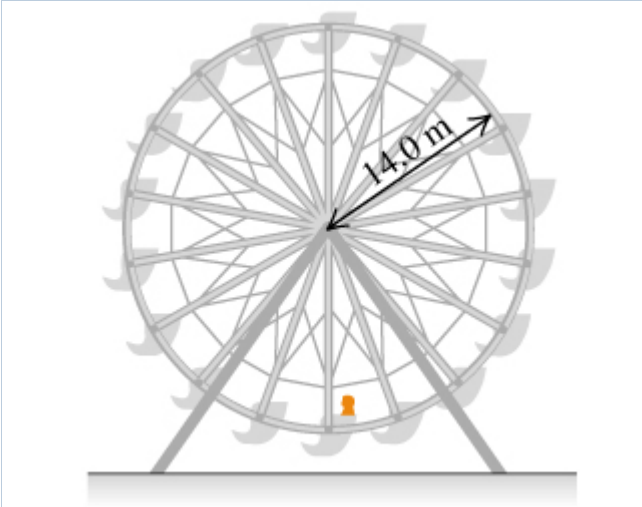
#8 Circular Motion Pre-class

Due: 11:00am on Monday, September 10, 2012

Note: You will receive no credit for late submissions. To learn more, read your instructor's Grading Policy

Exercise 3.33

A Ferris wheel with radius 14.0 m is turning about a horizontal axis through its center (the figure). The linear speed of a passenger on the rim is constant and equal to 6.99$\mathrm{m/s}$.



Part A

What is the magnitude of the passenger's acceleration as she passes through the lowest point in her circular motion?

ANSWER:

a = 3.49 $\mathrm{m/s^2}$

Correct

Part B

What is the direction of the passenger's acceleration as she passes through the lowest point in her circular motion?

ANSWER:

- (•) towards the center
- ( ) outwards the center

Correct

Part C

What is the magnitude of the passenger's acceleration as she passes through the highest point in her circular motion?

ANSWER:

a = 3.49 $\mathrm{m/s^2}$

Correct

Part D

What is the direction of the passenger's acceleration as she passes through the highest point in her circular motion?

ANSWER:

- (•) towards the center
- ( ) outwards the center

Correct

Part E

How much time does it take the Ferris wheel to make one revolution?

ANSWER:

T = 12.6 s

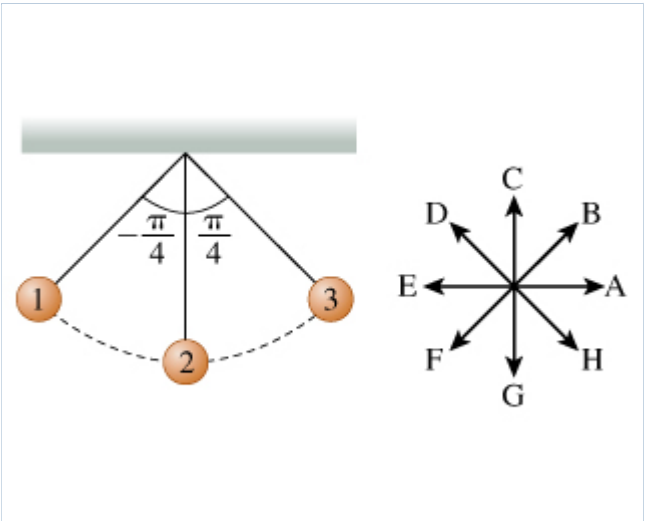
Correct

Direction of Acceleration of Pendulum

Learning Goal:

To understand that the direction of acceleration is in the direction of the *change* of the velocity, which is unrelated to the direction of the velocity.

The pendulum shown makes a full swing from $-\pi/4$ to $+\pi/4$. Ignore friction and assume that the string is massless. The eight labeled arrows represent directions to be referred to when answering the following questions.



Part A

Which of the following is a true statement about the acceleration of the pendulum bob, $\vec{a}$.

