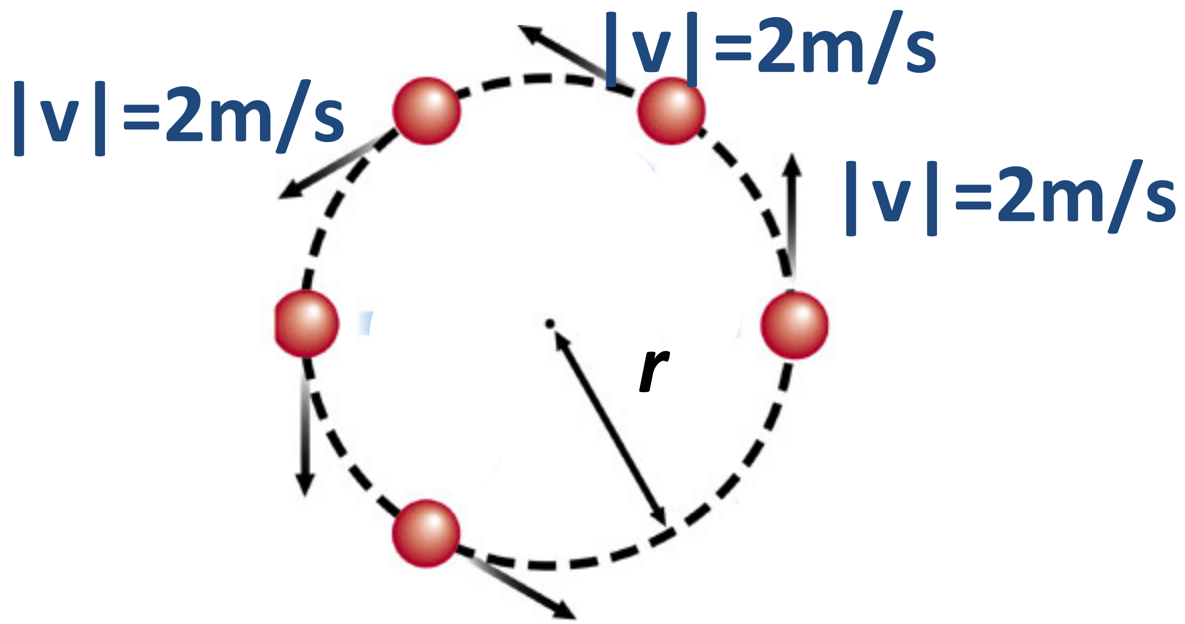
Clicker Question

Room Frequency BA



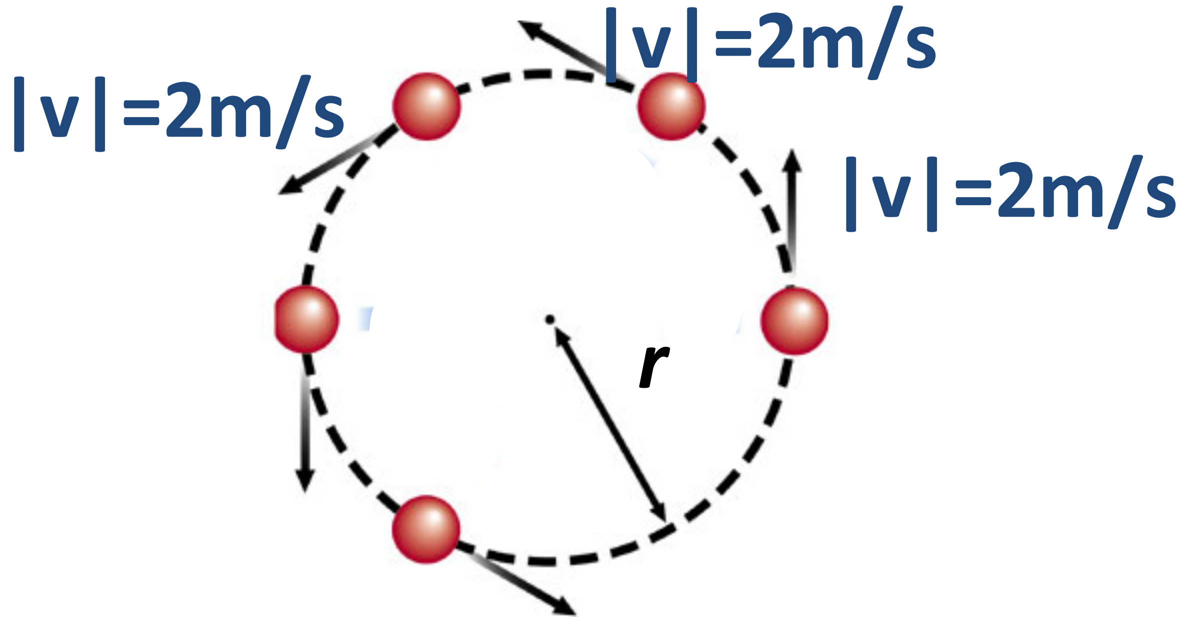
Is the object accelerating?

