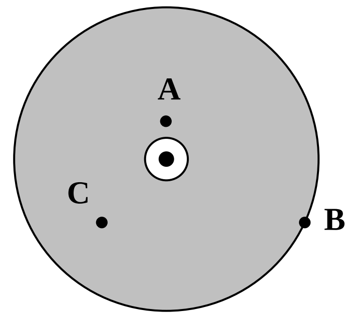
Lab #7

Rotational Motion

Physics 111 Name: _______________

I. Constant angular velocity



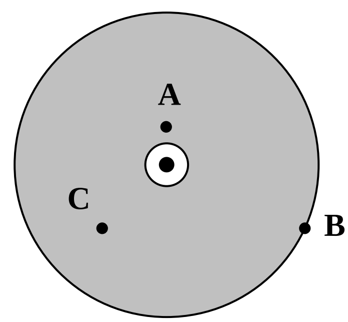
A wheel is spinning counter-clockwise at a constant rate about a fixed axis. The diagram at right is a snapshot of the wheel at one instant in time.

A. [3 pts] Draw arrows on the diagram to represent the magnitude and direction of the tangential velocity, $\mathbf{v}_T$ for each of the points A, B, and C at the instant shown.

[3 pts] Rank the ***magnitudes*** of the tangential velocities $\mathbf{v}_T$ of points A, B, and C.

B. Suppose the wheel makes ***two*** complete revolutions in 3.0 seconds.

[3 pts] Calculate the ***angular speed*** $\omega=\Delta\theta/\Delta t$ of the wheel.



[6 pts] Find the *change in angle* $\Delta\theta$ made in ***1.0***sec by the position vector for each point. Do this in radians ***and*** degrees.

point A:

point B:

point C:

C. Do the following descriptions of directions depend on your location relative to the wheel?

[2 pts] "clockwise" or "counter-clockwise"? yes no (circle one)

[2 pts] the vector $\boldsymbol{\omega}$? yes no (circle one)

[5 pts] Use the wheel provided to have various members of your lab group demonstrate ***to a staff member*** the motion of an object whose angular velocity vector points

- ❑ west, parallel (horizontal) to the floor
- ❑ north, at an angle of 45^0 above horizontal
- ❑ straight towards your own left shoulder
- ❑ various other directions for $\boldsymbol{\omega}$ as called upon by a staff member…

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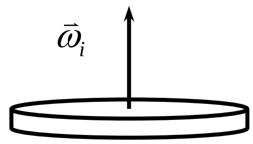
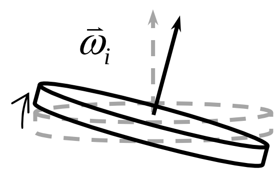
II. Changing angular velocity: Use your wheels for each situation described below.

Make the initial angular velocity $\vec{\omega}_i$ of a wheel point up to the ceiling. To the ***right*** of each case described below, draw ***three vectors***: the initial angular velocity $\vec{\omega}_i$ the final angular velocity $\vec{\omega}_f$ and the ***change*** in angular velocity $\Delta\vec{\omega}$.

[3 pts] the wheel were made to spin ***faster***, keeping the rotation axis fixed.



[3 pts] the wheel were rotated by 10° to the right, but ***continued to spin at the same rate***.

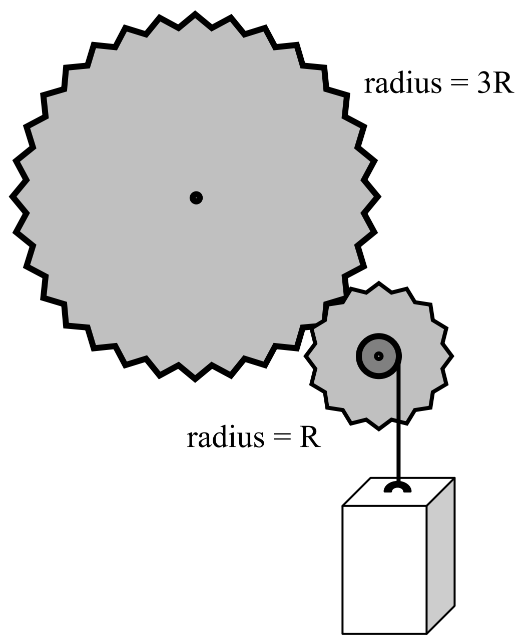


For a rotating object, how do the directions of $\vec{\omega}$ and $\vec{\alpha}$ compare if the object is:

[3 pts] spinning faster and faster

[3 pts] spinning slower and slower

Two geared wheels roll on each other without slipping. One is three times the radius of the other. A string is wrapped around the axis of the small wheel. A 2.0-kg mass is attached to the string. The entire apparatus is initially ***stationary***.



