

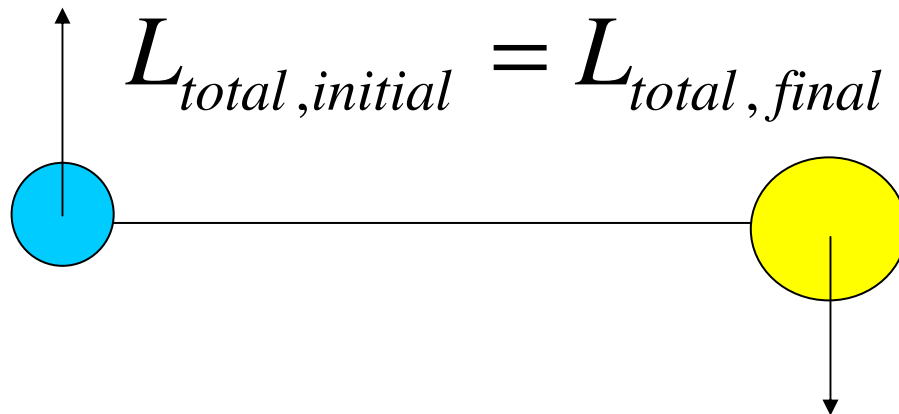
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We have

$$\sum \tau_{\text{external}} = \frac{\Delta L_{\text{system}}}{\Delta t}$$

If there are no *external* torques _____

A system of objects that receives no *external torques* has a **constant total angular momentum**.



Imagine two space stations connected by a cable. They are rotating about their center of mass.

The blue station on the left pulls the cable in so their separation distance decreases.

What happens?

Does the force applied have a *tangential* component?

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Skater and spinning

A skater has an initial ω of 2 rad/s and $I = 30 \text{ kg m}^2$. When he brings in his arms, $I = 5 \text{ kg m}^2$.

What is the final ω ?

Is rotational kinetic energy conserved?

The skater's kinetic energy is

- a. more
- b. less
- c. the same

Hint: one way to guess is to think of the work he might do.



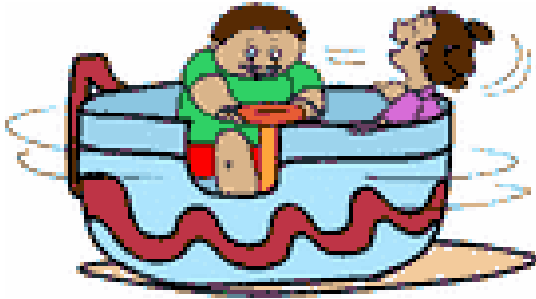
A planet has a 10 hour day. It then heats up due to some chemical reaction in its core, and expands to *three times* the original radius. It keeps the same mass. Consider it to be a uniform solid sphere.

After the expansion, the “day” will be _____ hours



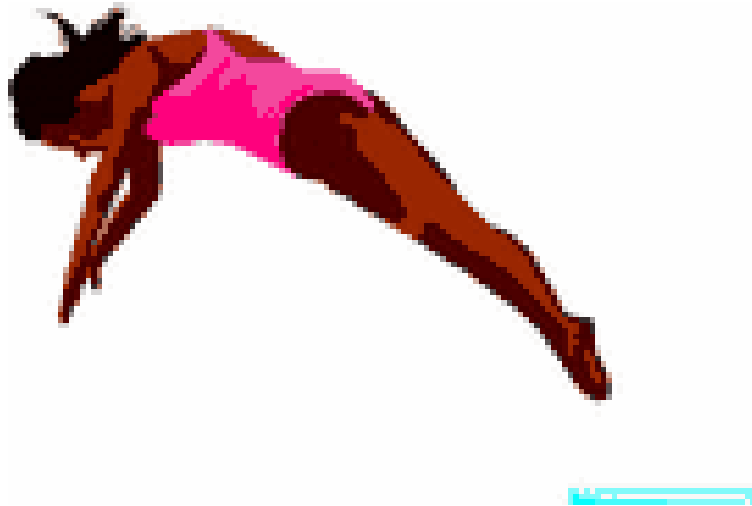
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Is L conserved for the riders in the teacup?