A) Yes

B) No

Clicker Question

Room Frequency BA

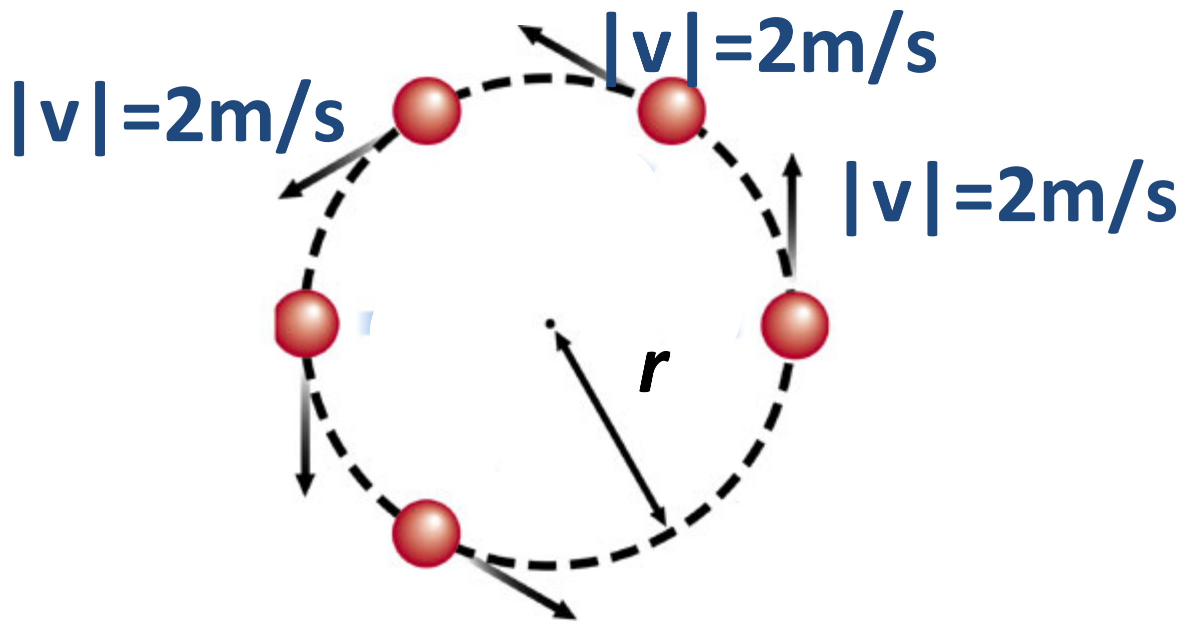


Is the object accelerating?

A) Yes

B) No

Is the object accelerating?



The speed |v| is not changing, but the velocity vector **direction** is constantly changing!

Recall definition of acceleration:

$$\text{acceleration} = \vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1}$$

Spring 2014

PHYS-2010

Lecture 20

Announcements

- Read Giancoli Chapter 5, start Chapter 6.
- **CAPA # 7** due next Tuesday at 11 pm.
- **No Written homework # 5** next week.
- **Midterm II** will be on Thursday, March 6, at 7:30 pm.
- **Practice exam** is posted on D2L.
- **Review session** will be held by Prof. Pollock and Rosemary Wulf on Tue. March 4, 5-6 pm, Duane G125.
- **Exam seating:**
  - if your TA is Rosemary Wulf or Andrew Hess, your exam is here, G1B30.
  - if your TA is Jake Fish or Clarissa Briner, your exam is next door, G1B20.
- More details about the exam are on the course website:

http://www.colorado.edu/physics/phys2010/phys2010_sp14/exams.html

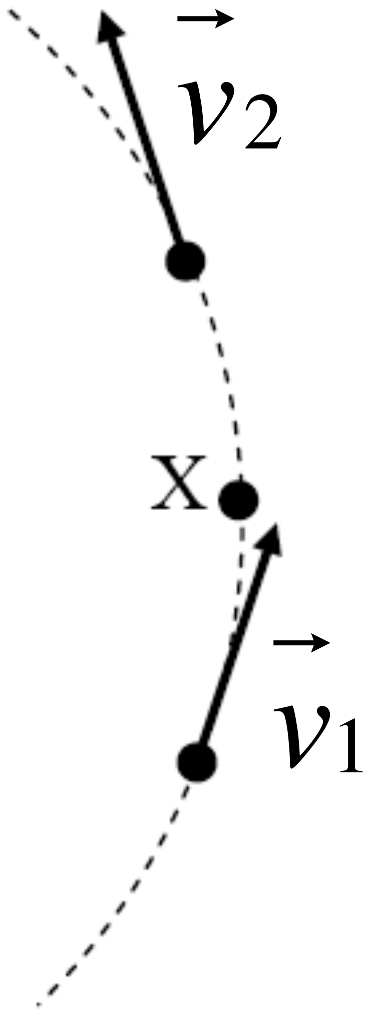
Materials to study for Mid-Term II

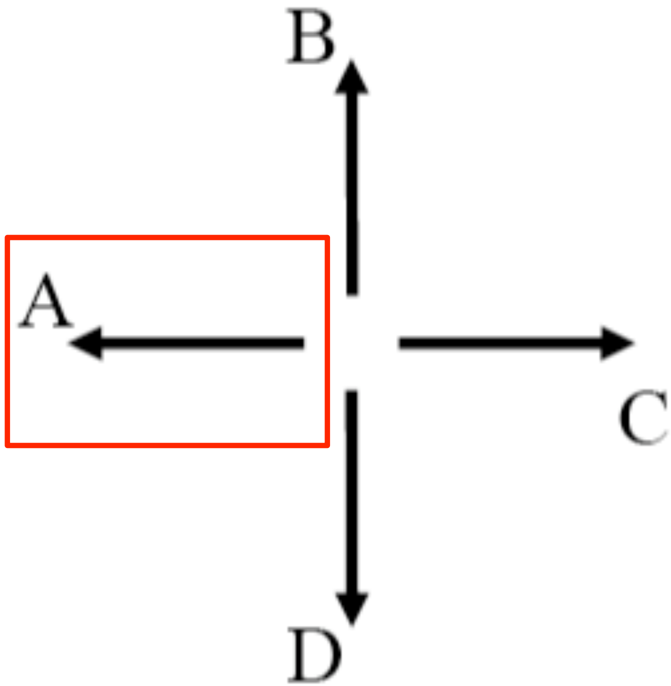
- **Giancoli Ch. 3.5 – 5.3** (Vectors, Projectile Motion, Newton's laws, Pulleys, Friction, Circular Motion).
- In-class **Clicker Questions & Lecture Materials**.
- Your **CAPAs** through # 7.
- **Written Homeworks** 3 - 5.
- **Recitation Assignments and Lab**.
- **Giancoli web site**: "Practice Questions", "MCAT Study Guide", "Practice Problems". Link on course web site.
- Old **practice exam** posted on D2L.
- Dr. Michael **Dubson's Chapter Notes** (link on course website).