The wheels are released so they are free to move.

While the mass is falling list:

[3 pts] the direction of $\vec{\omega}$ for the small wheel:

[3 pts] the direction of $\vec{\omega}$ for the large wheel:

[3 pts] the direction of $\vec{\alpha}$ for the small wheel:

[3 pts] the direction of $\vec{\alpha}$ for the large wheel:

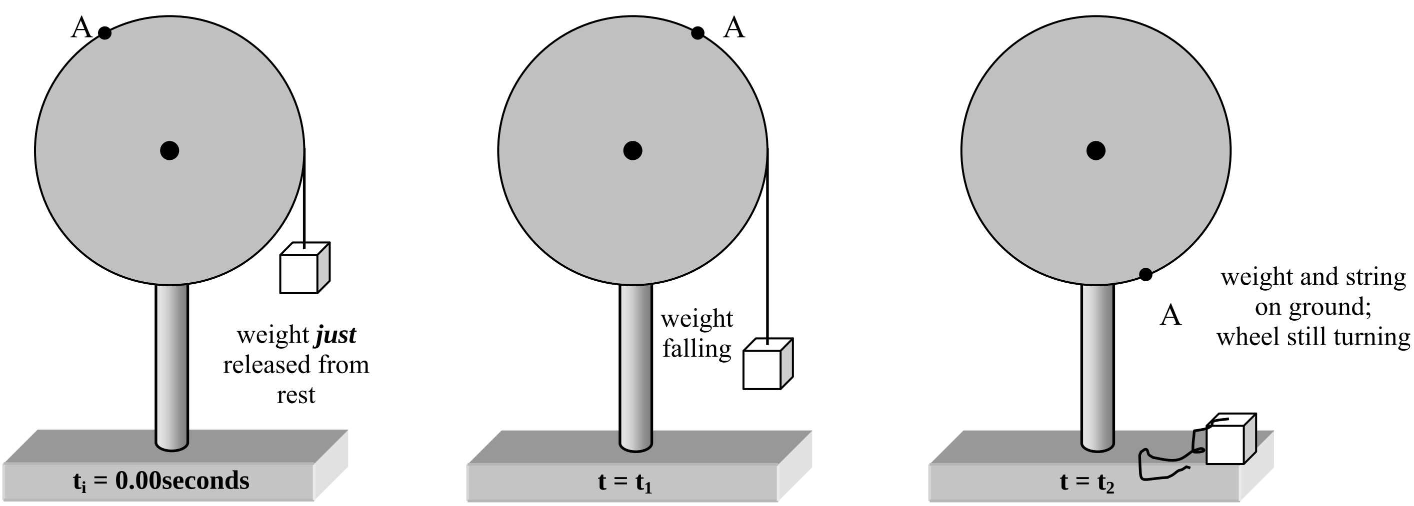
While the mass is falling compare:

[5 pts] the magnitude of $\vec{\omega}$ for the small and large wheels (if there is a specific number describe how you arrived at that number):

[5 pts] the magnitude of $\vec{\alpha}$ for the small and large wheels (if there is a specific number describe how you arrived at that number):

III. Applications: A bicycle wheel is mounted on a fixed, ***frictionless*** axle. A light string is wound around the wheel's rim. Aweight is attached to the string.

At $\mathbf{t_i = 0.00}$seconds, the weight is released from rest; the weight has ***not started to move***.
At $\mathbf{t = t_1}$, the weight is falling, but the string is ***still*** partially wound around the wheel.
At $\mathbf{t = t_2}$, the weight and string have both reached the ground; the wheel is ***still*** turning.



[15 pts] In the table below list each item listed. If any of the items is zero state that explicitly.

	t_i=0.00 sec	t_1	t_2
Direction of $\vec{\omega}$:			
Direction of $\vec{\alpha}$:			
Rank of $a_{centripetal}$:			

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Describe a real-life situation involving a turning disk such that each of the following cases is true. All of the cases below ***are*** possible.

- ❑ [3 pts] $\alpha = 0$ and $a_c = 0$
- ❑ [3 pts] $\alpha \neq 0$ and $a_c = 0$
- ❑ [3 pts] $\alpha = 0$ and $a_c \neq 0$
- ❑ [3 pts] $\alpha \neq 0$ and $a_c \neq 0$