“Teacups”: Hands-on-post is connected to the platform floor

What quantities can divers change after they leave the board? (circle KE_{rot} , ω , L and/or I)

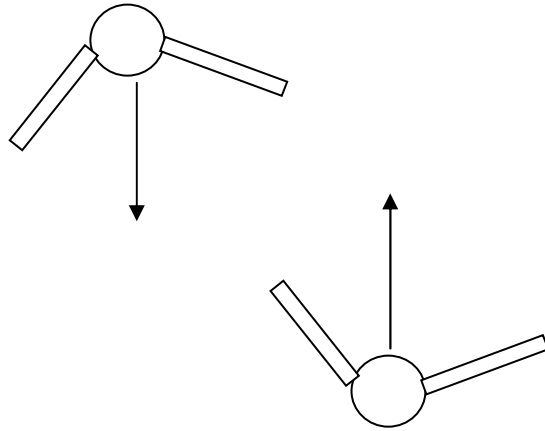


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Two skaters joining hands

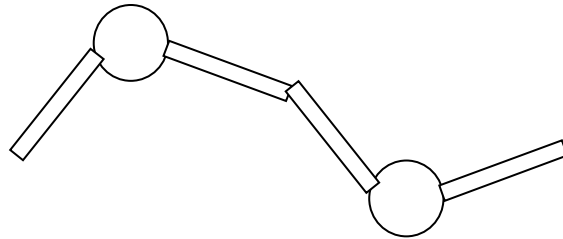
Before

Any L?



After

Any L?



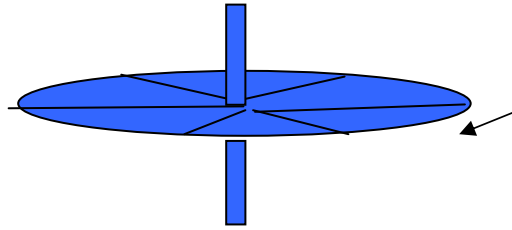
Is angular momentum conserved? Yes if there are no external torques.

$$L = rp_{\perp} \quad \text{or} \quad L = I\omega$$

Directionality: In the context of this course, you can say that total **CW** or **CCW** angular momentum is conserved.

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So we could say: L is _____ when viewed from above.



Frank sits on frictionless ice, holding a spinning bicycle wheel. From **above** it is going clockwise (CW) (see above diagram).

Neglect external friction.

P4. If he grabs on to the wheel edge firmly and “stops” it he will then be

1. turning CW (viewed from the top)
2. turning CCW
3. not turning

P5. If instead of stopping it he flips the wheel over, so it is going CCW (viewed from the top), he will be

1. turning CW slower than in P4.
2. turning CCW slower than in P4
3. turning CW faster than in P4.
4. turning CCW faster than in P4

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$$L = rp_{\perp} \quad L = I\omega$$

A merry-go-round with moment of inertia is spinning with a girl at the edge.

What will happen to **the rotational speed ω of the merry-go-round** if she...

HINT: Sometime it's easier to think of the forces (torques) she put on the merry-go-round to change, rather than conservation of L.

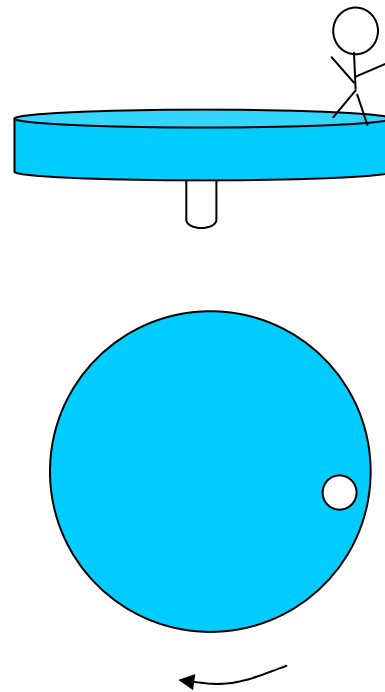
Walks into the center of the merry-go-round?

1. it slows down
2. it stays same speed
3. it speeds up

Runs opposite to the spinning so she is at rest vs the ground?

Slips off when she steps on a frictionless icy part?

Jumps tangentially off the merry-go-round so that she goes faster relative to the ground than she was before she jumped?



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HOMEWORK HINTS: