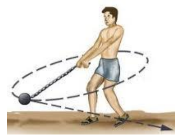
PHY131H1F - Class 8

Today, finishing off Chapter 4:

- Circular Motion
- Rotation



Quiz time… – Angular Notation: it's all Greek to me!

$$\frac{d\theta}{dt} = \omega$$

θ is an angle, and the S.I. unit of angle is rad.
The time derivative of θ is ω.
What are the S.I. units of ω ?

A. m/s^2
B. rad / s
C. N/m
D. rad
E. rad /s^2

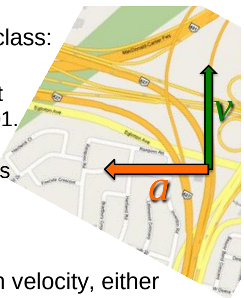
Quiz time… – Angular Notation: it's all Greek to me!

$$\frac{d\omega}{dt} = \alpha$$

The time derivative of ω is α.
What are the S.I. units of α ?

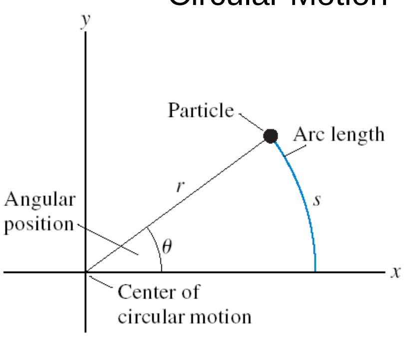
A. m/s^2
B. rad / s
C. N/m
D. rad
E. rad /s^2

Last day I asked at the end of class:



- You are driving North Highway 427, on the smoothly curving part that will join to the Westbound 401. Your speedometer is constant at 115 km/hr. Your steering wheel is not rotating, but it is turned to the left to follow the curve of the highway. Are you accelerating?
- ANSWER: YES! Any change in velocity, either magnitude or speed, implies you are accelerating.
- If so, in what direction?
- ANSWER: West. If your speed is constant, acceleration is always perpendicular to the velocity, toward the centre of circular path.

Circular Motion



r = constant

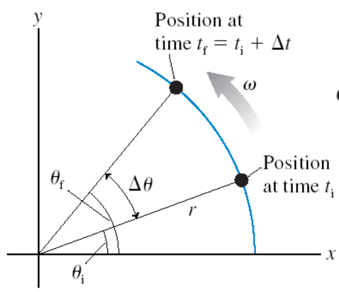
s and θ both change as the particle moves

s = "arc length"

θ = "angular position"

$s = r\theta$ when θ is measured in radians

Angular Velocity

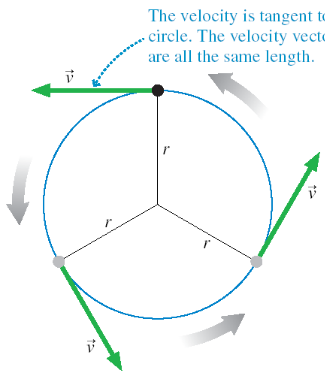


$$\omega \equiv \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt}$$

$v_t = r\omega$ when ω is measured in rad/s

Special case of circular motion:

Uniform Circular Motion

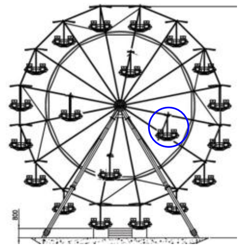


Tangential velocity is constantly changing direction

Tangential speed is constant

$$v_t = \frac{2\pi r}{T}$$

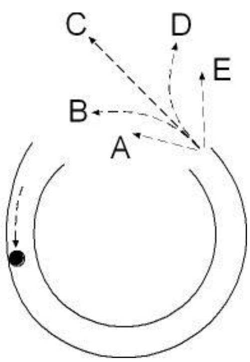
where T = Period [s]



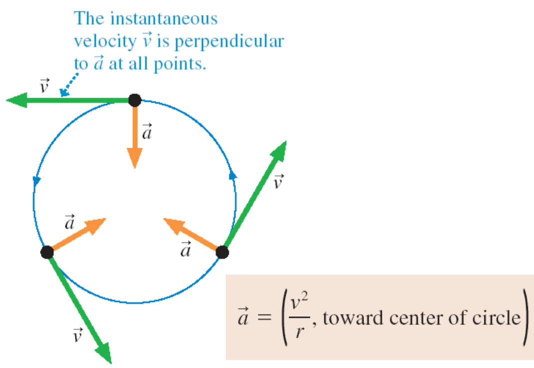
A carnival has a Ferris wheel where some seats are located halfway between the center and the outside rim. Compared with the seats on the outside rim, the inner cars have

A. Smaller angular speed and greater tangential speed
B. Greater angular speed and smaller tangential speed
C. The same angular speed and smaller tangential speed
D. Smaller angular speed and the same tangential speed
E. The same angular speed and the same tangential speed

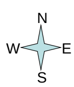
Demo and Discussion Question
A ball rolls in a horizontal circular track (shown from above). Which arrow best represents the ball's path after it leaves the track?