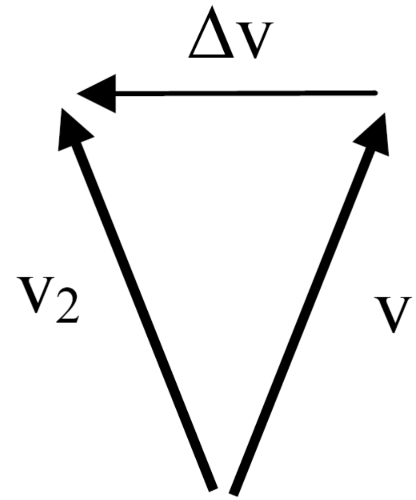
Clicker Question

Room Frequency BA

What is the ***direction*** of the acceleration when particle is at point X?







$$\vec{v}_1 + \Delta\vec{v} = \vec{v}_2$$

$$\Delta\vec{v} = \vec{v}_2 - \vec{v}_1$$

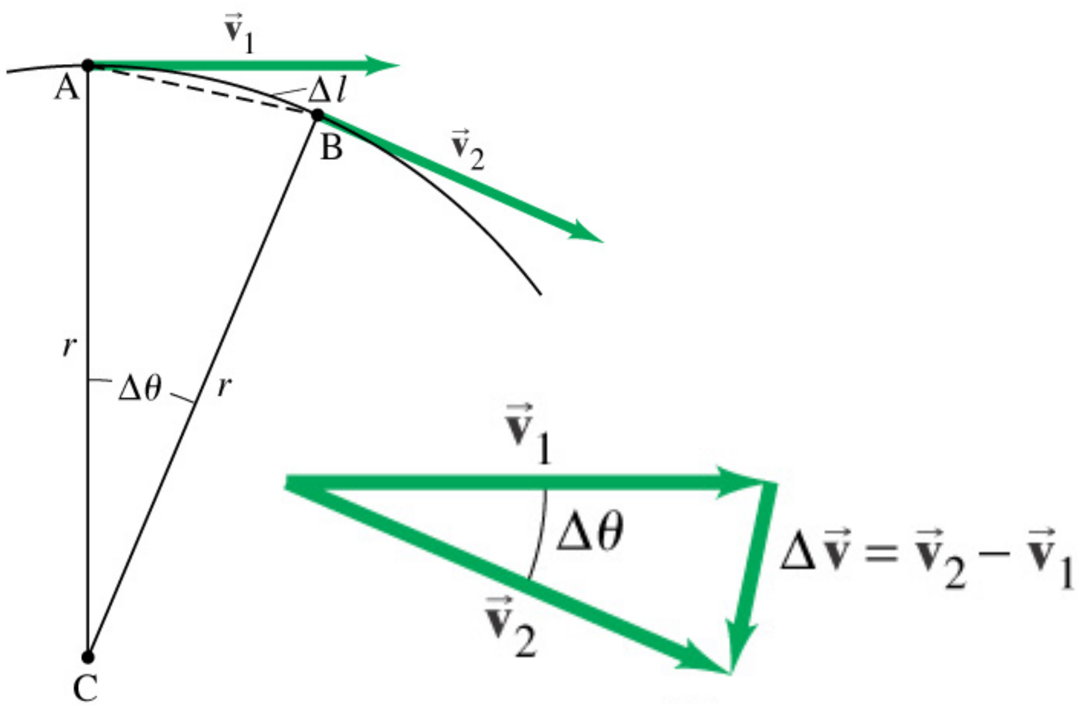
Acceleration points toward the center of the circle.

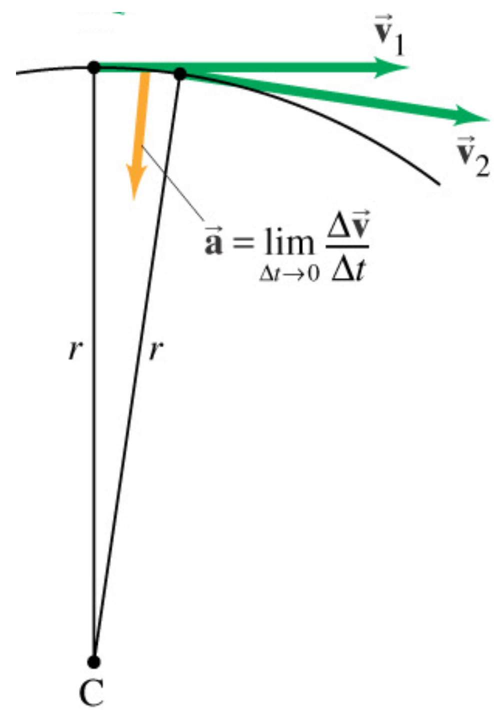
Circular Motion: Centripetal Acceleration

Acceleration points toward the center of the circle.

