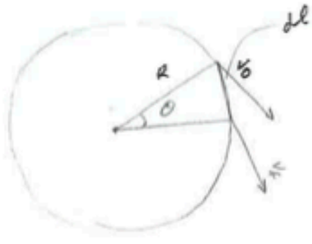
1. Please derive the relationship for centripetal acceleration: $a_c = v^2/r$. You may have noticed that I neglected to define my lens in the video. Please do a better job than I did.



$$\frac{dl}{R} = \frac{dv}{v_0}$$

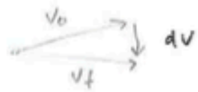
$$\frac{dl\,v_0}{R} = dv$$

A

$$v_0 = \frac{dl}{\Delta t}$$

$$\Delta t = \frac{dl}{v_0}$$

$$a_c = \frac{dv}{\Delta t} = \frac{\frac{dl\,v}{R}}{\frac{dl}{v_0}} = \frac{dl\,v_0}{R} \cdot \frac{v_0}{dl} = \frac{v_0^2}{R} = \frac{v^2}{r}$$ ✓



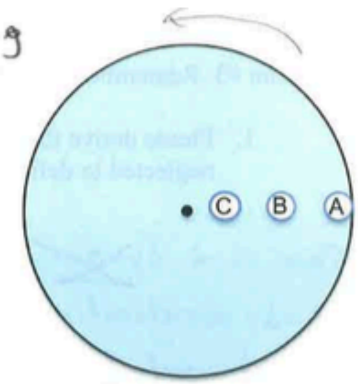
Using a kinematics lens to show that acceleration is equal to derivative of velocity over change in time. After finding dv and Δt, pluged in $a_c = \frac{dv}{dt}$, to find the acceleration

Dynamics because pennies are accelerating

2. Three pennies are sitting on a turn table at different radii as shown at right. When I start the turn table up,

a) Which penny slides off first? And explain why you know this with clear reference to the relevant physics

b) Draw the trajectory of that penny.



a. Penny A slides off first b/c it will be accelerating faster (since its on the edge) and it will overcome static friction faster than the other two

$$a = \frac{V^2}{R}$$

b.

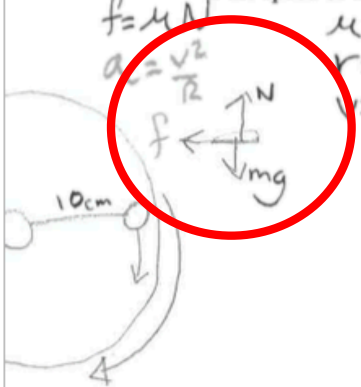
A

C has a smaller radius but a has a faster velocity

The key to this is to recognize:

1) That the force of friction is the same for all of these, and this force causes the centripetal acceleration that keeps the penny moving in a circle. Please see circled formula on the next sheet. This should be the required force drawing for both questions 2 and 3.
2) The speed is proportional to r because distance = circumference, and they all go around in the same amount of time, so if you double the radius, you double the speed, and so

speed squared goes up by a factor of 4, and this doubles the centripetal acceleration. So, A will require the greatest amount of friction to stay on the turning table.



3. If a penny is located at a radius of 10 cm and has a static coefficient of 0.3 with the surface, what is the speed of the penny when it slides off the turn table?

$f = \mu N$

$a_c = \frac{v^2}{R}$

$\mu = .3$

$r = 10cm = .1m$

$v =$

A

* not sure how to solve w/ friction involved. I need to work on that more

-I would use a forces lens b/c dealing w/ friction that has to do w/ where the forces are to keep it in place

$F_y \Rightarrow N - mg = 0$

$N = mg$

$F_x \Rightarrow f = ma_c$

$\mu mg = ma_c$

$g\mu = a_c$

$3 \, m/s^2 = a_c$

$a_c = \frac{v^2}{R}$

$\sqrt{(3 \, m/s^2)(.1m)} = v$

$.55 \, m/s = v$