ANSWER:

- $\vec{a}$ is equal to the acceleration due to gravity.
- $\vec{a}$ is equal to the instantaneous rate of change in velocity.
- $\vec{a}$ is perpendicular to the bob's trajectory.
- $\vec{a}$ is tangent to the bob's trajectory.

Correct

Part B

What is the direction of $\vec{a}$ when the pendulum is at position 1?

Enter the letter of the arrow parallel to $\vec{a}$.

Hint 1. Velocity at position 1

What is the velocity of the bob when it is exactly at position 1?

ANSWER:

$v_1 = 0 \ \text{m/s}$

Hint 2. Velocity of bob after it has descended

What is the velocity of the bob just after it has descended from position 1?

ANSWER:

- very small and having a direction best approximated by arrow D
- very small and having a direction best approximated by arrow A
- very small and having a direction best approximated by arrow H
- The velocity cannot be determined without more information.

ANSWER:

H

Correct

Part C

What is the direction of $\vec{a}$ at the moment the pendulum passes position 2?

Enter the letter of the arrow that best approximates the direction of $\vec{a}$.

Hint 1. Instantaneous motion

At position 2, the instantaneous motion of the pendulum can be approximated as uniform circular motion. What is the direction of acceleration for an object executing uniform circular motion?

ANSWER:

C

Correct

We know that for the object to be traveling in a circle, some component of its acceleration must be pointing radially inward.

Part D

What is the direction of $\vec{a}$ when the pendulum reaches position 3?

Give the letter of the arrow that best approximates the direction of $\vec{a}$.

Hint 1. Velocity just before position 3

What is the velocity of the bob just before it reaches position 3?

ANSWER:

- very small and having a direction best approximated by arrow B
- very small and having a direction best approximated by arrow C
- very small and having a direction best approximated by arrow H
- The velocity cannot be determined without more information.

Hint 2. Velocity of bob at position 3

What is the velocity of the bob when it reaches position 3?

ANSWER:

v_3 = 0 m/s

ANSWER:

F

Correct

Part E

As the pendulum *approaches* or *recedes from* which position(s) is the acceleration vector $\vec{a}$ almost parallel to the velocity vector $\vec{v}$.

ANSWER:

- position 2 only
- positions 1 and 2
- positions 2 and 3
- positions 1 and 3

Correct

Exercise 3.32

The radius of the earth's orbit around the sun (assumed to be circular) is $1.50 \times 10^8\ \mathrm{km}$, and the earth travels around this orbit in 365 days.

Part A

What is the magnitude of the orbital velocity of the earth in $\mathrm{m/s}$?

ANSWER:

$2.97\times10^{4}\ \mathrm{m/s}$

All attempts used; correct answer displayed

Part B

What is the radial acceleration of the earth toward the sun?

ANSWER:

$5.91\times10^{-3}\ \mathrm{m/s^2}$

Correct

Part C

What is the magnitude of the orbital velocity of the planet Mercury (orbit radius $= 5.79 \times 10^{7}\ \mathrm{km}$, orbital period = 88.0 days)?

ANSWER:

$4.78\times10^{4}\ \mathrm{m/s}$

Correct

Part D

What is the radial acceleration of the Mercury?

ANSWER:

$3.95\times10^{-2}\ \ \mathrm{m/s^2}$

Correct

Test Your Understanding 3.4: Circular Motion

An object moves around a horizontal circle at constant speed.

Part A

If the radius of the circle is halved while the speed of the object is doubled, how does the acceleration of the object change?

ANSWER:

- it becomes 2 times as great
- it becomes 8 times as great
- it becomes 1/2 as great
- it remains the same
- it becomes 4 times as great

Correct

The acceleration of an object moving at a constant speed v in a horizontal circle of radius R is $a_{\text{rad}} = v^2/R$. If v increases by a factor of 2 and R becomes $1/2$ as great, the acceleration increases by a factor of $2^2/(1/2) = 2^3 = 8$.

Score Summary:

Your score on this assignment is 89.5%.
You received 17.89 out of a possible total of 20 points.