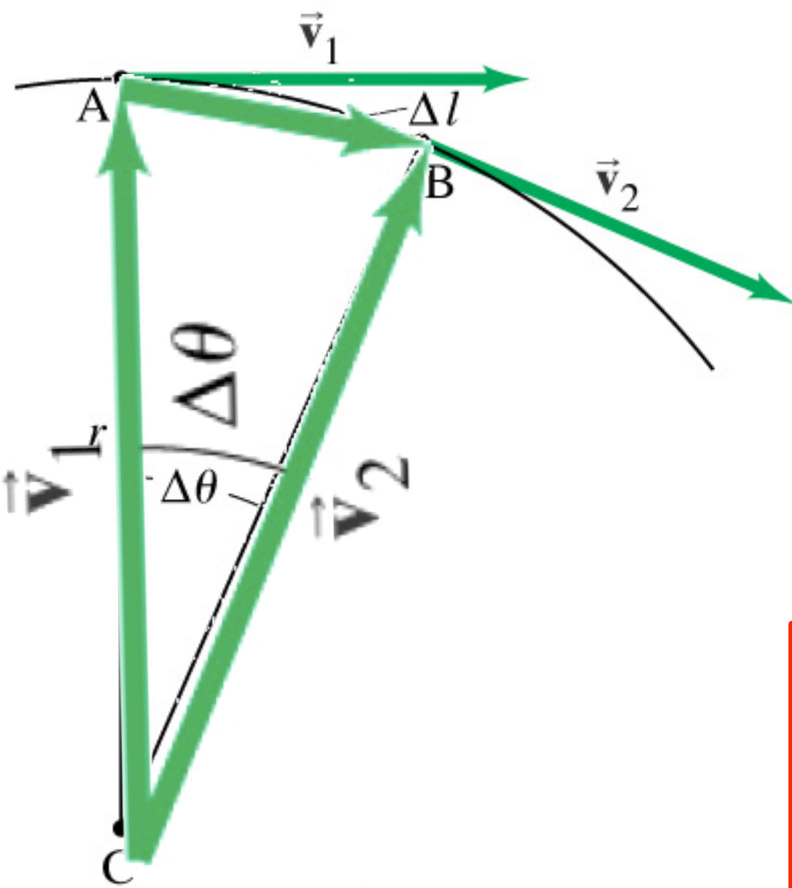
"Centripetal acceleration" → from Latin ***centrum*** "center"
and ***petere*** "to seek"

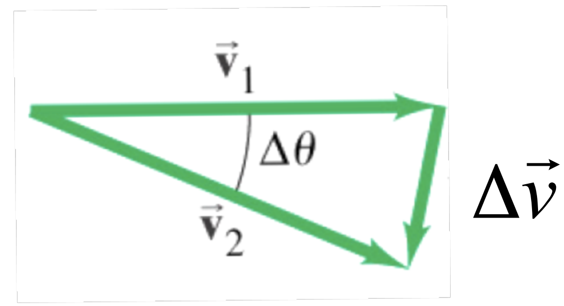
Q: What is the **magnitude** of centripetal acceleration?





What is the ***magnitude*** of centripetal acceleration?

