$$v = r\omega$$



Which wheels spin faster?

$$\underset{\text{same}}{v} = \underset{\text{bigger}}{r}\ \underset{\text{smaller}}{\omega}$$



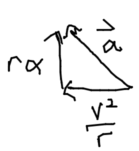
What is $\vec{a}$ at point?

A) ↑ B) ↖ C) ←

D) ↙ E) ↓

$$\vec{a} = \underset{\overset{\leftarrow}{v^2/r}}{\vec{a}_c} + \underset{\overset{\uparrow}{r\alpha}}{\vec{a}_t}$$

compare
$v = r\omega$
$a_t = r\alpha$



$$|a| = \sqrt{\left(\frac{v^2}{r}\right)^2 + (r\alpha)^2}$$

If wheel is speeding up
a_t points in same direction as v

If $\tau_{net} = 0$, $\alpha = 0$

$\tau_{net} \neq 0$, $\alpha \neq 0$

$F = ma$

$\tau_{net} = I \alpha$

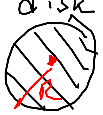
I: rotational inertia
or moment of inertia

I: analogous to mass,
how hard it is to change angular velocity.

I depends on

- mass
- radius
- axis spin it around
- shape — how mass is distributed

e.g. disk



$I = \frac{1}{2} M R^2$.

ring

$I = MR^2$

If mass is distributed further from axis, I increases

solid sphere

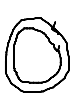
smaller circle

A)

$\frac{2}{5} MR^2$

hollow sphere

B)



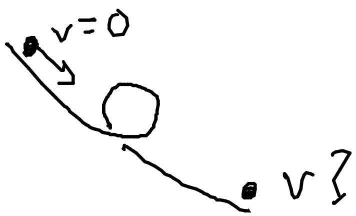
$\frac{2}{3} MR^2$

points on equator go around a larger circle

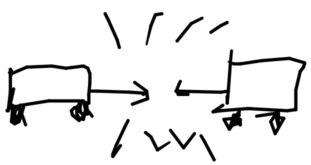
Which has larger I
if same M & R?

Kinematics & Forces are technically all you need to know to describe motion

e.g.



easy with energy



easy with momentum

Conservation

A conserved quantity is one that doesn't change during an interaction

e.g. from chemistry

$$2H_2 + O_2 \rightarrow 2H_2O$$

- H & O atoms is conserved
- mass is conserved