Centripetal Acceleration



A car is traveling East at a constant speed of 100 km/hr. Without speeding up of slowing down, it is turning left, following the curve in the highway. What is the direction of the acceleration?



A. North
B. East
C. North-East
D. North-West
E. None; the acceleration is zero.

Practicals Schedule for the next few weeks…

October 2012

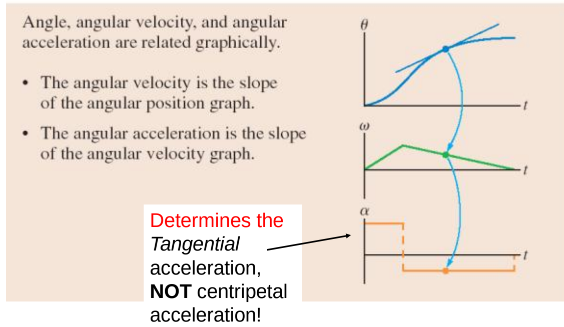
You are here (→ 3)

Thanksgiving (→ 8)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3 Session 3	4	5	6
	8	9	10 Session 4	11	12	13
14	15	16	17 Session 5	18	19	20
21	22	23	24 Session 6	25	26	27
28	29	30	31			

Centripetal Acceleration

- A bike wheel of diameter 1.0 m turns 20 times per second. What is the magnitude of the centripetal acceleration of a yellow dot on the rim?

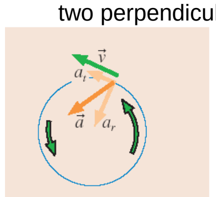


Summary of definitions:

- θ is angular position. The S.I. Unit is radians, where 2π radians = 360°.
- ω is angular velocity. The S.I. Unit is rad/sec.
- α is angular acceleration. The S.I. Unit is rad/sec^2.
- s is the path length along the curve: $s = \theta r$ when θ is in [rad].
- v_t is the tangential speed: $v_t = \omega r$ when ω is in [rad/s].
- a_t is the tangential acceleration: $a_t = \alpha r$ when α is in [rad/s^2].

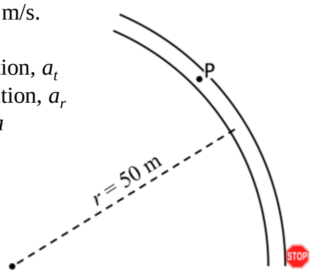
Nonuniform Circular Motion

- Any object traveling along a curved path has **centripetal acceleration**, equal to v^2/r.
- If, as it is traveling in a circle, it is speeding up or slowing down, it also has **tangential acceleration**, equal to $r\alpha$
- The total acceleration is the vector sum of these two perpendicular components

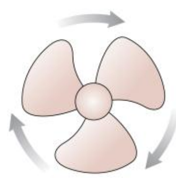


Example

- A circular road has a radius of curvature of 50 m.
- You accelerate away from a stop sign with a *steadily increasing speed* as you drive on the road.
- 4.0 seconds after starting, at point P in the diagram, you are driving at a speed of 12 m/s.
- At point P find:
  - the tangential acceleration, a_t
  - the centripetal acceleration, a_r
  - the total acceleration, a



The fan blade is slowing down. What are the signs of ω and α?
[Let's define, as Knight often does, positive to be counter-clockwise.]



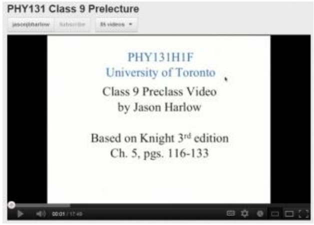
A. ω is positive and α is positive.
B. ω is negative and α is positive.
C. ω is positive and α is negative.
D. ω is negative and α is negative.

Moving on to Chapters 5 and 6..

- Up until now, we have been studying **kinematics**, a description of HOW things move and how to describe this.
- In Chapter 5 we begin to study WHY things move the way they do: This is **dynamics**, which includes the important concepts of **Force** and **Energy**.

Before Practicals NEXT week (after Thanksgiving)

- Please watch the Class 9 Preclass Video available on portal.
- http://youtu.be/UZe7FaT8WFw



Before Class 9 on Wednesday

- Please read **Chapter 5** of Knight.
- The next MasteringPhysics thing is a Pre-class quiz due Wed. Oct. 10
- Something to think about: A paperback novel has a mass of 0.3 kg and slides at a constant velocity of 5 m/s, to the right. A physics textbook has a mass of 3.0 kg, and slides at a constant velocity of 5 m/s, to the right. How does the net force on the textbook compare to the net force on the novel?
- Happy Thanksgiving!