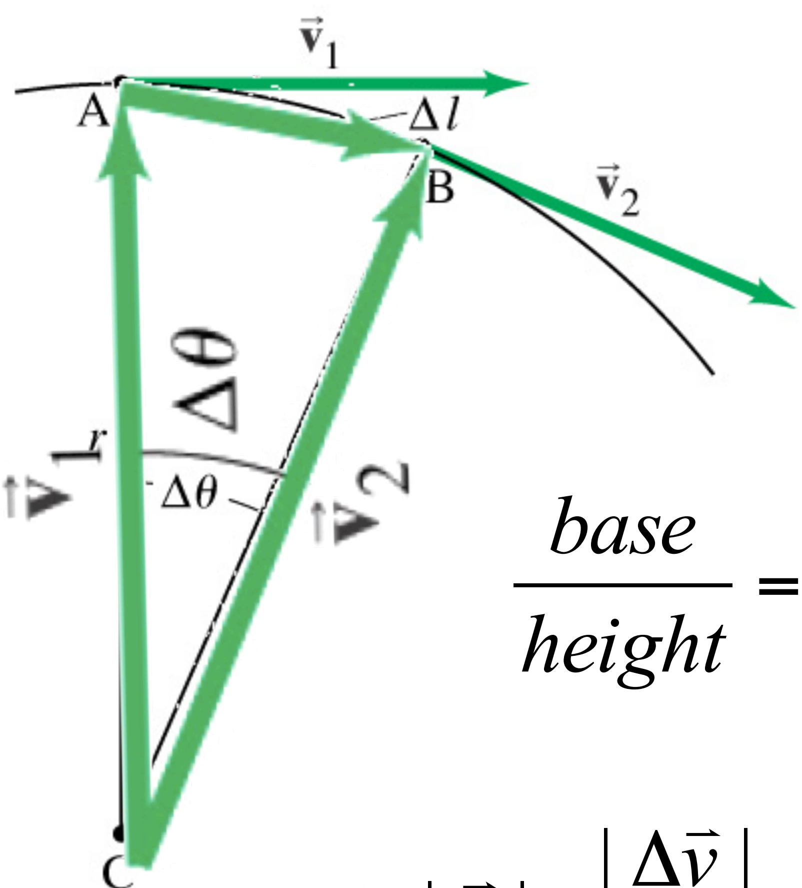


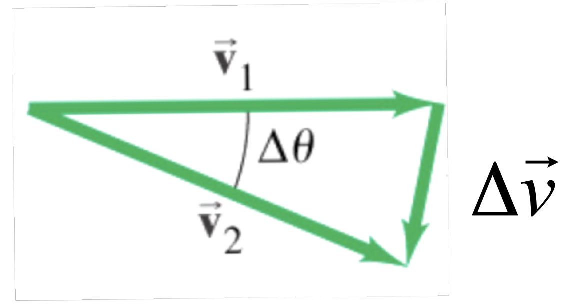


The two triangles are similar triangles!

$$|\vec{a}| = \frac{v^2}{r}$$

What is the ***magnitude*** of centripetal acceleration?





The two triangles are similar triangles!

$$\frac{base}{height} = \frac{|\Delta\vec{v}|}{|\vec{v}|} = \frac{\Delta\ell}{r} \Rightarrow \Delta v = \frac{v}{r}\Delta\ell$$

$$|\vec{a}| = \frac{|\Delta\vec{v}|}{\Delta t} = \frac{\frac{v}{r}\Delta\ell}{\Delta t} = \frac{v}{r}\frac{\Delta\ell}{\Delta t} = \frac{v}{r}v = \frac{v^2}{r}$$

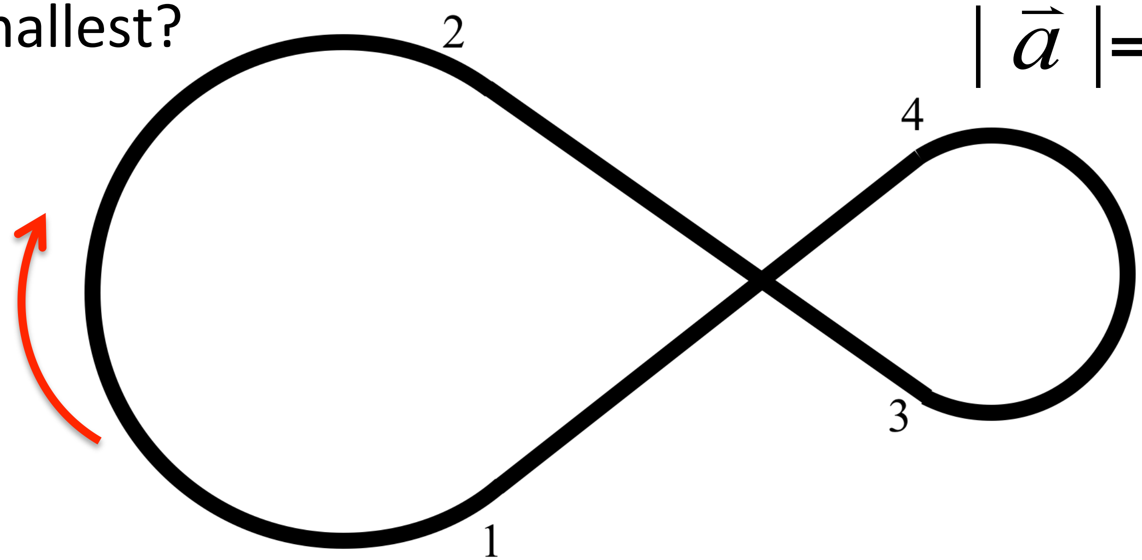
$$|\vec{a}| = \frac{v^2}{r}$$

Clicker Question

Room Frequency BA

A race car travels around the track shown at ***constant speed***. Over which portion of the track is the magnitude of the acceleration the smallest?

$$|\vec{a}| = \frac{v^2}{r}$$



A) From 1 to 2

B) From 2 to 3

C) From 3 to 4

D) Acceleration is the same for all 3 segments.

Answer B: from 2 to 3.

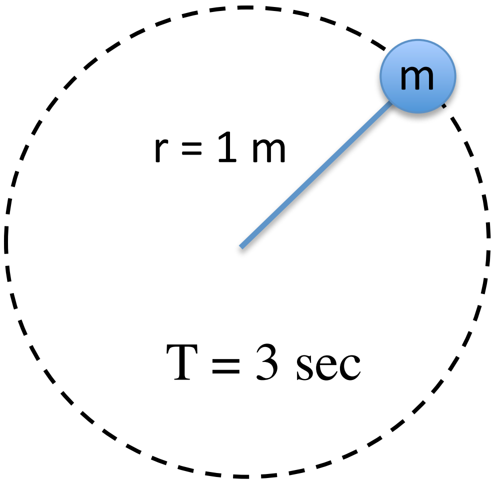
The acceleration is zero along the straight line portions of the track!

What about the two curved segments, 1-2 and 3-4 ?

Clicker Question

Room Frequency BA

A merry-go-round has a radius r = 1 meter.
It's pushed to have a period of T = 3 seconds.



$$|\vec{a}| = \frac{v^2}{r}$$

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

What is the approximate centripetal acceleration?

A) 1 m/s^2

B) 4 m/s^2

C) 0 m/s^2

D) 100 m/s^2

E) 500 m/s^2

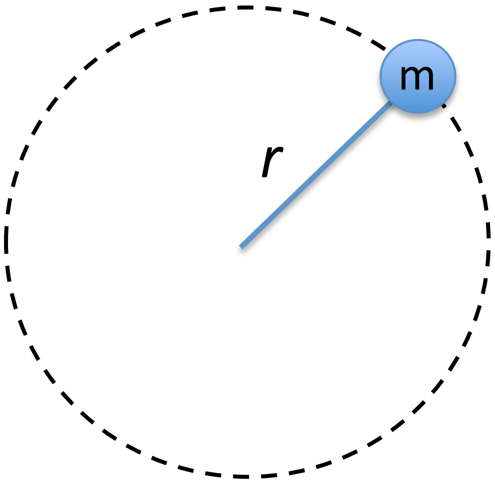
$$v = \frac{2\pi r}{T} \approx \frac{2 \times 3 \times 1m}{3s} \approx 2m/s$$

$$a = \frac{v^2}{r} \approx \frac{(2m/s)^2}{1m} = 4m/s^2$$

Clicker Question

Room Frequency BA

A merry-go-round has a radius *r*.
It's pushed to have a period *T*.



$$|\vec{a}| = \frac{v^2}{r}$$

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

If the rotation is then slowed down so that the ***period doubles****, the centripetal acceleration will…*

A) increase by a factor of 2

B) decrease by a factor of 2

C) increase by a factor of 4

D) decrease by a factor of 4

$$a = \frac{v^2}{r} = \frac{(2\pi r / T)^2}{r} \sim \frac{1}{T^2}$$

Kinematics of Circular Motion

Circular Motion – fixed radius and at constant speed $|v|$

Always accelerating due to change in direction of velocity vector.

Centripetal acceleration inwards towards the circle center with magnitude $|a| = v^2/r$

Note: this is purely kinematic result!

“Wall-of-Death”

But don’t I feel out outward force?

Clicker Question

Room Frequency BA

Consider the “Wall-of-Death”

Which diagram correctly shows the real forces on the rider?